

Effects of Ethanol Production on US Gasoline Prices

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Motivation & Objective

- Modeling: partial vs. full equilibrium
- Lower fuel prices an important benefit of policy debate
- Objective: determine the effects on gasoline prices of
 - US ethanol production
 - The public policy of promoting ethanol production
- Further objective: weigh costs and benefits of policy

Diverse Beliefs: Farm Bureau (2008)

“[gasoline] could cost as much as 5 cents to 10 cents more a gallon if was not routinely blended with ethanol.”

Diverse Beliefs: Merrill Lynch (2008)

“oil and gasoline prices would be about 15% higher if biofuel producers weren't increasing their output”

Diverse Beliefs: Urbanchuck (2008)

- Use of a 10% ethanol blend in Missouri saved drivers \$0.077 per gallon in 2007.
- Takes national gasoline and ethanol prices as exogenous

Diverse Beliefs: RFA (2008)

“removing 4.5 billion gallons of ethanol from the market ... would increase gasoline prices in the short term ... by up to 31 percent.”

Diverse Beliefs: Du & Hayes (2007)

- Look at how the price of gasoline has changed relative to crude oil prices as ethanol use has increased
- Effects vary by region
- For the US, the ave. level of ethanol blending from 1995-2007 results in gasoline prices being between \$0.29 and \$0.40 lower

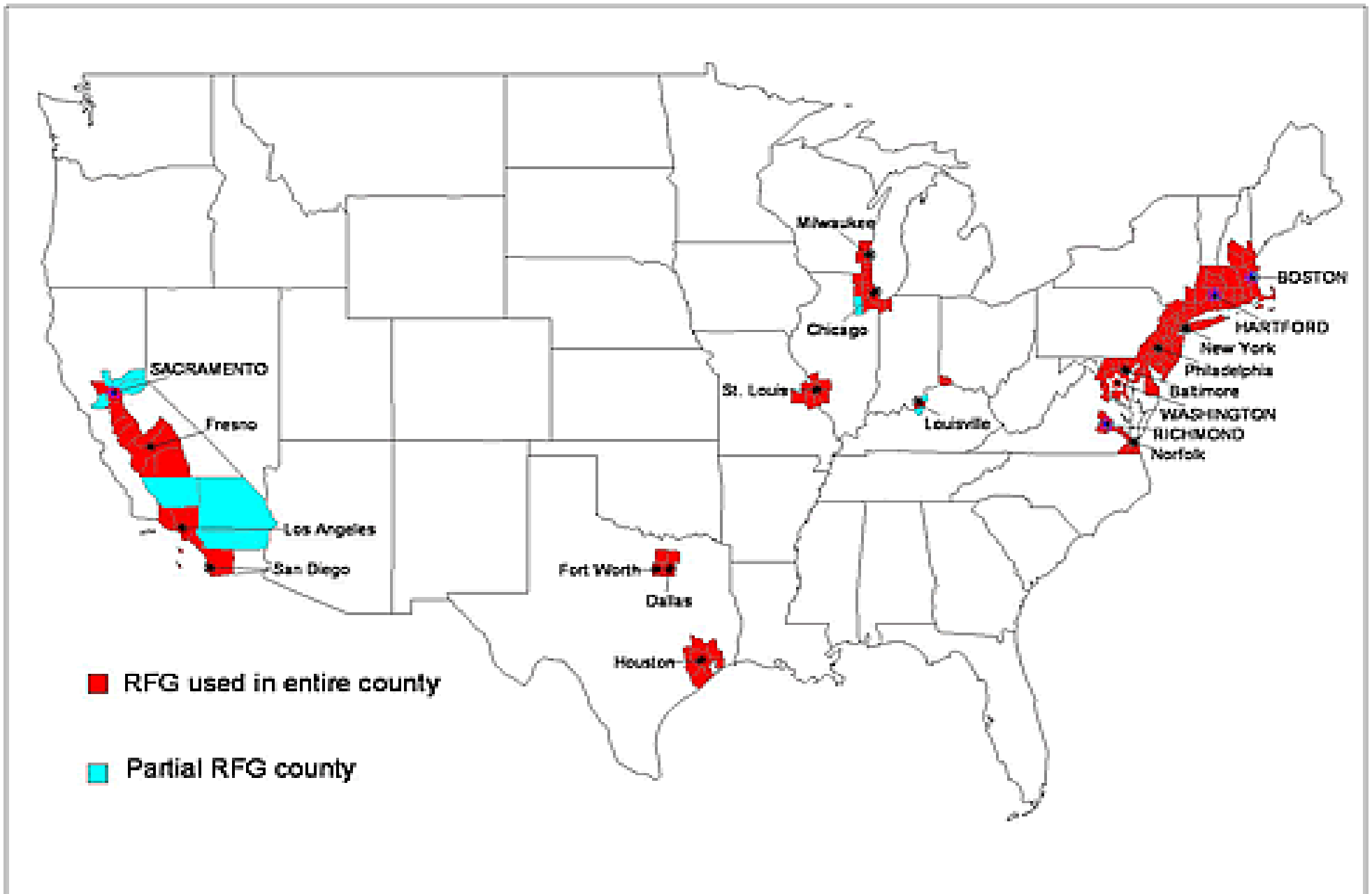
Diverse Beliefs: American Petroleum Institute (2007)

- Ethanol production and blending leads to *higher* gasoline prices
- Discourages expansion of refinery capacity

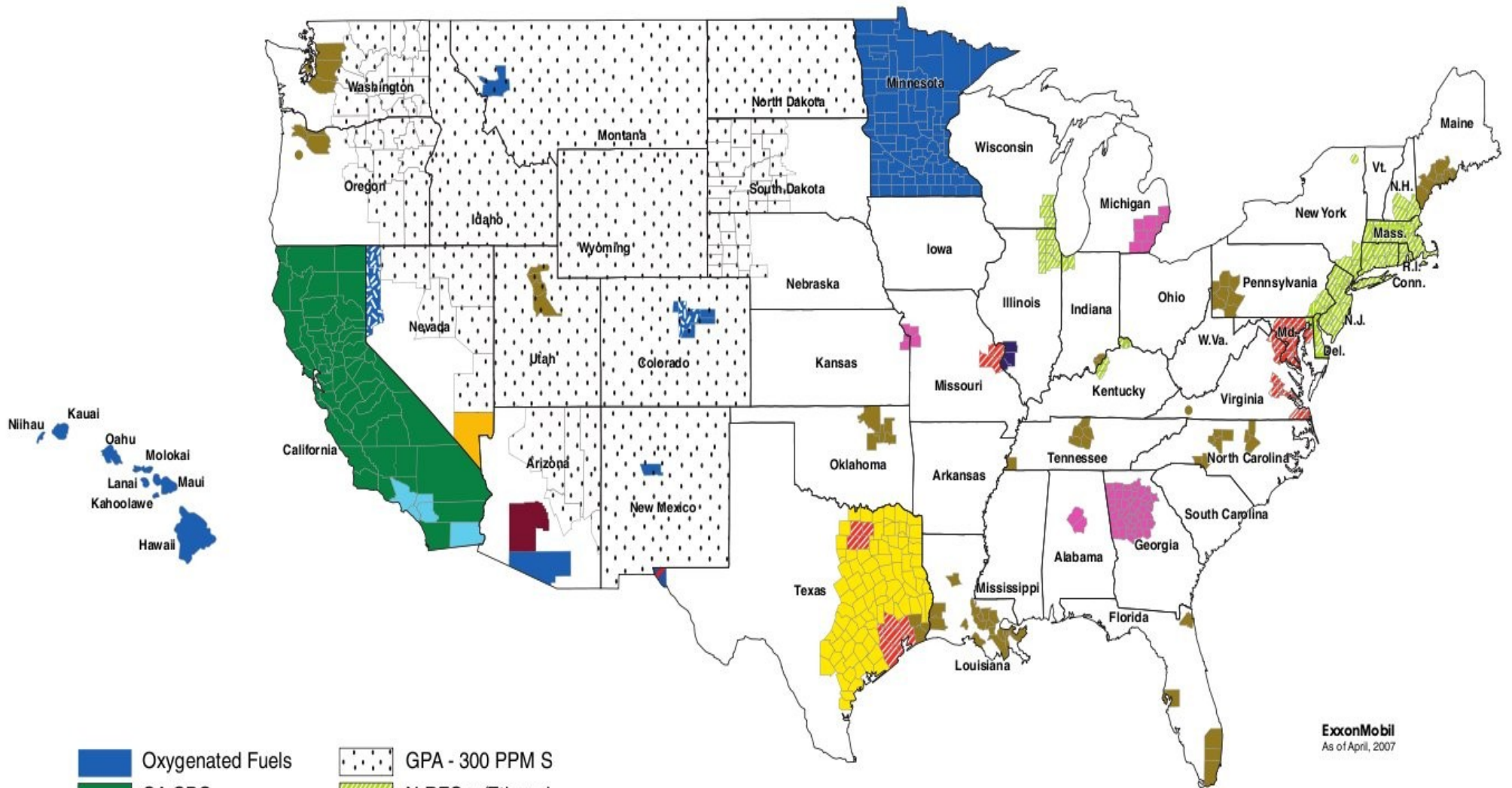
Ethanol is a compliment to and substitute for gasoline
















- Marginal use is for gasoline substitution
- How much use is complimentary?

RFG Areas



U.S. Gasoline Requirements



- | | | | |
|---|-------------------|---|---------------------------|
|  | Oxygenated Fuels |  | GPA - 300 PPM S |
|  | CA CBG |  | N RFG w/Ethanol |
|  | CA OXY CBG |  | S RFG w/Ethanol |
|  | AZ CBG |  | NV CBG |
|  | Oxy Fuels/7.8 RVP |  | 7.0 RVP |
|  | Oxy Fuels/7.0 RVP |  | 7.8 RVP, MTBE-No Increase |
|  | Conventional |  | 7.8 RVP |
|  | 7.2 RVP | | |

ExxonMobil
As of April, 2007

This map is not intended to provide legal advice or to be used as guidance for state and/or federal fuel requirements, including but not limited to oxy fuel or RFG compliance requirements. ExxonMobil makes no representations or warranties, express or otherwise, as to the accuracy or completeness of this map.

K.W. Gardner
IN#2018

Ethanol Use: Compliment vs. Substitute

- Oxygenate use (2006):
 - Mandatory: 0.308 billion gallons
 - Opt-in: 0.097 billion gallons
- Reformulated gasoline use (2007):
 - Mandatory: 2.077 billion gallons
 - Opt-in: 0.377 billion gallons

Ethanol Use: Compliment vs. Substitute

- Future increases assumed proportionate to projected increases in total fuel consumption (EIA)
- Total expected complimentary ethanol use in 2008 (RFG and oxygenate, including opt-in): 2.78 billion gallons

Expected Total Ethanol Production, Less Complimentary Use, 2009

- Current: 9.5 billion gallons
- No RFS: 9.5 billion gallons
- No VEETC (blenders' credit): 8.8 billion gallons
- No RFS, no VEETC: 7.8 billion gallons

Price Elasticity of Gasoline Demand

- Percentage change in quantity of gasoline consumed caused by a one percent increase in gasoline price
- Reviews of estimates: Epsey (1998), Sterner & Dahl (1992), Goodwin (1992), Basso & Oun (2007)
- Meta meta estimates
 - Short-run: -0.24
 - Long-run: -0.77

Adjusting Fuel Replacement Use for Energy Content

- Energy content of ethanol is lower than that of gasoline
- Calculate gasoline price effects based on BTUs of ethanol used for gasoline replacement, not volumes
 - Expected 2009 substitution use of ethanol: 0.25 quads
 - Expected 2009 total motor fuel use: 18.23 quads

Questions or Answers are Complicated

- Fuel demand adjusts over time
- Current effect of ethanol use on gasoline prices is path-dependent
- What are scenarios relative to?
 - Ethanol industry never existed?
 - Policy change?
 - When?
- What about expected future increases in ethanol production?

How much more would gasoline cost today if we had never used ethanol for gasoline substitution?

\$0.42 / gallon

How much more would gasoline
cost in 2009 if we eliminated the
RFS?

< \$0.01 / gallon

How much more would gasoline
cost in 2009 if we eliminated the
VEETC?

\$0.06 / gallon

How much more would gasoline cost in 2009 if we eliminated the RFS and the VEETC?

\$0.15 / gallon

Implications For Motor Fuel Expenditure in US

- Expected total US motor fuel expenditure for 2009: \$553 billion
- Estimated change in 2009 motor fuel expenditure if:
 - RFS was eliminated: +\$0.05 billion
 - VEETC was eliminated: +\$33 billion
 - RFS and VEETC were eliminated: +\$78 billion

Effects on Food Expenditure

- Approximate changes in food expenditure (at home and away from home) due to changes ethanol programs:
 - Eliminate RFS: -\$0.06 billion
 - Eliminate VEETC: -\$5.0 billion
 - Eliminate RFS & VEETC: -\$13.8 billion
- Caveats!

Effects on Fuel Expenditure vs. Effects on Food Expenditure

- Net of *partial* costs minus benefit to US consumers/taxpayers of some program changes:
 - Eliminate RFS: -\$0.01 billion
 - Eliminate VEETC: +\$21.7 billion
 - Eliminate RFS & VEETC: +\$57.9 billion
- Changes in fuel expenditure outweigh other considerations

Other Implications

- Trade balance
 - Marginal dollar spent on crude oil goes abroad
 - Marginal dollar spent on ethanol goes to ???
 - But less ag exports
- Energy security
- Environment:
 - Monoculture, run-off, etc.
 - Are lower fuel prices actually good?

Conclusions

- Ethanol production is substantially lowering motor fuel prices
- Current RFS has minimal effects *under normal market conditions*
- Benefits of VEETC probably outweigh the costs

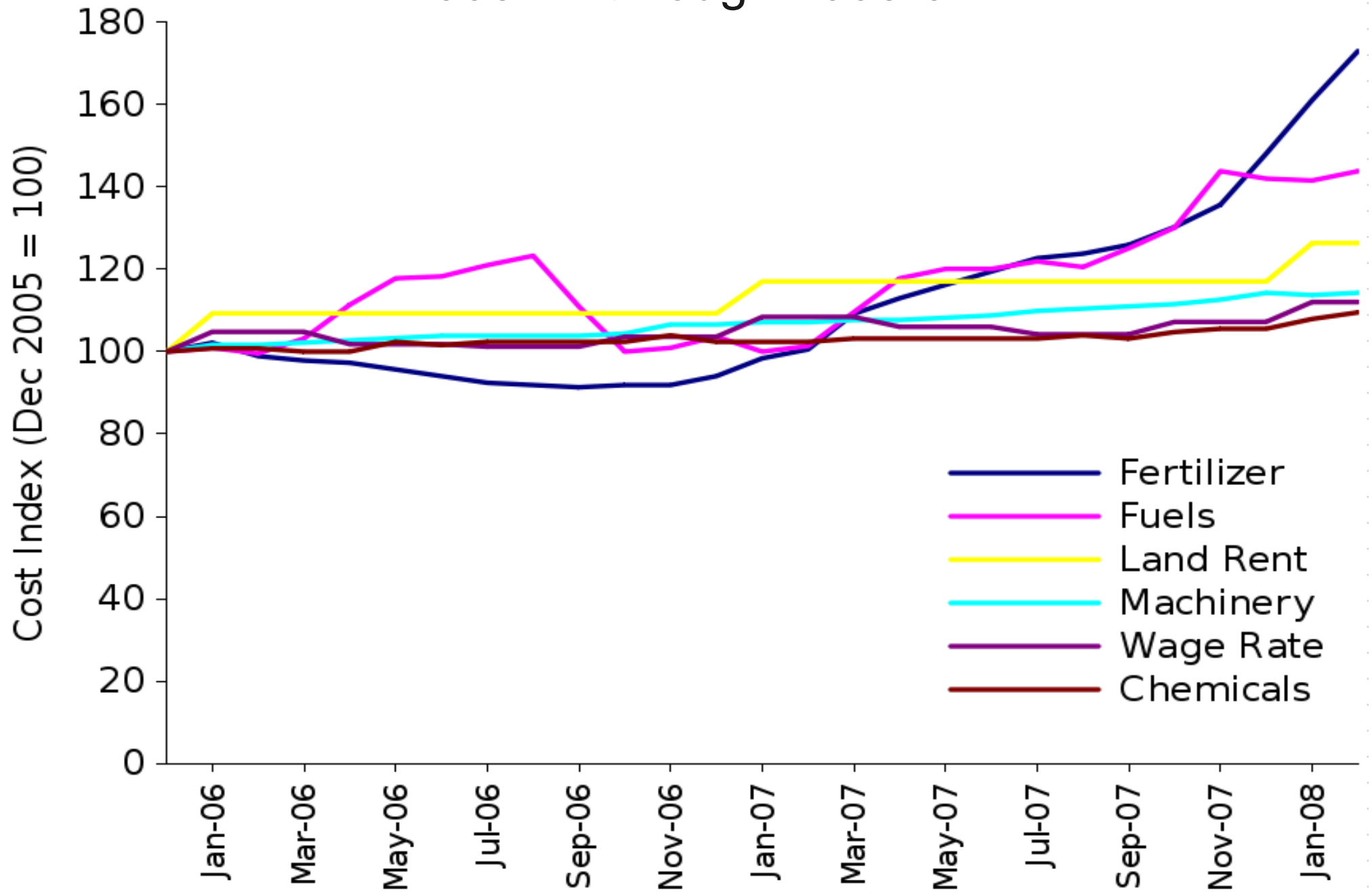
Input Cost Inflation: Cost-push vs. Demand-pull

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Selected Input Cost Indices, 2005-12 through 2008-02



Objective

Determine roughly the proportions of input cost increases that are due to factors outside of agriculture

Methodology

- Marry dated survey data on input costs with timely input cost index data
- Categorize input costs as external to agriculture, internal, or mixed
- For mixed input costs, estimate proportion of price increases due to external factors
- Assume no substitution in production

Cost & Returns Survey Data

- Published by USDA-ERS
- Utilizes surveys conducted about every 4-8 years as part of the annual Agricultural Resource Management Survey (ARMS)
- Estimates are “historical” accounts based on actual costs incurred by producers
- We use 2005 U.S. Average data for corn, wheat, cotton, and rice

Cost Index Data

- Published by USDA-NASS
- Prices paid indices for **agricultural chemicals, fuels, feed, fertilizer, machinery, and seed** are based on surveys of prices charged by 8,500 firms supplying farmers and ranchers
- Prices paid indexes for new **autos and trucks, building materials, farm supplies, motor supplies, and marketing containers** are updated based on selected Bureau of Labor Statistics indexes

Cost Categories in ARMS Survey Data

- Seed
- Fertilizer
- Chemicals
- Custom operations
- Fuel, lube, electricity
- Repairs
- Water
- Interest
- Ginning
- Hired labor
- Opportunity cost of unpaid labor
- Capital recovery for machinery
- Land rent
- Taxes & Insurance
- General farm overhead

Cost Categories Assumed External To Ag

- Seed
- Fertilizer
- Chemicals
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Cost Categories Assumed Internal To Ag

- Seed
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- Ginning
- Hired labor
- Opportunity cost of unpaid labor
- Capital recovery for machinery
- Land rent
- Taxes & Insurance
- General farm overhead

Cost Categories Assumed Mixed

- Seed
- Fertilizer
- Chemicals
- Custom operations
- Fuel, lube, electricity
- Repairs
- Water
- Interest
- Ginning
- Hired labor
- Opportunity cost of unpaid labor
- Capital recovery for machinery
- Land rent
- Taxes & Insurance
- General farm overhead

External Factors Affecting Mixed Input Costs

<i>Cost category</i>	<i>Assumed to be a function of</i>
Fertilizer	price of natural gas
Chemicals	price of natural gas
Hired labor	general labor costs
Unpaid labor	general labor costs
Machinery	price of steel

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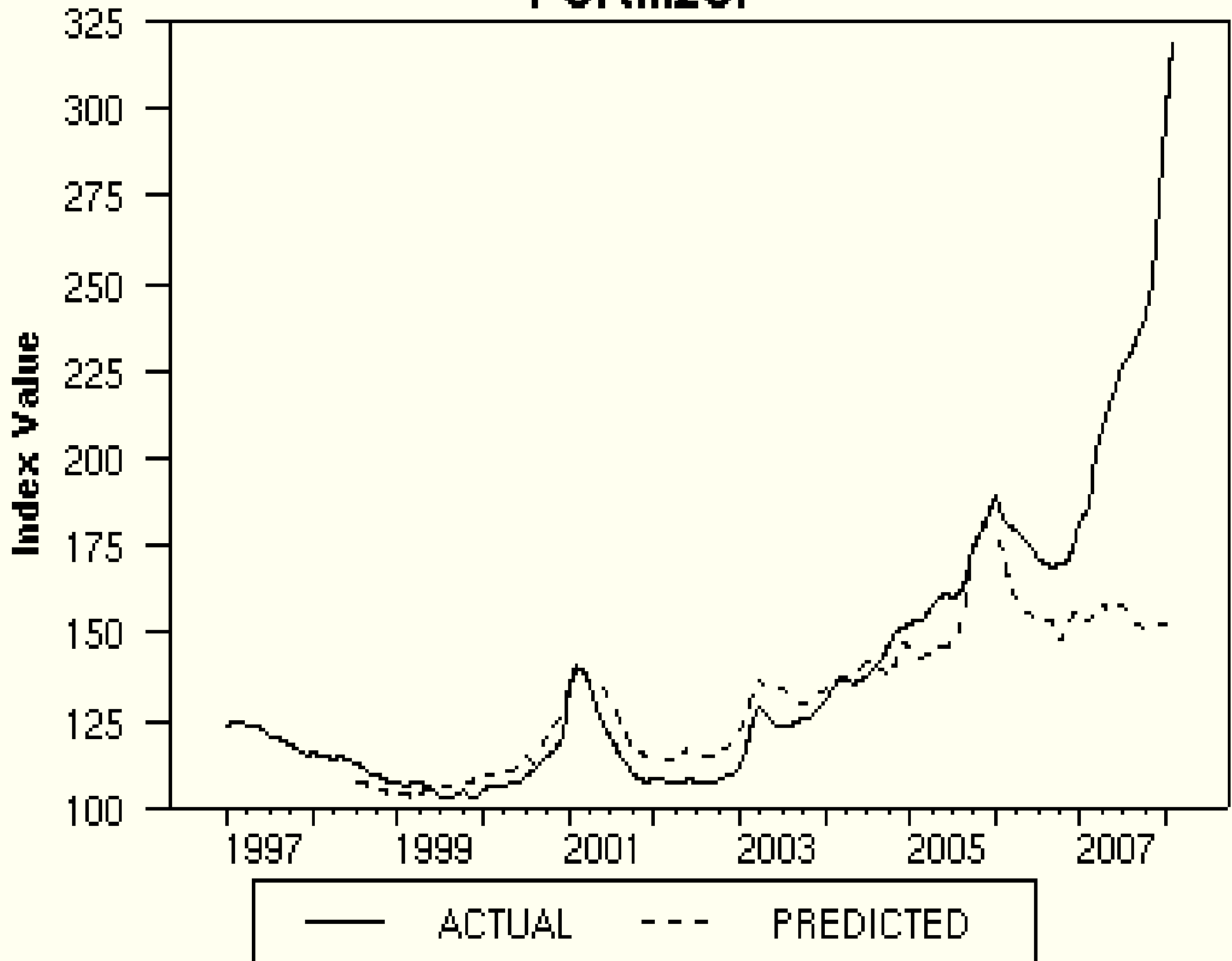
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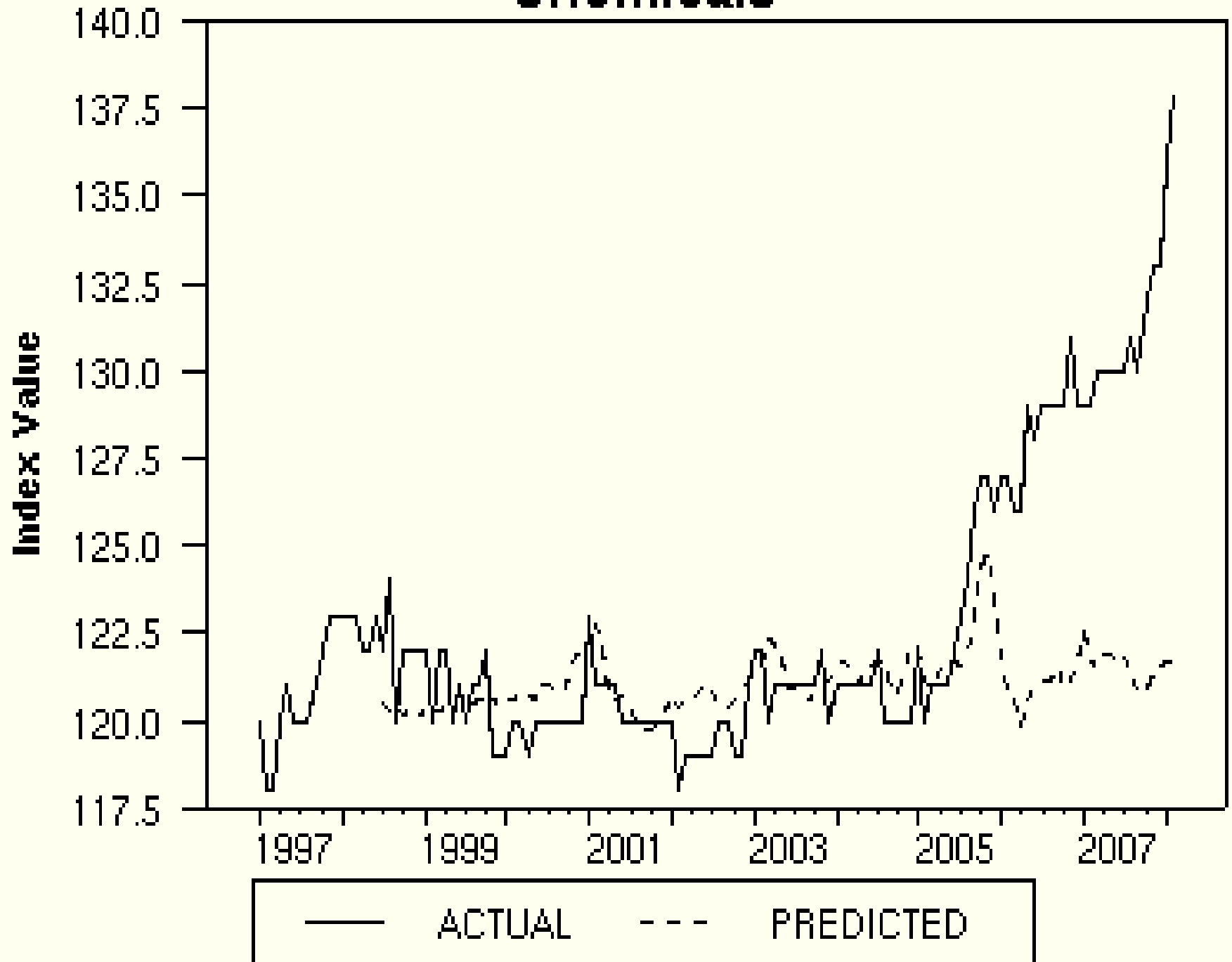
Predicting Mixed Input Costs

- Simple linear models with up to 18 lags of exogenous variables
- Estimation based on monthly data through 2005-12
- Predictions for 2006-01 onward compared to observed values

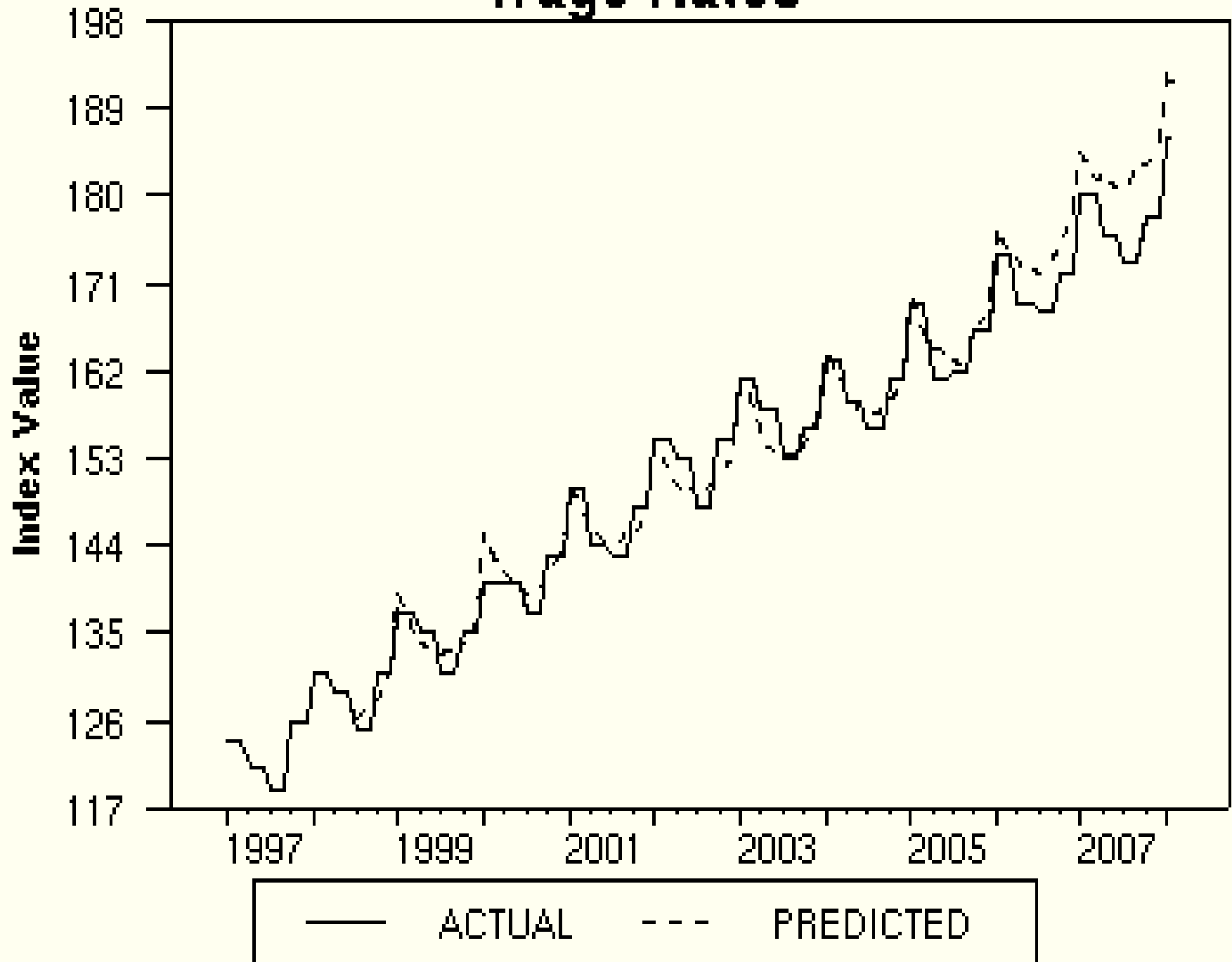
Fertilizer



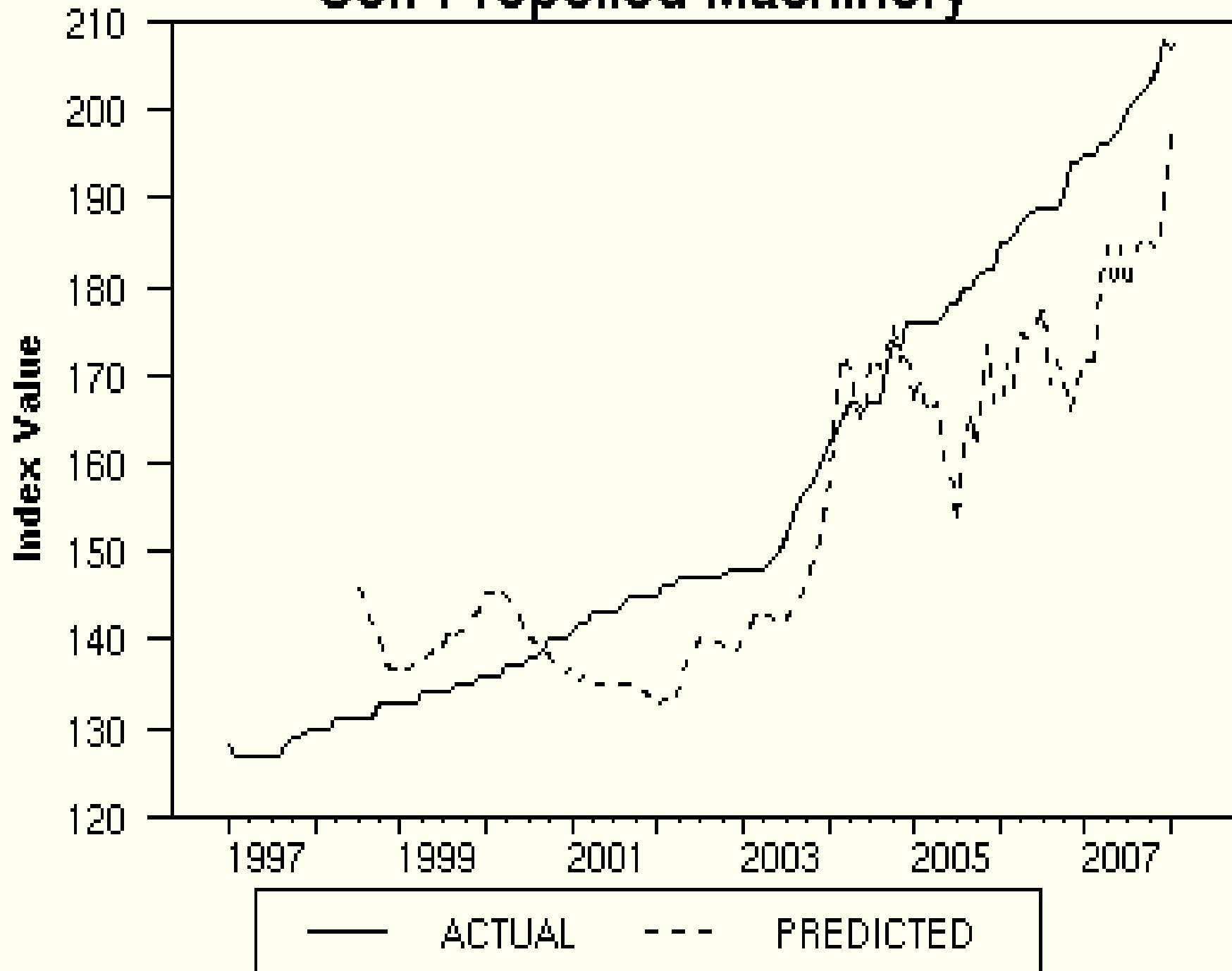
Chemicals



Wage Rates



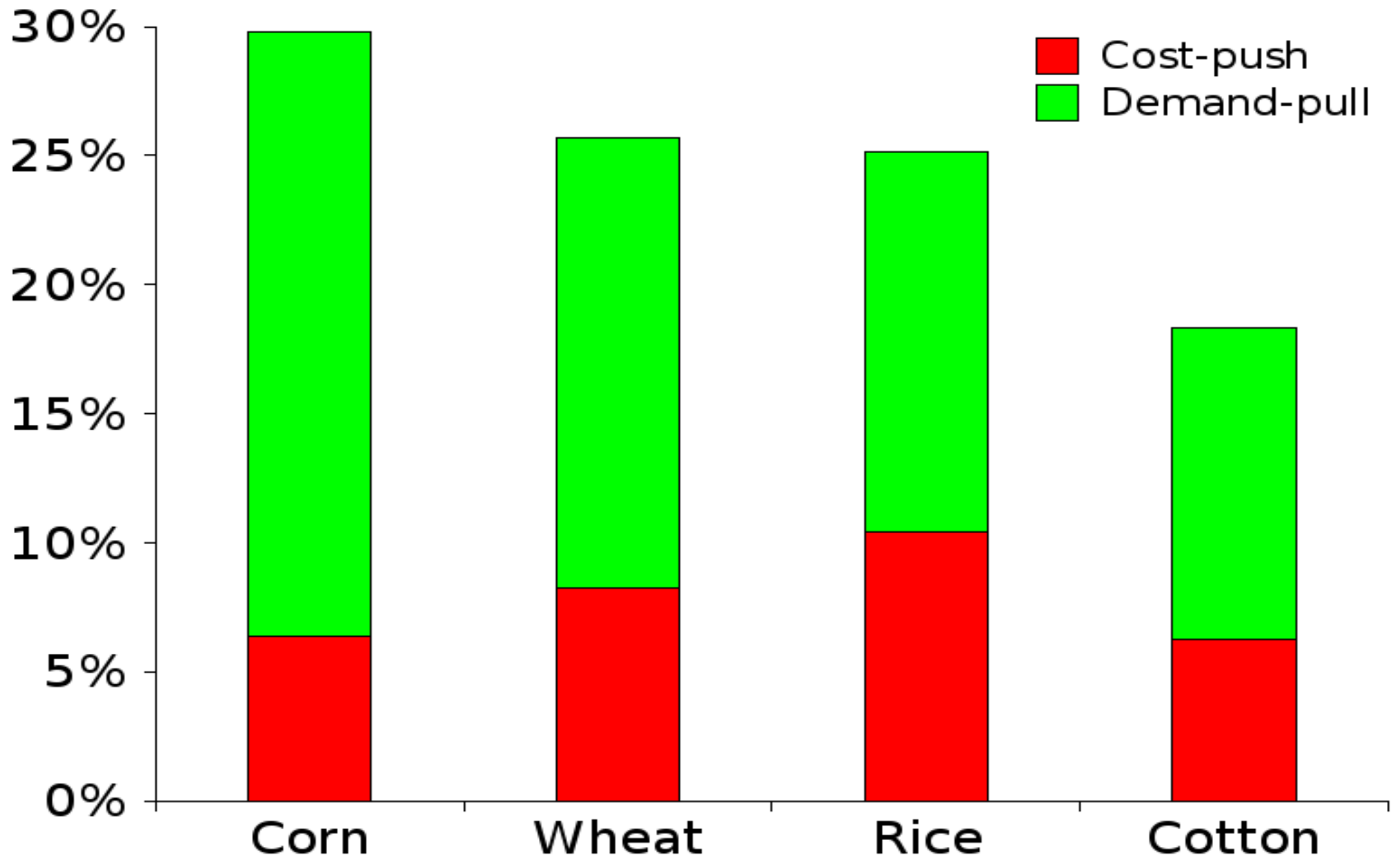
Self-Propelled Machinery



Results for Mixed Input Costs

- Fertilizer cost increases 100% internal
- Chemical cost increases 100% internal
- Labor cost increases 100% external
- Machinery cost increases 100% external

Total Cost of Production Increases, 2006-01 through 2008-02



Output price increases less cost of production increases

- Corn: 128.4%
- Wheat: 139.8%
- Rice: 101.9%
- Cotton: 5.1%

Conclusions

- Significant input cost inflation recently
- Cost-push inflation relatively limited
- Increases in costs of production smaller than increases in output prices
- Caveat: structural change in fertilizer production