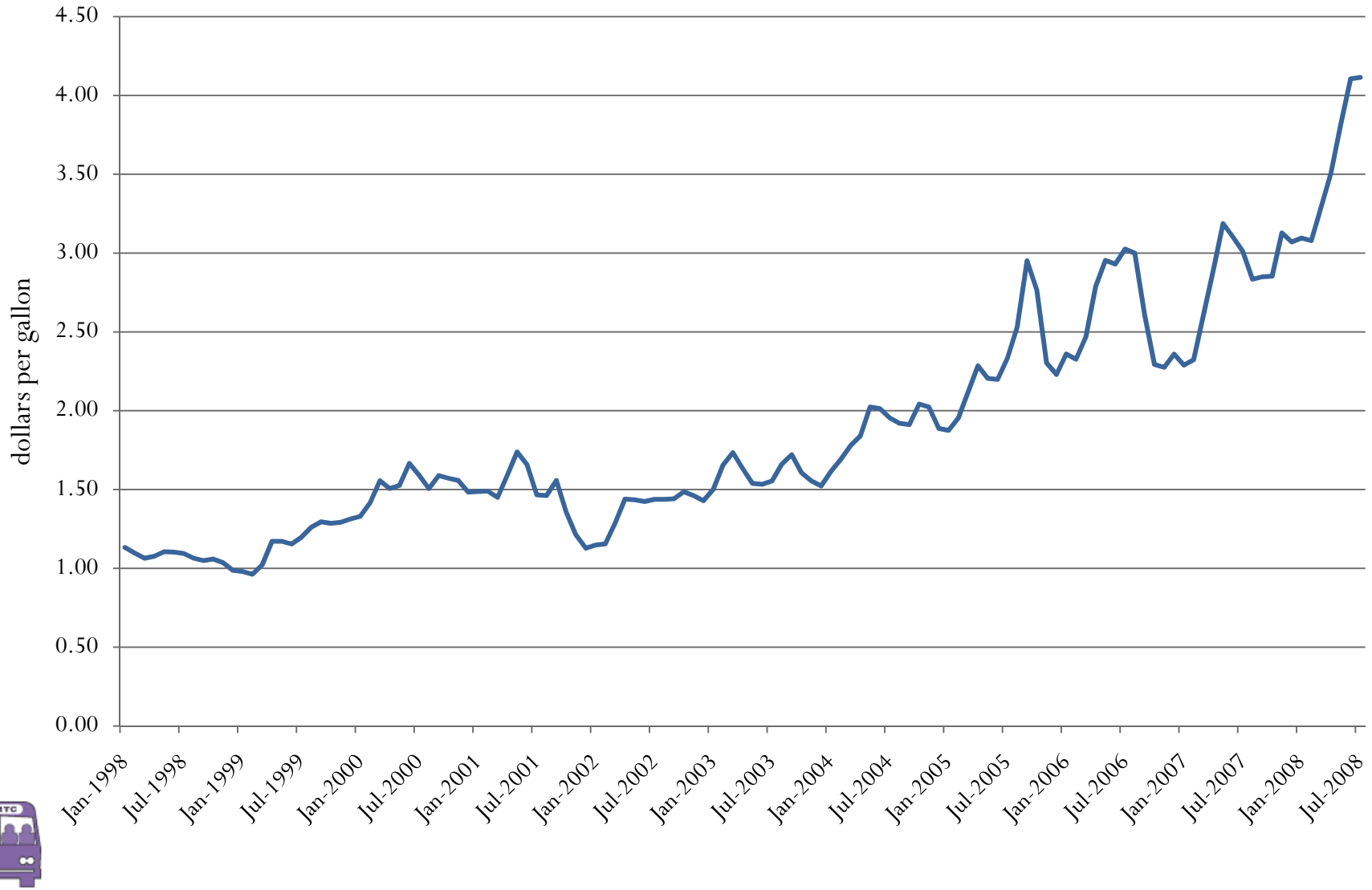
Effects of Rising Fuel Prices on Transit Ridership

UGPTI Transportation Seminar
September 22, 2008
Jeremy Mattson

Overview

- Trends in gas prices, vehicle travel, and bus ridership
- Factors affecting ridership
- Model and data used to estimate effect of gas price on bus ridership
- Results
- Changes in fare revenues and fuels costs for transit systems
- Conclusions

U.S. Average Gasoline Price



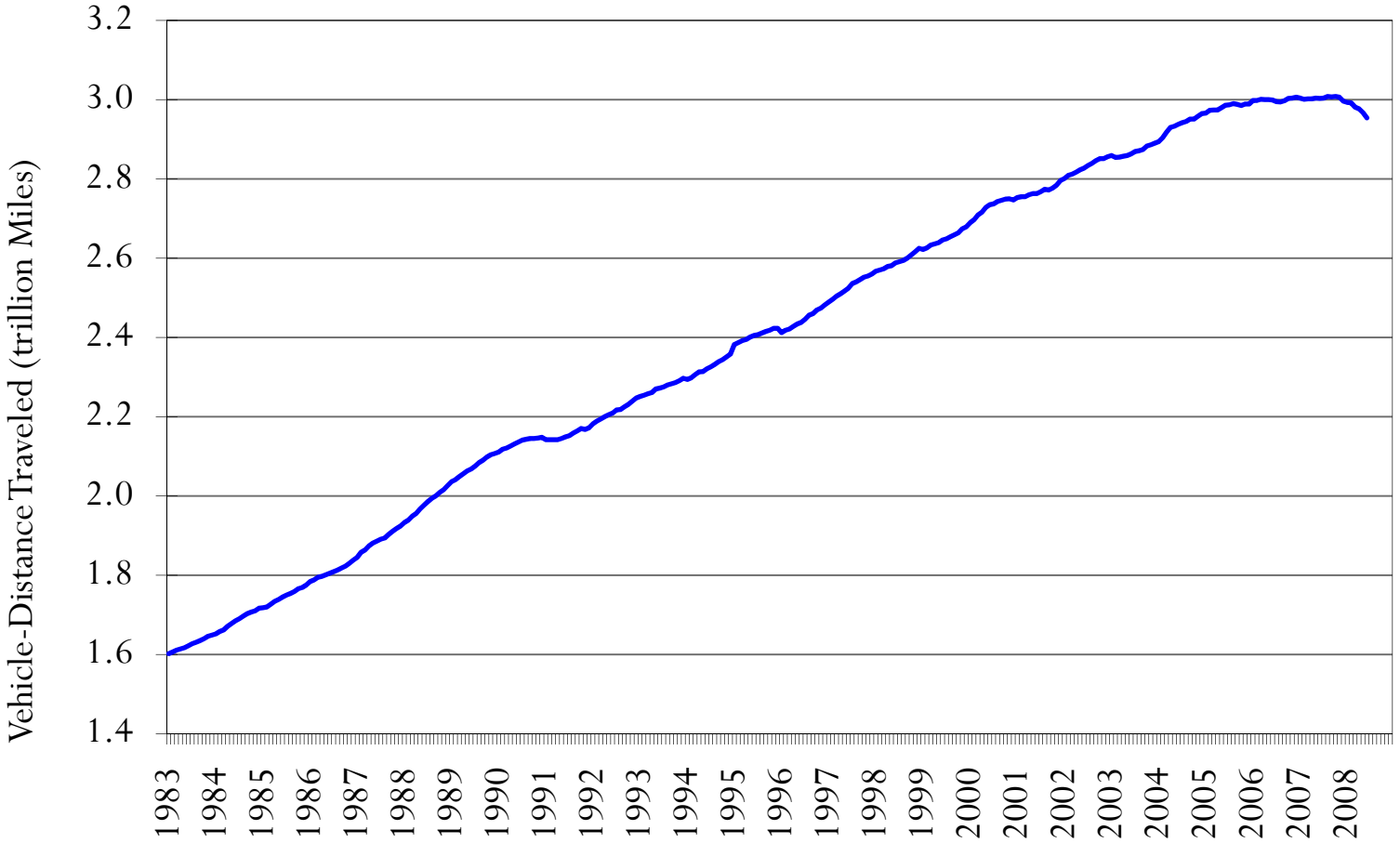
Have drivers responded?

- Vehicle miles traveled (VMT) began decreasing in 2007.
- There was a 4.7% decrease (12.2 billion miles) in travel on all U.S. roads and streets in June 2008 compared to June 2007.
- Through June, travel was down 2.8% (42.1 billion miles) in 2008 compared to 2007.
- Public transportation ridership in 2007 was the highest in 50 years.
- In the second quarter of 2008, transit ridership was up 5.2% compared to the second quarter of 2007.

Have drivers responded?

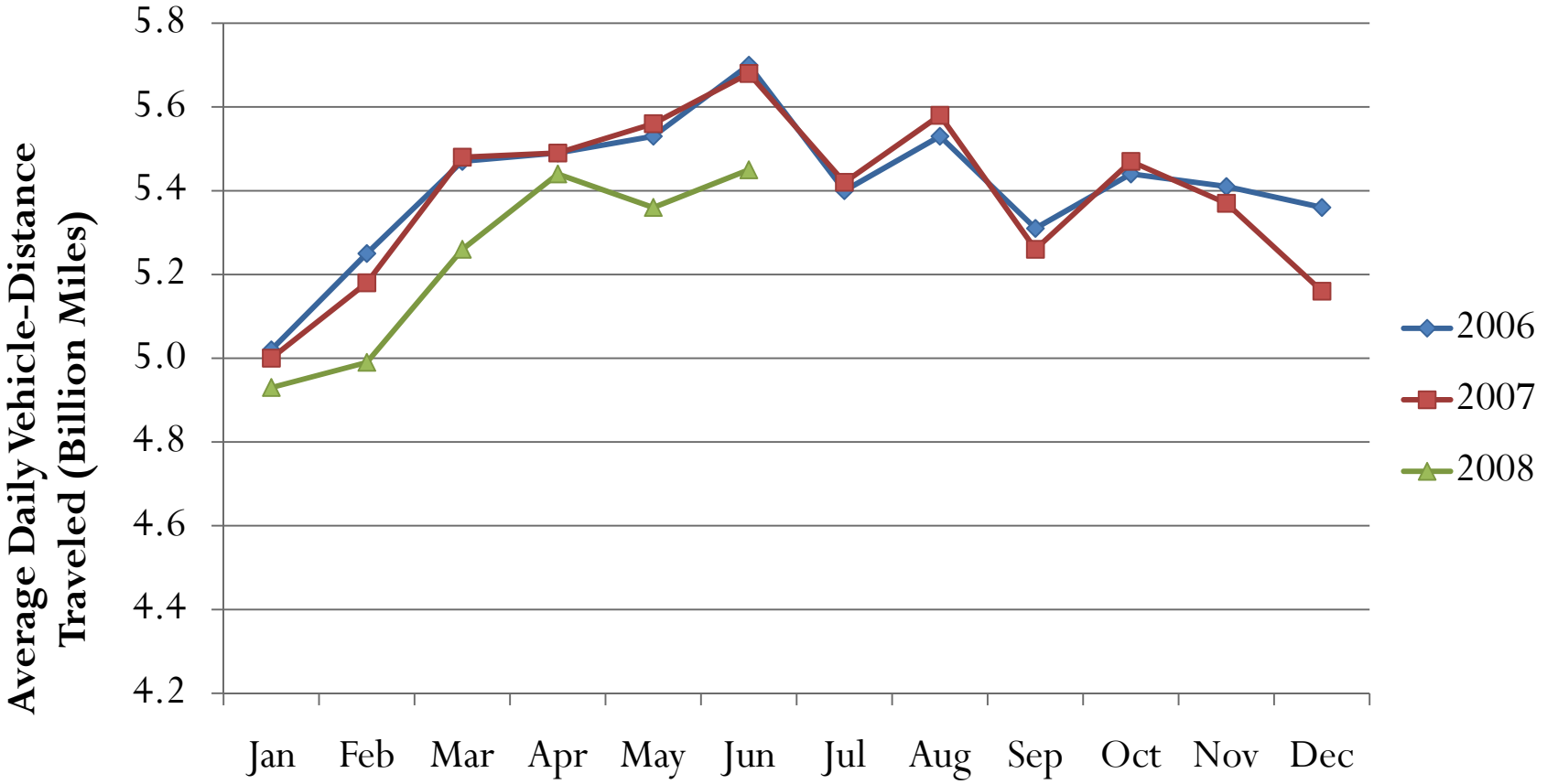
- Ipsos poll released June '08 shows
  - 67% of respondents have changed driving habits.
  - About half of those who have not, would change driving habits if price rose to $5/gallon.
  - The first substantial change people make is
    - 30% cut back on travel/recreational driving
    - 27% consolidate trips
    - 8% carpool
    - 6% walk/bike
    - 5% use public transportation more often
    - 3% buy more fuel efficient car

U.S. 12-Month Moving Average VMT, 1983-2008



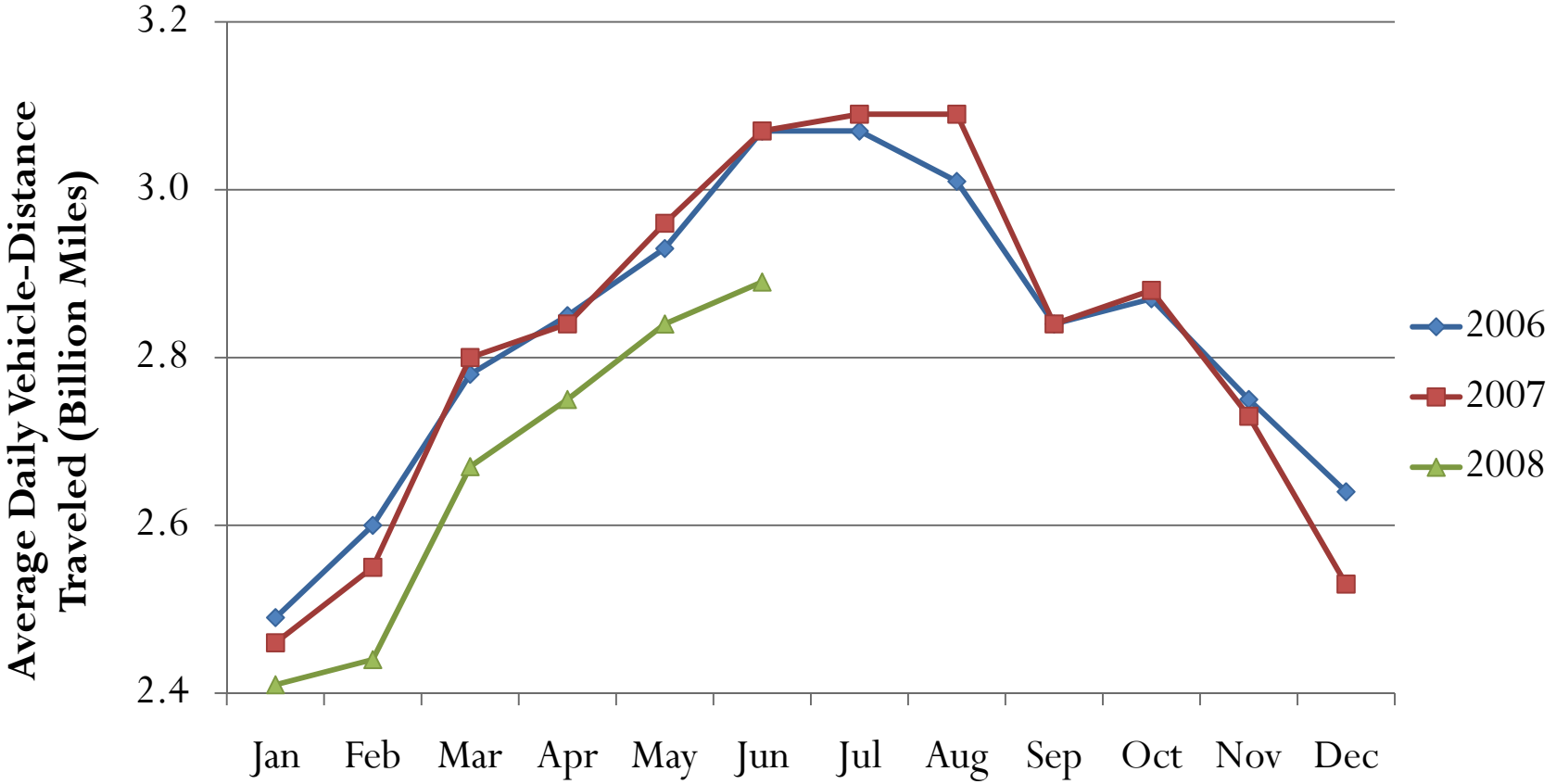
Source: U.S. Department of Transportation, U.S. Highway Administration

VMT Decreases in 2008, Urban Highways



Source: U.S. Department of Transportation, U.S. Highway Administration

VMT Decreases in 2008, Rural Highways

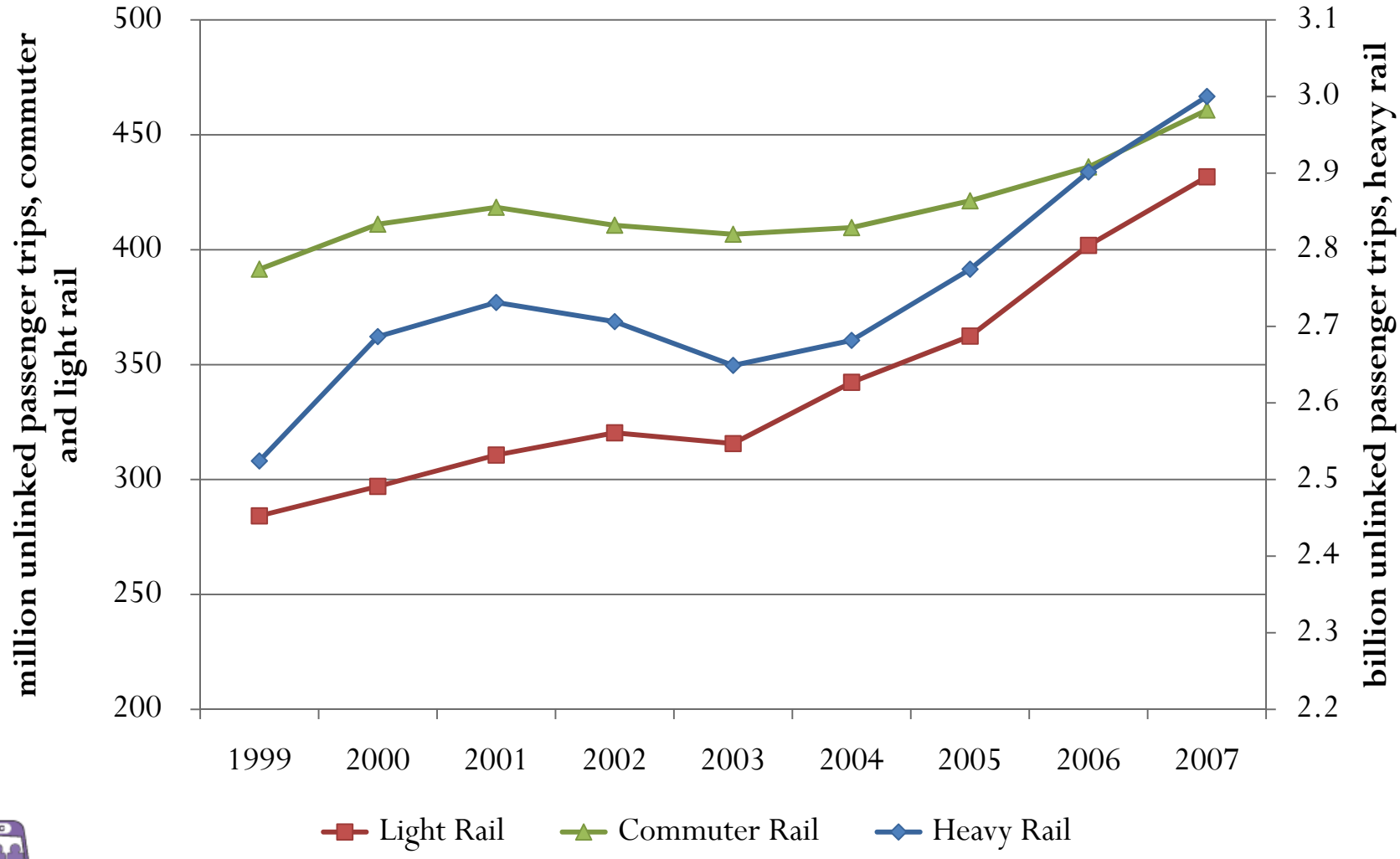


Source: U.S. Department of Transportation, U.S. Highway Administration

Transit Ridership Data Sources

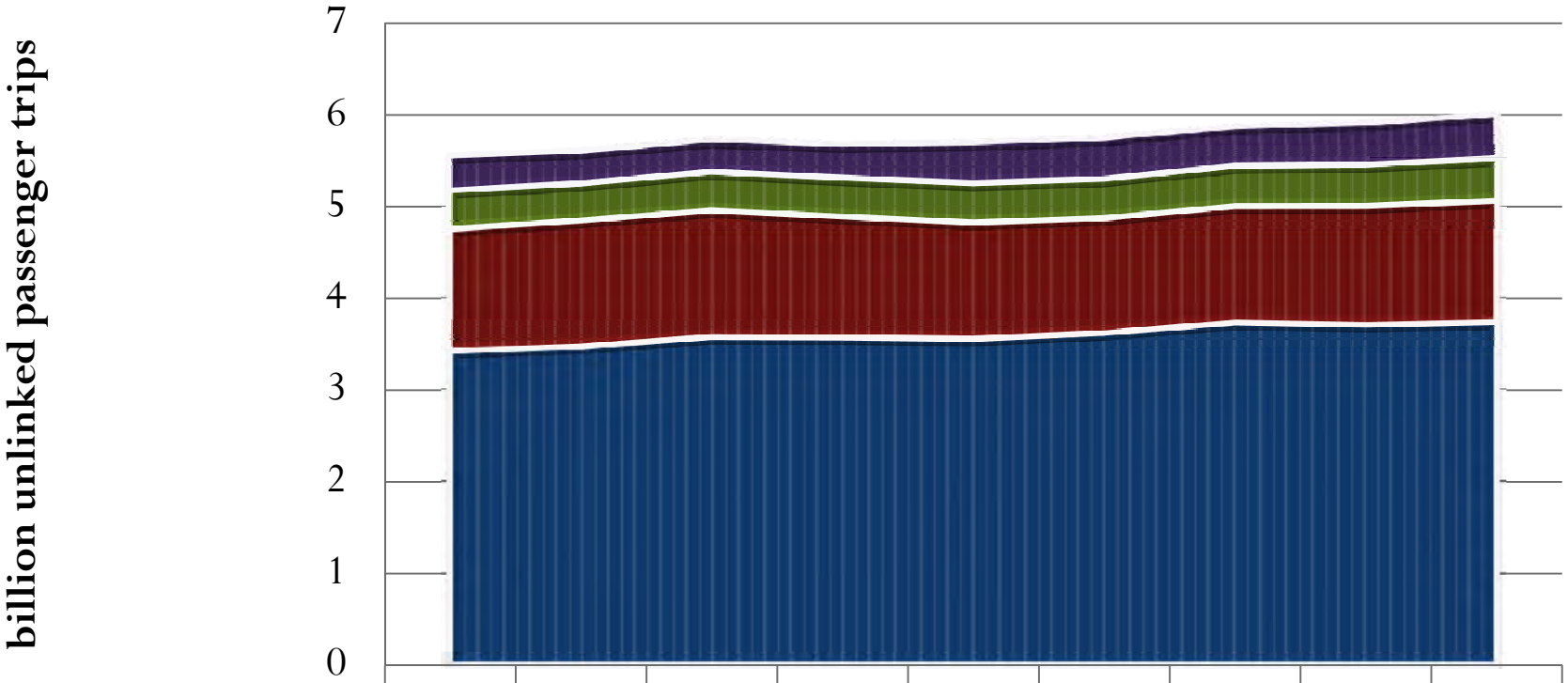
- American Public Transportation Association (APTA)
  - Aggregate nationwide data
- National Transit Database
  - Annual data for regional small urban systems
- Specific Transit Systems
  - Fargo Metro Area Transit (MAT)
  - Clay County Rural Transit (CCRT)
  - Cheyenne Transit Program (CTP)

Trends in Rail Transit Ridership



Source: APTA

Trends in Bus Transit Ridership



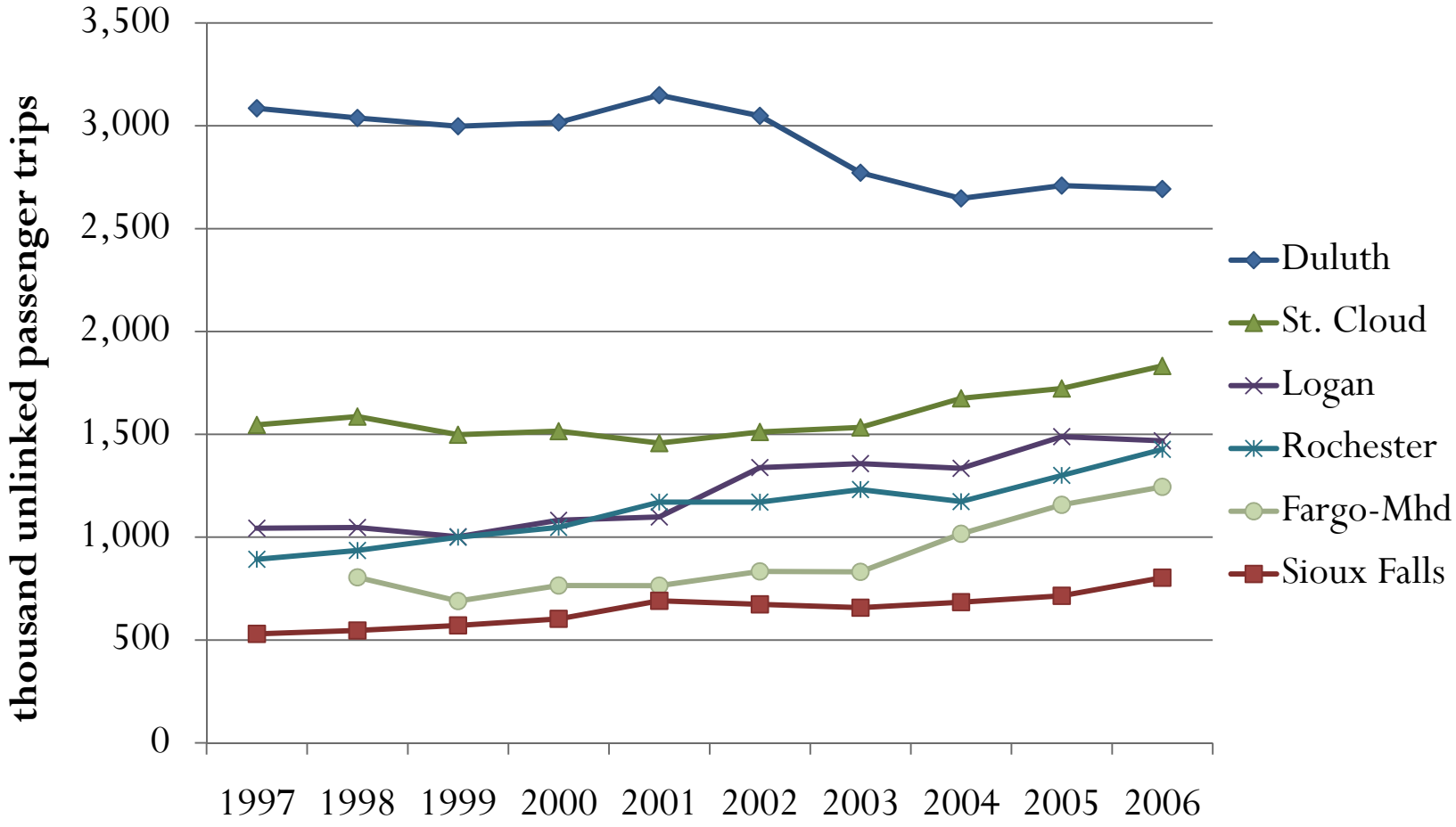
	1999	2000	2001	2002	2003	2004	2005	2006	2007
Below 100,000	0.38	0.35	0.34	0.36	0.44	0.44	0.42	0.45	0.48
100,000-499,999	0.42	0.41	0.42	0.42	0.43	0.43	0.44	0.45	0.46
500,000-1,999,999	1.33	1.37	1.38	1.32	1.27	1.25	1.27	1.30	1.32
2,000,000+	3.42	3.47	3.58	3.57	3.56	3.62	3.73	3.71	3.74

Source: APTA

Ridership Increases Through First Half of 2008

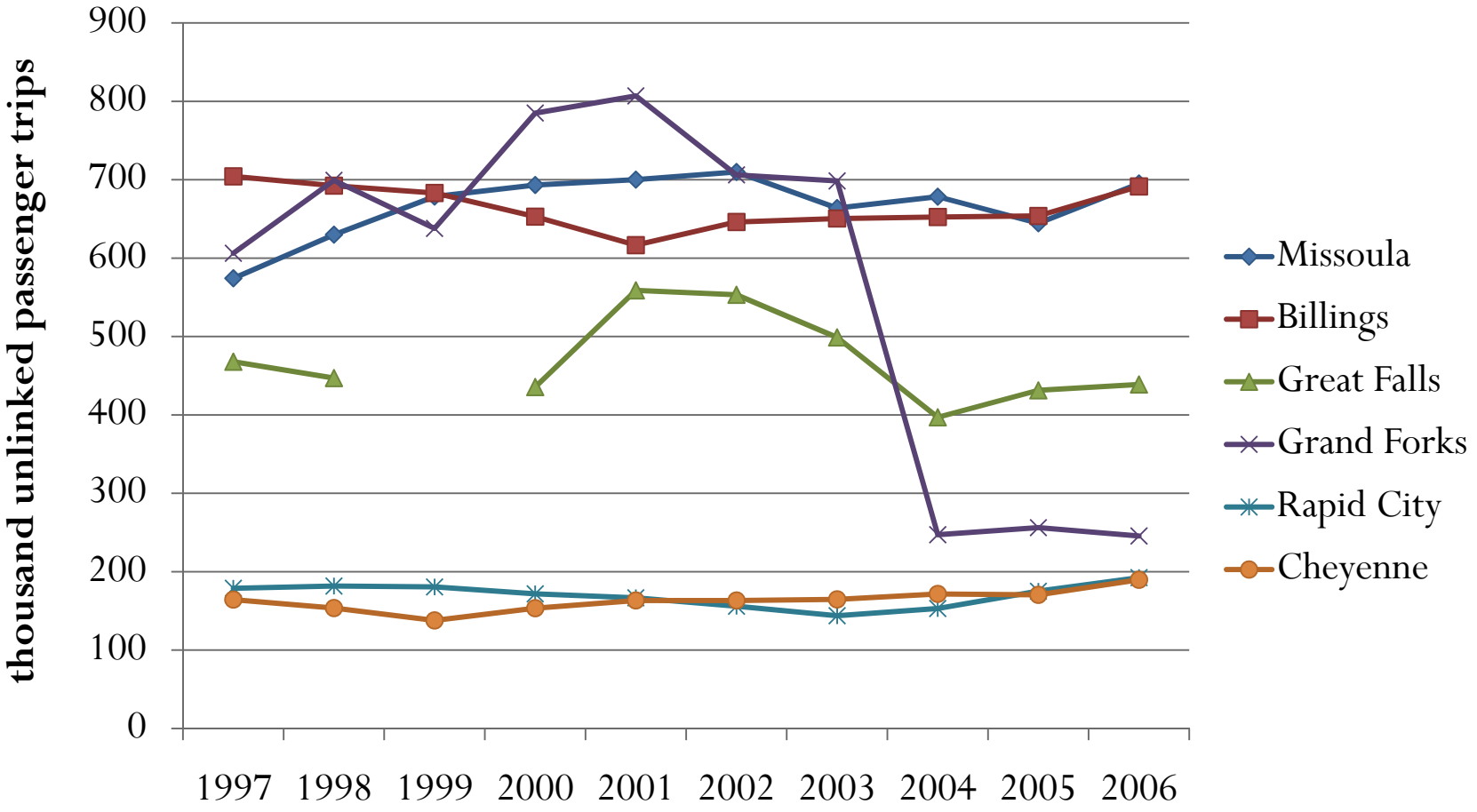
Mode	Increase from 2007 to 2008
Heavy Rail	4.4%
Light Rail	11.2%
Commuter Rail	5.4%
Bus Population Group	
2,000,000+	2.1%
500,000-1,999,999	4.0%
100,000-499,999	10.4%
Below 100,000	9.2%

Ridership for Regional Small Urban Transit Systems



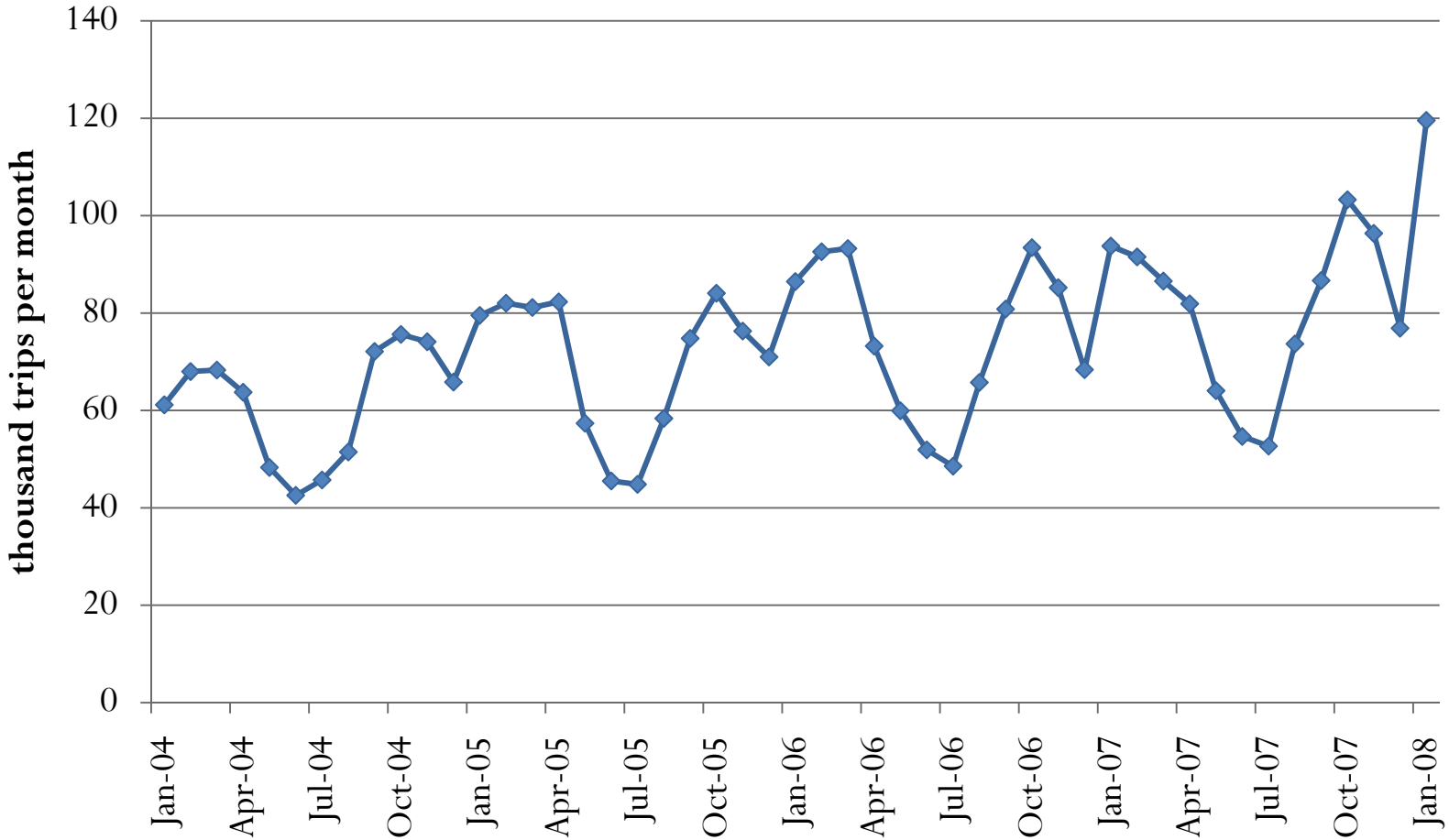
Source: National Transit Database

Ridership for Regional Small Urban Transit Systems

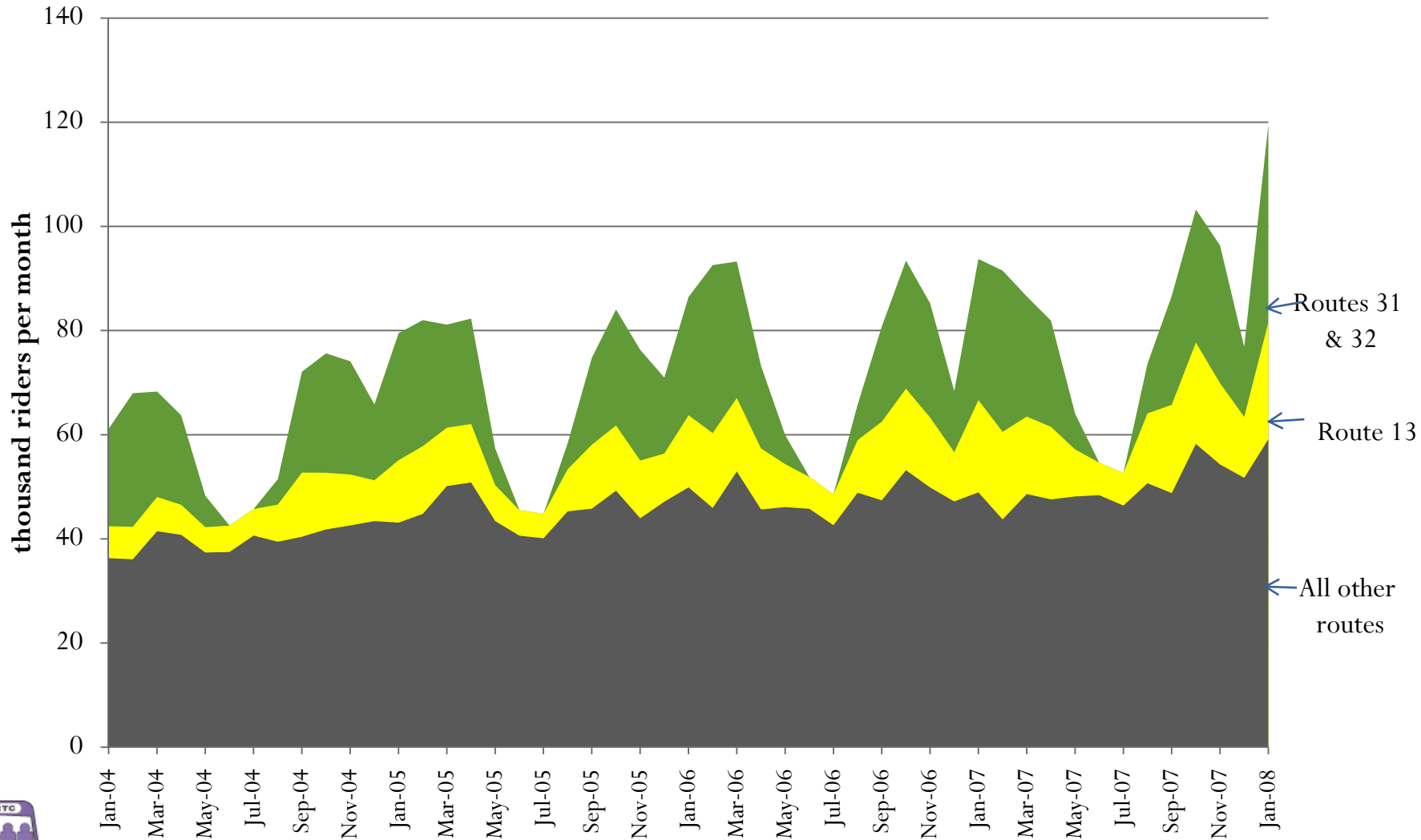


Source: National Transit Database

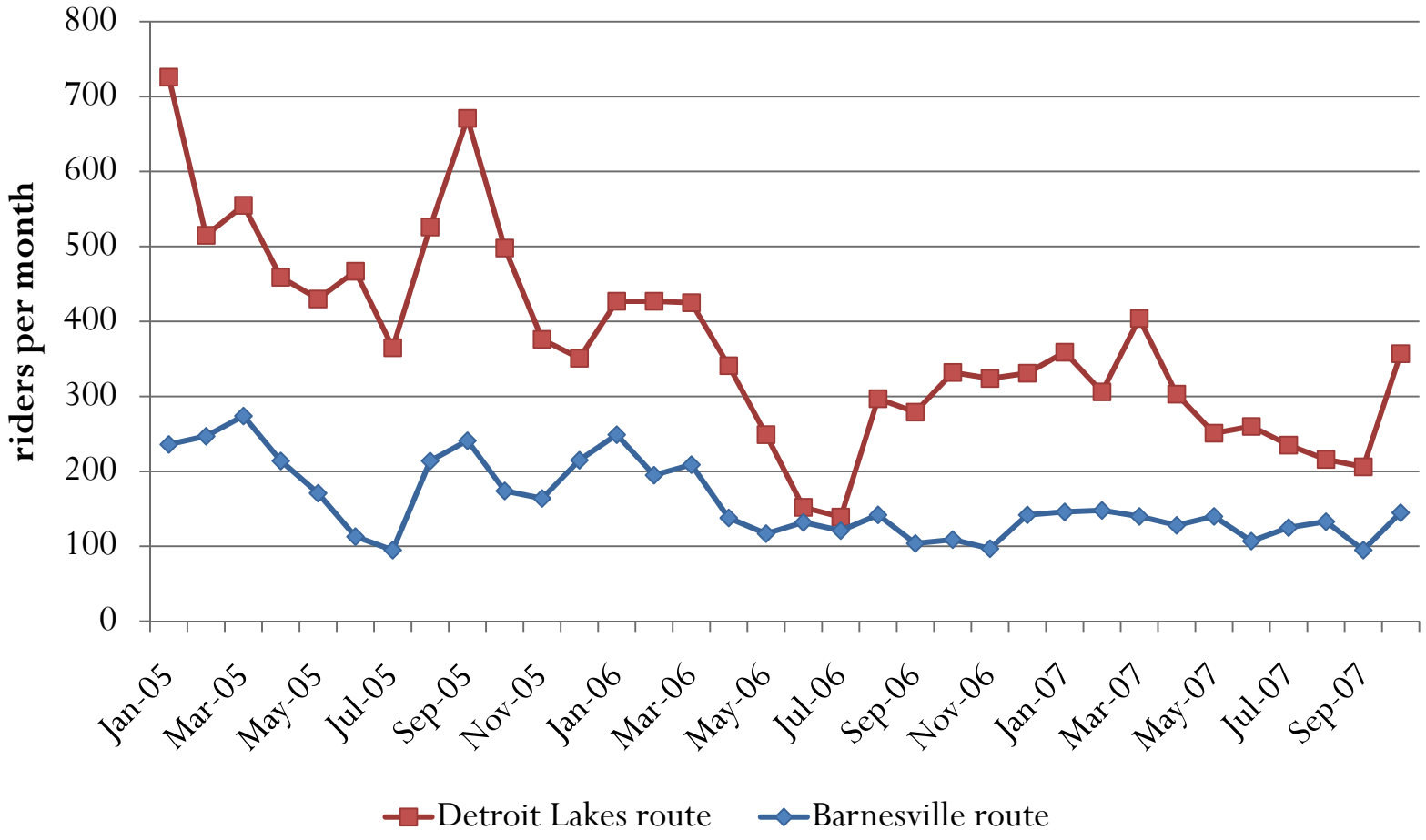
Fargo MAT Ridership



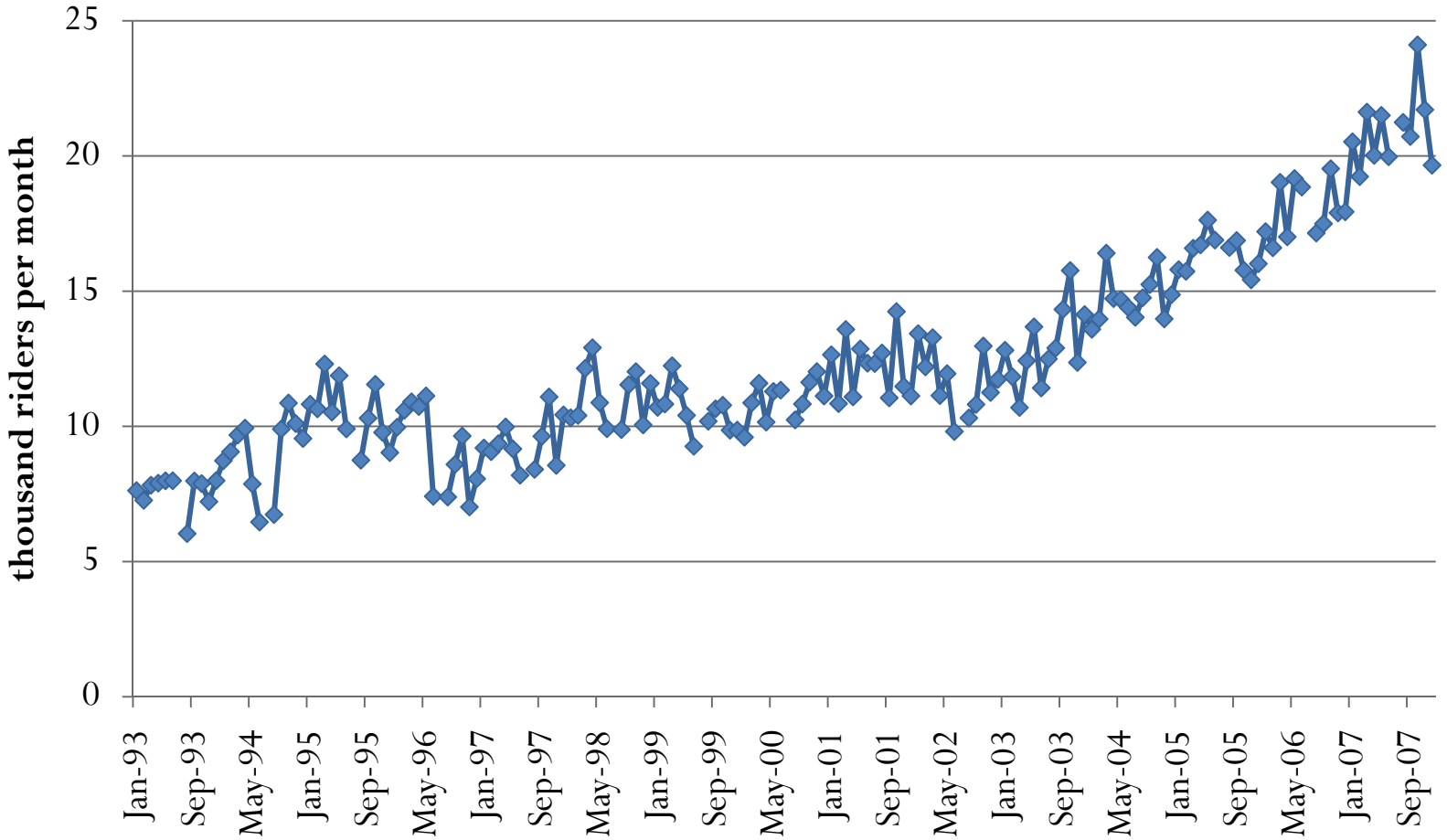
Fargo MAT Ridership



Ridership for Clay County Rural Transit Commuter Routes



The Cheyenne Transit Program Ridership



Are rising gas prices responsible for the growth in ridership?

Sampling of Media Reports on Gas Prices and Transit Ridership

Date	Article Title	Source
23-Apr-05	High gas prices fuel public transit use	USA Today
20-Aug-05	Bus fares, ridership up in wake of rising gas prices	Waukesha Freeman
11-Sep-05	Gas Prices Propel Rise in Carpoolers, Metro Users	Washington Post
28-Sep-05	Rail, bus ridership rises with gas prices	Associated Press
30-Sep-05	DART ridership increasing along with gas prices	Dallas Business Journal
18-Jan-06	Gas Prices Spur Mass Transit Use	CBSNews.com
25-Apr-06	Drivers switch to public transit	USA Today
26-Apr-06	Does mass transit benefit from increasing gas prices?	Oakland Tribune
6-May-06	Poll: Americans changing driving habits as gas prices soar	USA Today
30-Dec-06	Bus Ridership Hits Record Amid High Gas Prices	Albuquerque Journal
25-May-07	Bus ridership increases as gas prices rise	Dayton Business Journal
4-Nov-07	High gas prices boost bus use	masslive.com
11-Nov-07	High Gas Prices Increase COTA Bus Ridership	msnbc.com
26-Nov-07	High gas prices help fill the buses	St. Petersburg Times
26-Dec-07	High gas prices help boost NJ Transit	The Press of Atlantic City
18-Mar-08	Boost in bus riders mirrors gas hike	Fargo Forum
22-Mar-08	As gas prices rise, bus ridership grows	Bangor Daily News
23-Mar-08	Bus ridership up with rising gas prices	Boston.com

Factors Affecting Ridership

- Internal factors
  - Fares, service quantity and quality
- External factors
  - Gas price, socioeconomic factors (employment level, income level, car ownership), spatial factors (parking cost, population densities), and others

Previous Research on Gas Prices and Ridership

- Ridership has generally not been too responsive.
- Effects differ from city to city and system to system.
- Rail tends to be affected more.
- Demand for longer-distance transit trips is affected more.
- Commuters and students are more likely to switch to transit than shoppers or leisure travelers.
- Long-run effects differ from short-run effects.

Short-run versus long-run effects

- Elasticities tend to increase over time as consumers have more options available to them.
  - Long-run elasticity of demand with respect to fares has been found to be 1.5 - 3 times higher than the short-run elasticity.
- Is this also true for gas price elasticities?

Previous elasticity estimates for transit demand with respect to gas/auto operating costs

Study	Elasticity	Study Area
Agthe & Billings (1978)	0.42	Tucson, AZ city bus system
Doi & Allen (1986)	0.11	New Jersey rail line
Luk & Hepburn (1993)	0.07	Australia
Hensher (1997)	0.02 – 0.12	Newcastle, Australia buses
TRACE	0.16 short-run 0.12 long-run	Review of European studies
Storchmann (2001)	0.07	Germany
Currie & Phung (2007)	0.04 (bus) 0.12 (all transit)	United States
Litman (2007)	0.05 – 0.15 short-run 0.2 – 0.4 long-run	Review of literature

Empirical Model

- Polynomial Distributed Lag Model
  - Applied to monthly data from APTA and three individual transit systems.
- Panel Data Model
  - Applied to annual data from the National Transit Database for 11 small urban transit systems of the Upper Great Plains.

Polynomial Distributed Lag Model

- Ridership in a given time period estimated as a function of the gas price for that time period, gas prices from previous time periods, and other variables, which include monthly dummy variables to account for seasonality, trend variables, changes in fares or service levels, and other community-specific variables.

Results from Aggregate Bus Model

	Large	Medium-Large	Medium-Small	Small
	(2,000,000 and over)	(500,000 to 1,999,999)	(100,000 to 499,999)	(Below 100,000)
GP_t	0.059	0.058	0.028	
GP_{t-1}	0.040	0.042	0.026	
GP_{t-2}	0.024	0.028	0.024	
GP_{t-3}			0.022	
GP_{t-4}			0.019	
GP_{t-5}			0.017	0.031
GP_{t-6}			0.015	0.027
GP_{t-7}			0.013	0.022
Cummulative effect	0.123	0.128	0.164	0.081
R^2	0.70	0.87	0.93	0.81

Results for Fargo MAT Routes

	Estimate
GP_t	-
GP_{t-1}	0.113
GP_{t-2}	0.107
Cumulative effect	0.220
R^2	0.82

Results for the Cheyenne Transit Program

	Estimate
GP_t	-
GP_{t-6}	0.025
GP_{t-7}	0.031
GP_{t-8}	0.035
GP_{t-9}	0.039
GP_{t-10}	0.041
GP_{t-11}	0.043
GP_{t-12}	0.043
GP_{t-13}	0.043
GP_{t-14}	0.041
GP_{t-15}	0.039
GP_{t-16}	0.035
GP_{t-17}	0.031
GP_{t-18}	0.025
Cumulative effect	0.47

Results for Clay County Rural Transit

	Detroit Lakes Route	Barnesville Route
GP_t	0.065	0.042
GP_{t-1}	-	0.025
GP_{t-2}	-	0.012
GP_{t-3}	-0.035	-
Cumulative effect	0.03	0.074
Long-run elasticity	0.5	4

Other Results

- Significant seasonality in ridership.
- North Dakota State University has had a significant impact on ridership for Fargo's MAT.
- A decrease in service in Fall 2005 for CCRT had a large negative effect on ridership, and an increase in fares also had a negative, but much smaller, effect.
- Service changes have affected ridership in Cheyenne.
- Ridership is also trending upward in Cheyenne due to other factors.

Panel Data Model

- Annual data for 11 transit systems from the Upper Great Plains for 1997-2006
  - Duluth Transit Authority (Duluth, MN)
  - St. Cloud Metropolitan Transit Commission (St. Cloud, MN)
  - City of Rochester Public Transportation (Rochester, MN)
  - Sioux Falls Transit (Sioux Falls, SD)
  - Fargo-Moorhead Metro Area Transit (Fargo, ND/Moorhead, MN)
  - Billings Metropolitan Transit (Billings, MT)
  - Cities Area Transit (Grand Forks, ND)
  - Missoula Urban Transportation District (Missoula, MT)
  - Great Falls Transit District (Great Falls, MT)
  - Rapid Transit System (Rapid City, SD)
  - City of Cheyenne Transit Program (Cheyenne, WY)

Panel Data Model

- Ridership is estimated as a function of regional gas price, service quantity, fares, size of labor force, unemployment rate, time trend, cross section dummy variables, dummy variables for specific systems (e.g., implementation of U-Pass system in Fargo).

Panel Data Results

	Estimate	t-value
Gas price	0.12	2.11**
Service miles	0.24	2.86**
Fare	-0.45	-5.73**
Labor force	0.01	0.01
Unemployment	-0.13	-2.50**

- Trend variables and dummy variables are also highly significant.

Average Annual Growth Rates for Fare Revenue and Fuel Costs, 2002-2006

	Fare Revenue	Fuel & Lube Costs
Duluth Transit Authority	7.7%	22.2%
St. Cloud Metro Transit Commission	6.2%	26.9%
Sioux Falls Transit	5.4%	32.3%
Fargo-Moorhead MAT	12.2%	40.3%
Billings Metropolitan Transit	4.9%	24.0%
Cities Area Transit	2.1%	24.7%
Missoula Transportation District	1.4%	17.8%
Great Falls Transit District	4.7%	23.1%
Rapid Transit System	4.5%	29.2%
Cheyenne Transit Program	2.9%	25.0%

Source: National Transit Database

Comparison of Fare Revenue and Fuel Expense Increases, 2002-2006

	Fare Revenue Increase	Fuel & Lube Expense Increase	Difference
	(thousand dollars)		
Duluth Transit Authority	487	497	-10
St. Cloud Metro Transit	166	342	-176
Sioux Falls Transit	76	154	-78
Fargo-Moorhead MAT	215	371	-156
Billings Metropolitan Transit	36	182	-146
Cities Area Transit	12	120	-109
Missoula Transportation District	19	113	-94
Great Falls Transit District	29	143	-115
Rapid Transit System	20	43	-23
Cheyenne Transit Program	9	65	-55

Source: National Transit Database

How are transit agencies responding?

- APTA survey (conducted July '08) shows:
  - 85% of public transit systems report capacity problems
  - 91% are facing problems in ability to add service to meet increased demands
  - 60% are considering fare increases
  - 35% are considering service cuts

Conclusions

- Ridership has been increasing for transit systems of all types.
- Previous research shows that demand for transit with respect to gas prices has been very inelastic.
- Results from this study show elasticity estimates ranging from 0.08 to 0.5, averaging around 0.1-0.2.

Conclusions

- While the elasticities are small, there is still a measurable impact on ridership due to the substantial increases in gas prices.
- Further research with updated data could be needed to determine if the elasticities change as prices continue rising (do motorists have a tipping point?).

Conclusions

- Motorists in larger urban areas are quicker to switch to transit, possibly due to greater familiarity.
- Over time, the response in small urban and rural areas can be just as great.
- Ridership on long-distance commuter routes could benefit the most.

Conclusions

- The growth in fare revenues has not been enough to offset the large increases in fuel costs.
- Demand for service is increasing while operating costs are increasing.
- Transit agencies will have difficulties expanding service to meet the growing demand due to budget pressures caused by higher fuel costs.

Thank you.