Hydro power. Market might.

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Motivation

Why is market power bad?

- Econ 101: Deadweight loss b/c dominant firms withhold production.

But is this really true?

- Suprisingly difficult to verify empirically.
- Identification is tough. Requires lots of imposed structure...

This paper

- Identify causal impact of market power on firm behaviour (in reduced-form setting).
- Bridge the gap between theory and empirics.

Introduction

(Or: Why should you care?)

Market power is "so hot right now"

Growing concerns...

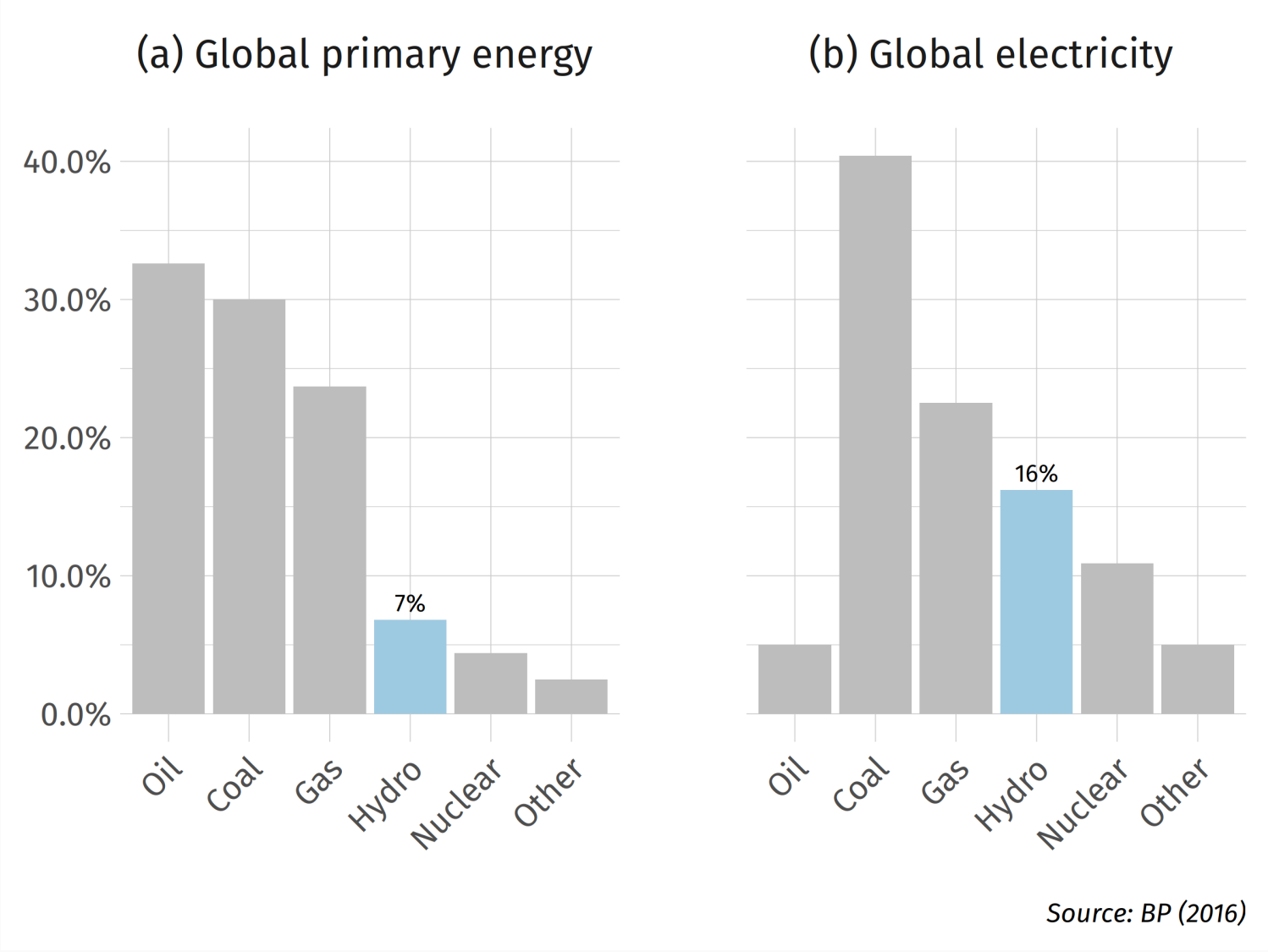
- Stagnant wages and falling labour productivity shares: Autor, Dorn, Katz, Patterson, and Reenen (2017); Azar, Marinescu, and Steinbaum (2017); Benmelech, Bergman, and Kim (2018a).
- Slowdown in aggregate output: De Loecker and Eeckhout (2017).

... across various dimensions

- Nationally and globally: Azar, Marinescu, Steinbaum, and Taska (2018); De Loecker and Eeckhout (2018).
- Traditional and nascent markets Benmelech, Bergman, and Kim (2018a); Dube, Jacobs, Naidu, and Suri (2018).

Okay, but what does all this have to do with hydropower?

Hydropower is important



Source: BP (2016)

Hydropower is empirically unique

Homogenous end-good (electricity)

- Don't have to worry about branding, advertising, etc.

Dispatchable production

- Don't have to worry about production inertia.

Negligible marginal costs

- Production based on the opportunity cost of water (use today vs. save tomorrow).

Theory

Institutional features

Norwegian electricity sector

Supply

- Hydropower totally dominant (> 95% of total).

Demand

- Winter double that of summer... but heating is substitutable and market fosters consumer responsiveness (variable contracts, in-house meters, etc.)

(Spoilers)

- Summer demand is significantly more *inelastic* than winter demand.
- Implies: Dominant firms to keep fuller reservoirs during summer (as they withhold production) and vice versa during winter.

Nord Pool and Elspot

The market exchange

- Norway is part of *Nord Pool*.
  - The world's first (and still largest) multi-national power exchange.
- Foundation of Nord Pool is the day-ahead *Elspot* market.
- Elspot market comprises distinct bidding areas.

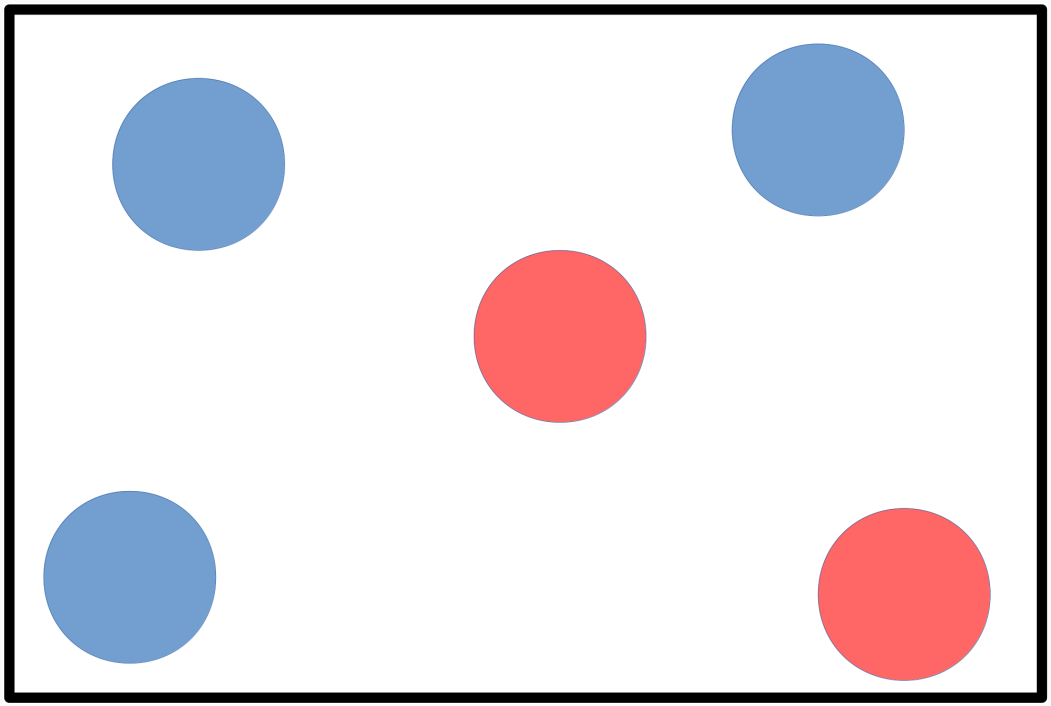
Role of transmission constraints

- Not binding: Common system price in all areas.
- Binding: Areas become their own markets.
- Creates opportunities for exploiting local market power.

Stylised example

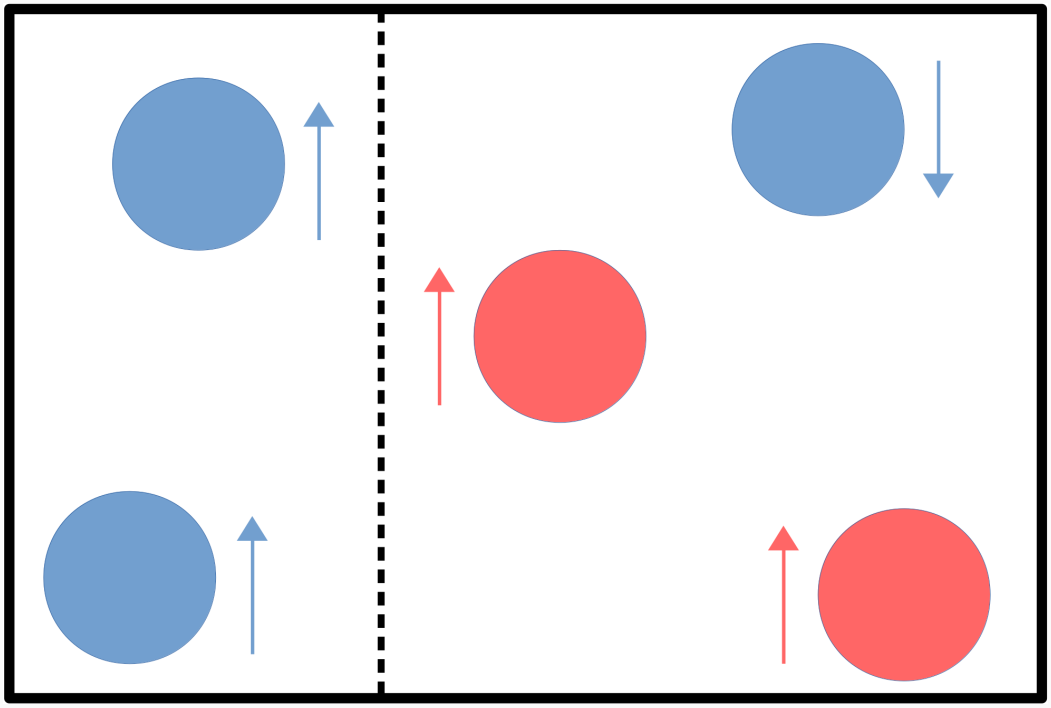
Blue: 60% market share.

Red: 40% market share.



Stylised example (cont.)

Blue 100% (↑) & 33% (↓) market share.
Red: 67% (↑) market share.



Data

Data

Hydropower reservoirs (2000-2013)

- Daily time series data for the 500 largest reservoirs in Norway (2 million obs).
- Approximately 90% of the total system capacity.
- Matched to other important covariates, such as plant ID, producer info, GIS, etc.

Electricity flows and prices (2000-2013)

- Prices and flows per bidding area over the same period.
- Transmission constraints and boundary changes.

Electricity bid curves (2014-2017)

- Allows for direct measurement of demand elasticities.

Weather (2000-2013)

- Precipitation and temperature data as controls.

Residual Supply Index

A better measure of market power

(And new to this version of the paper)

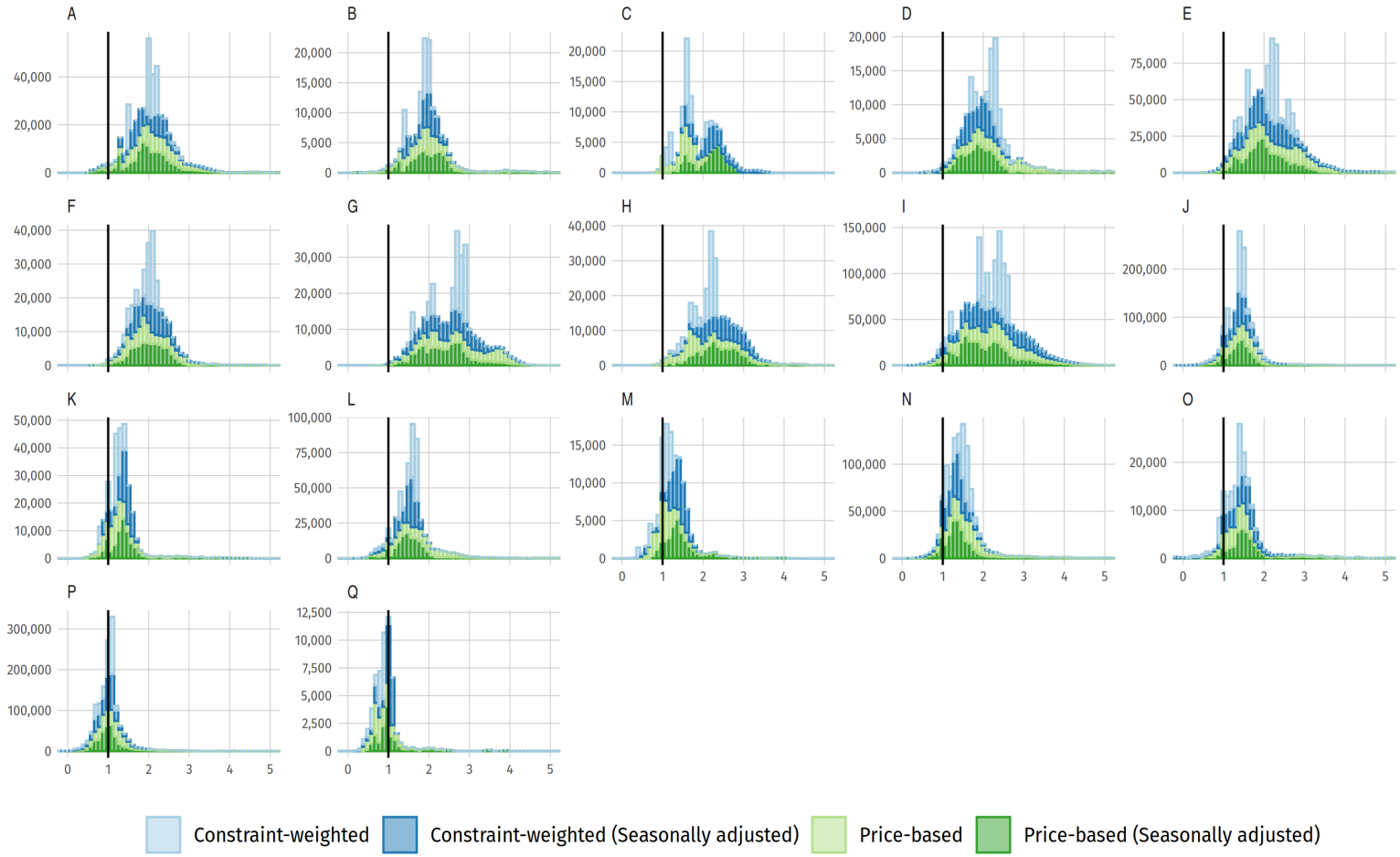
$$RSI_f = \frac{\text{Total capacity} - \text{Firm f's capacity}}{\text{Total Demand}}$$

Basically, how difficult is it to meet supply without firm f's production?

Note that $\downarrow$ RSI $\Rightarrow \uparrow$ market power

- RSI < 1 implies that a firm is "pivotal".

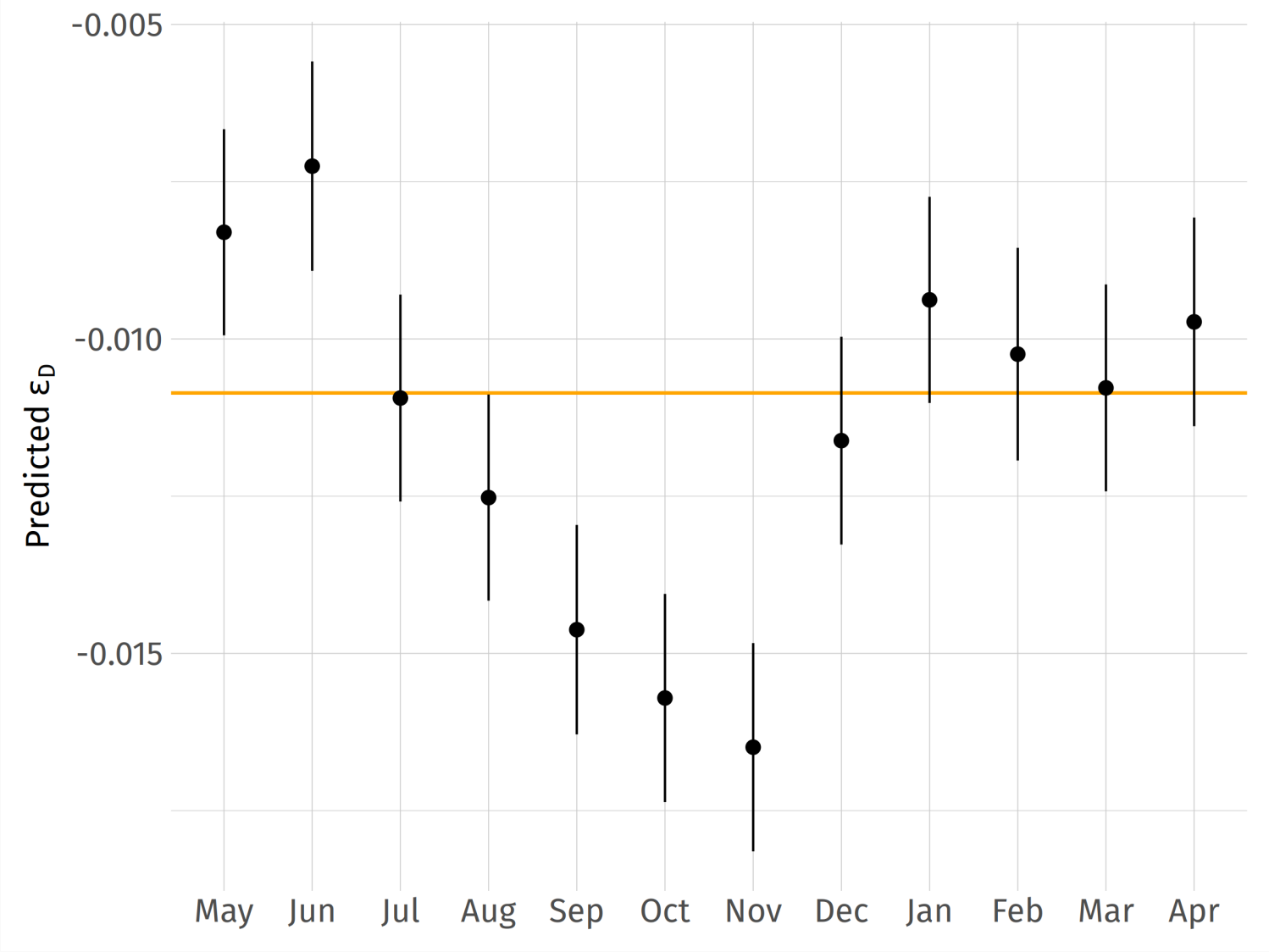
Residual Supply Index (cont.)



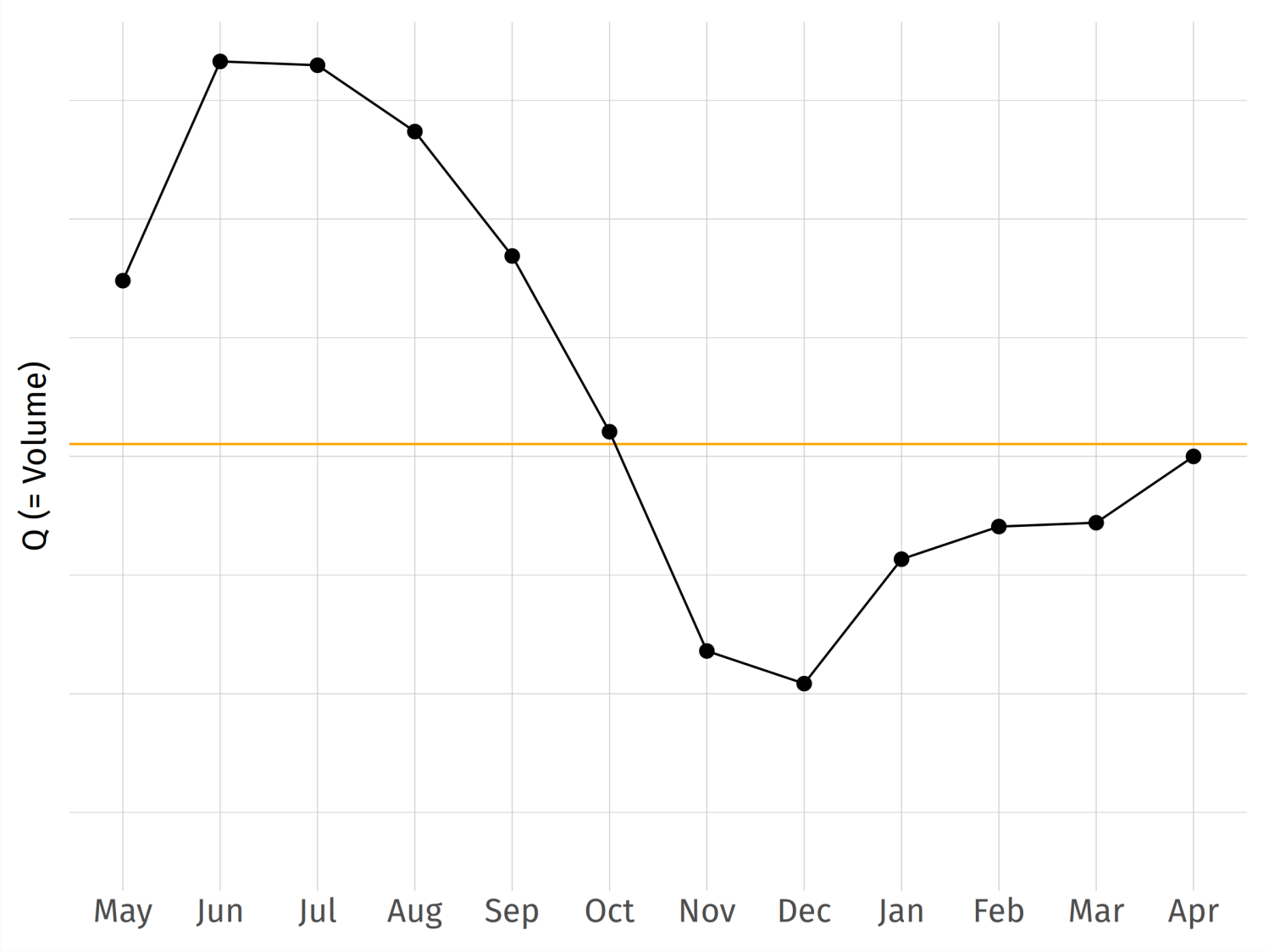
Econometrics

Results

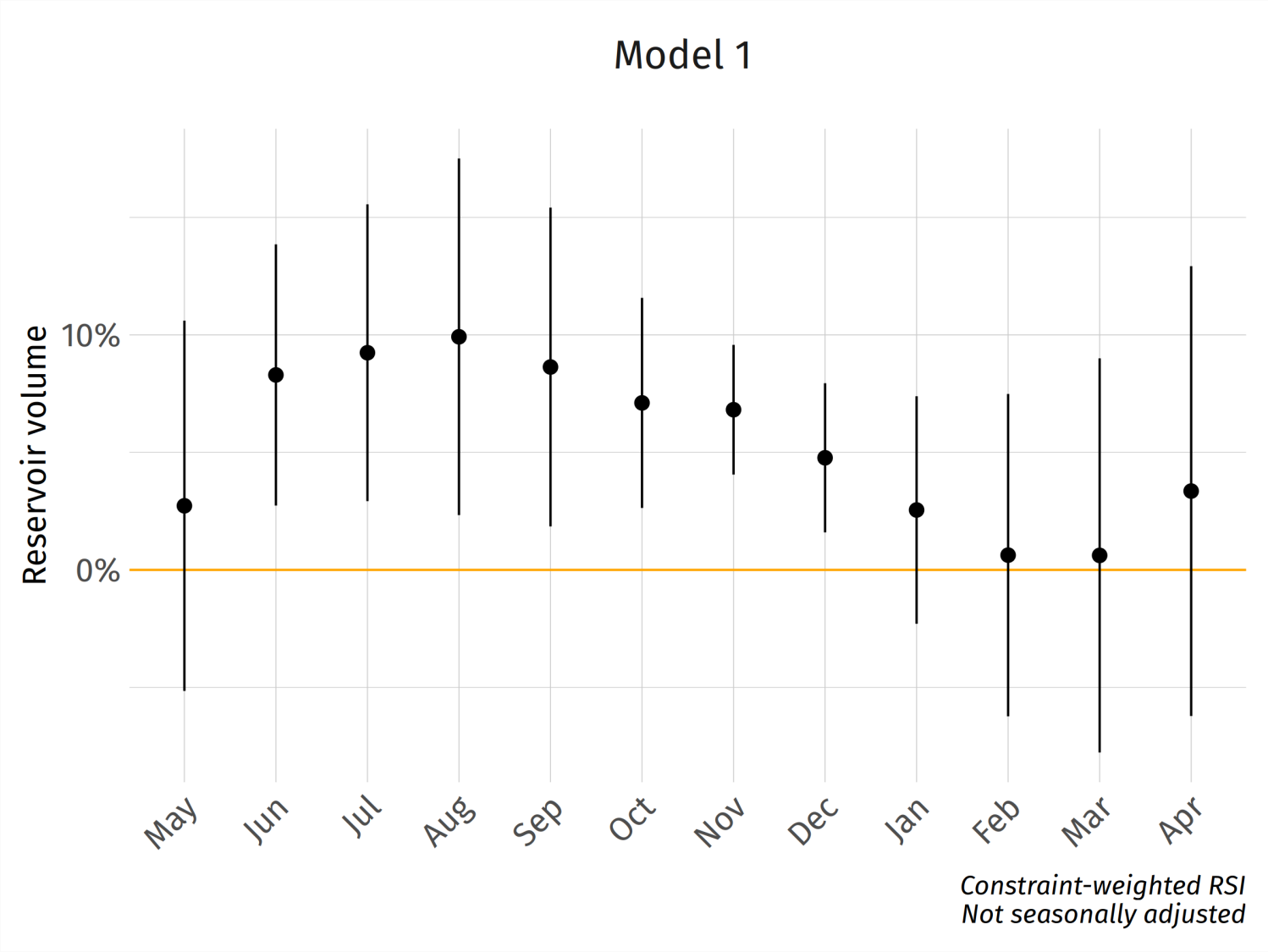
From to demand elasticities...



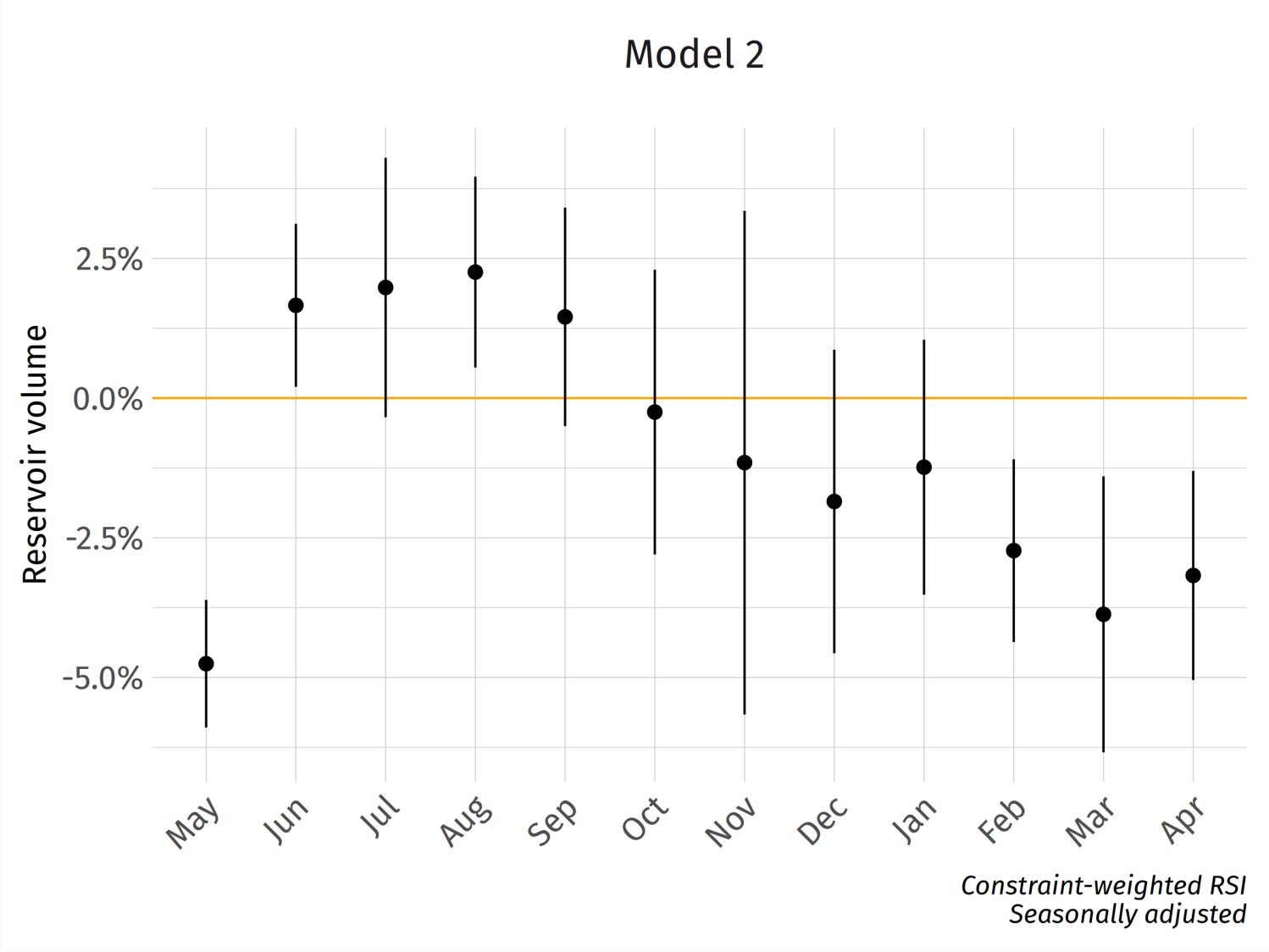
...to implied reservoir volumes (stylised)



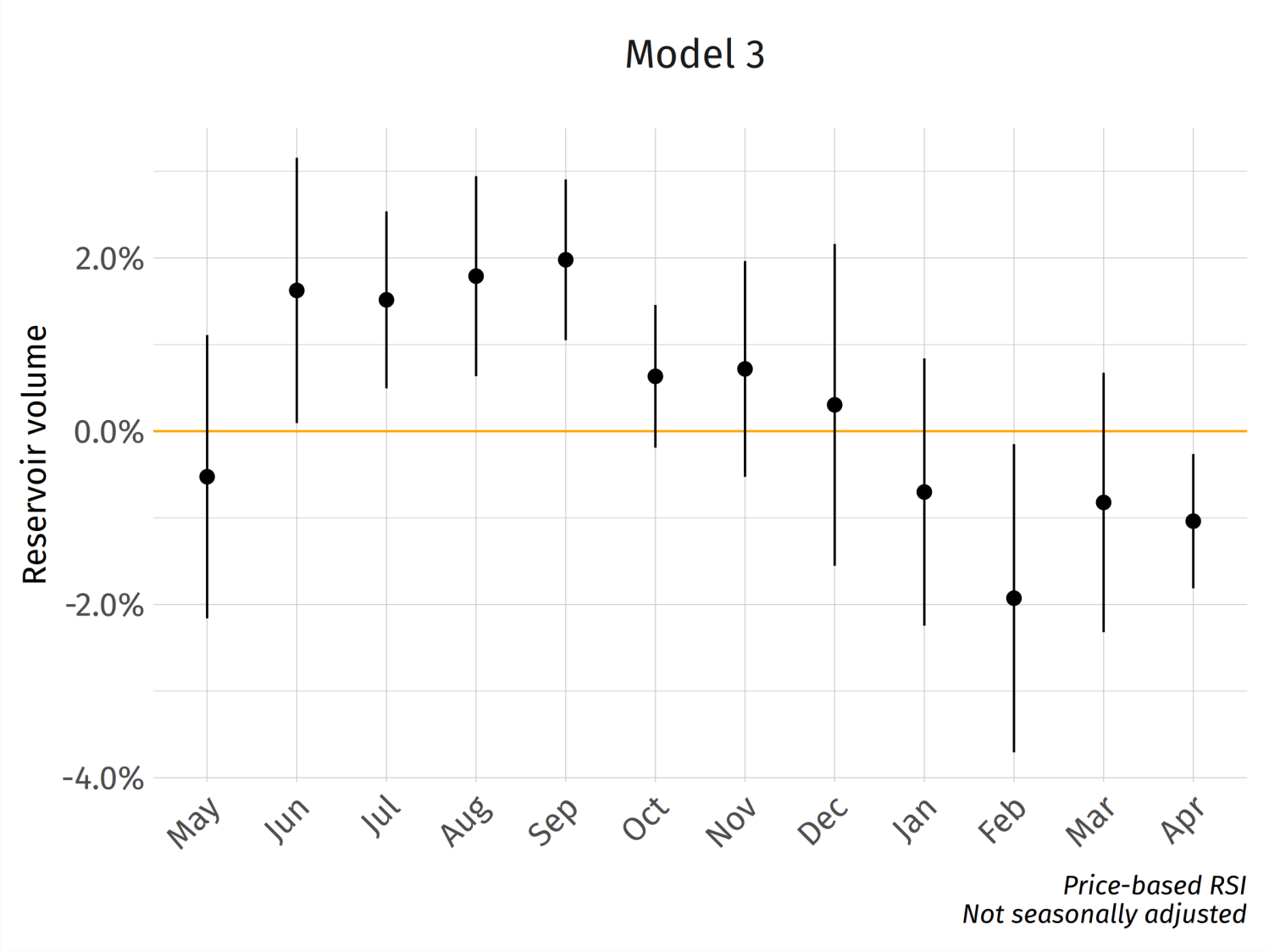
Effect of market power



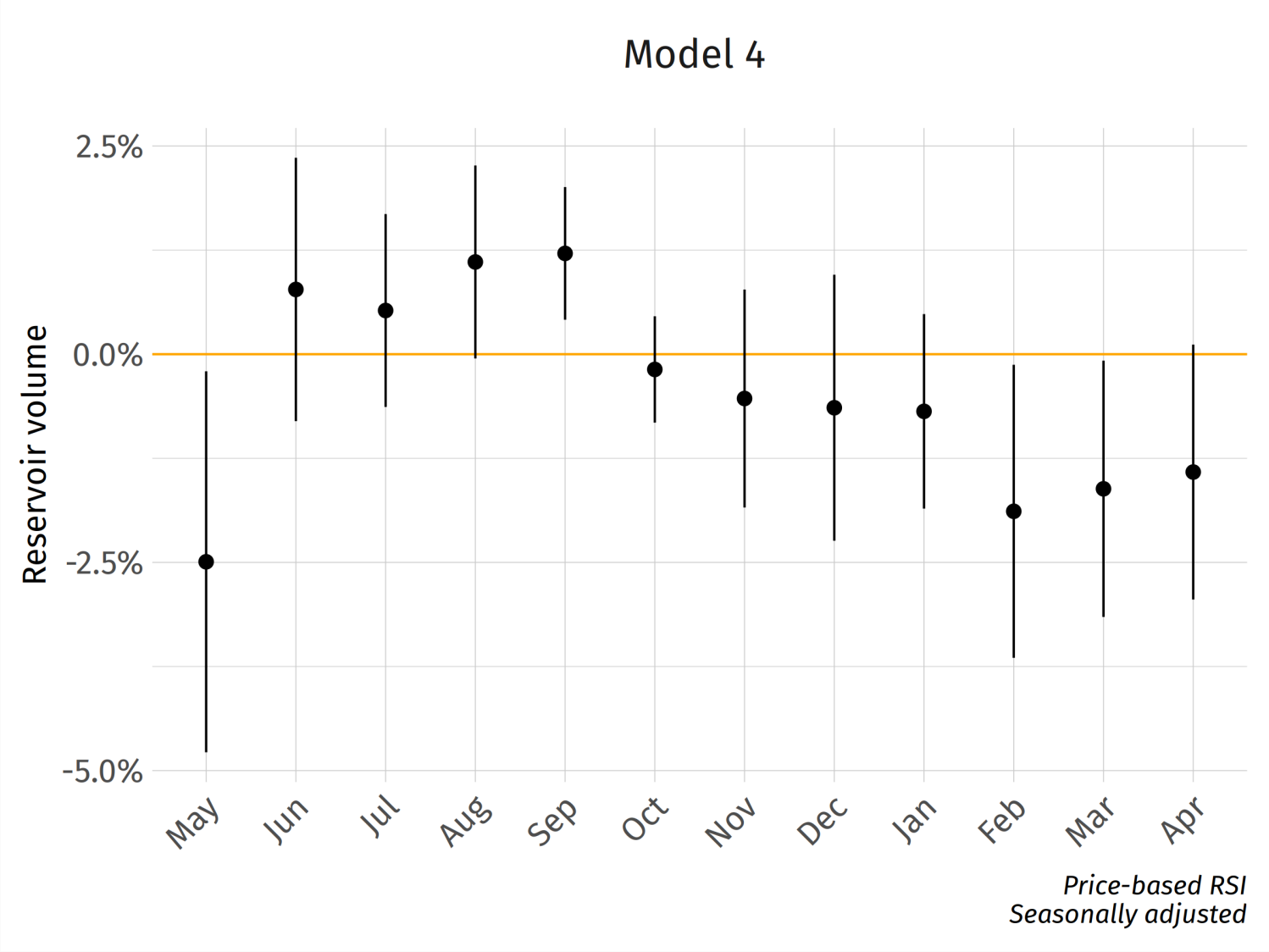
Effect of market power (cont.)



Effect of market power (cont.)



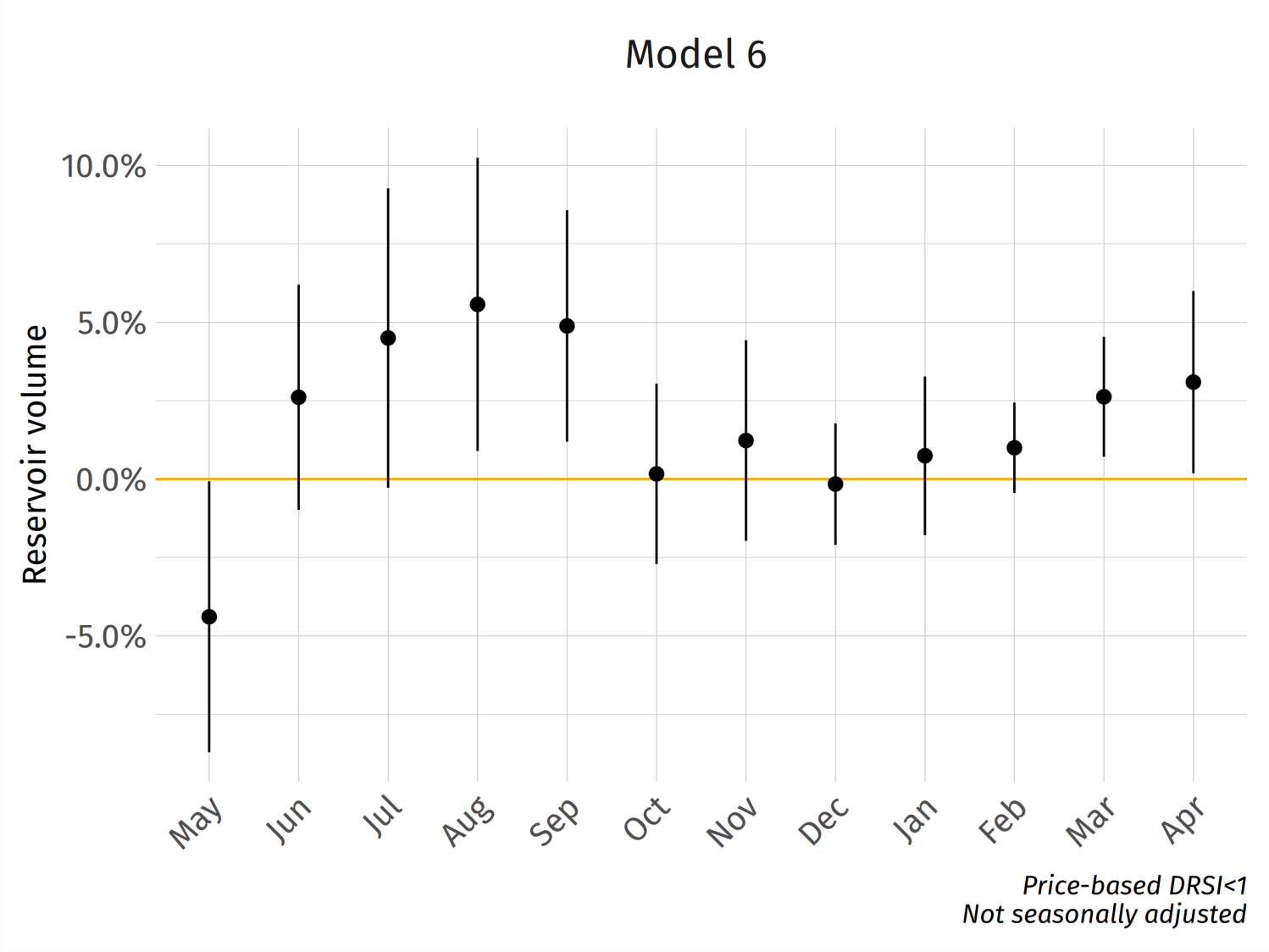
Effect of market power (cont.)



What about a discrete measure of market power?

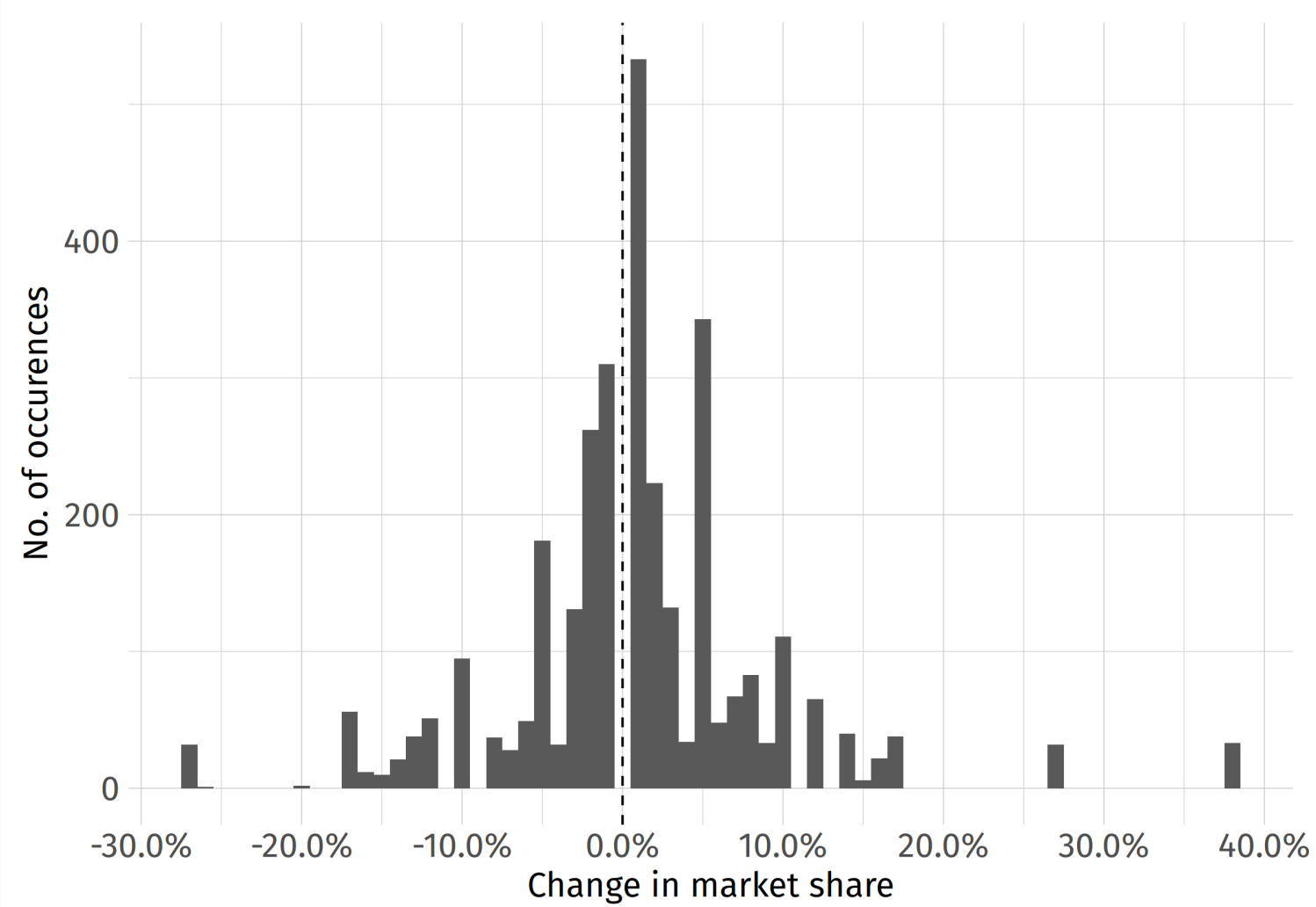
$$D_{RSI<1} = \text{Pivotal}$$

Effect of becoming a pivotal firm



Conclusions

Variation from regime changes



Excludes observations with approximately zero change.