Speculative Oil

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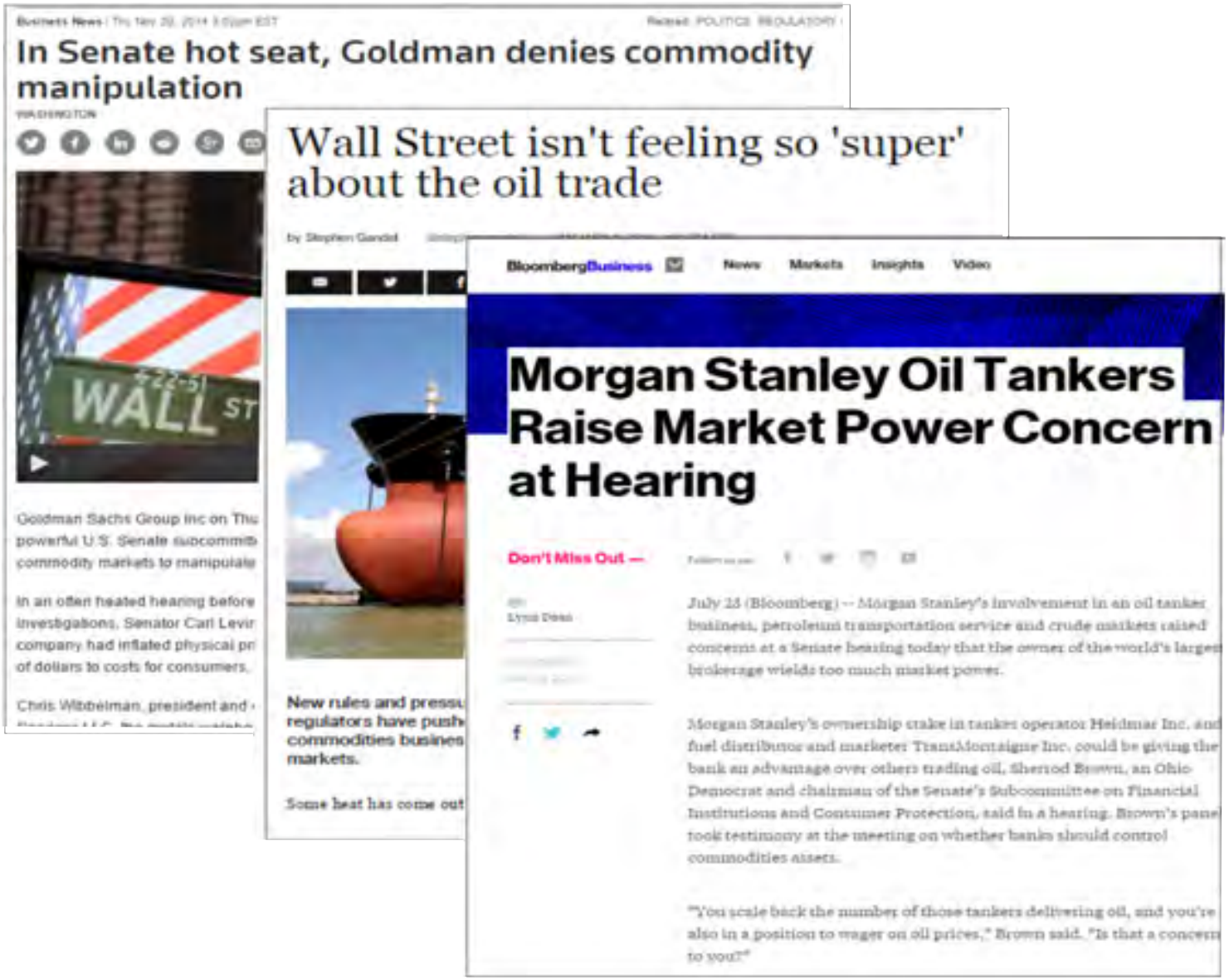
Motivation

- The price of oil is driven by supply and demand.
- There are economic and statistical models about the demand for oil and demand shocks.
- There are also economic and statistical models about the supply of oil and supply shocks.
- We want to learn from the data.
- Very, very detailed U.S. seaborne imports data.

Sherlock Holmes: "It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts."
A Scandal in Bohemia by Arthur Conan Doyle.

Theories



In Senate hot seat, Goldman denies commodity manipulation

Goldman Sachs Group Inc on Thu
powerful U.S. Senate subcommitt
commodity markets to manipulate

In an often heated hearing before
investigations, Senator Carl Levir
company had inflated physical pr
of dollars to costs for consumers.

Chris Wittbelman, president and

Wall Street isn't feeling so 'super' about the oil trade

by Stephen Gandel

New rules and pressu
regulators have push
commodities busines
markets.

Some heat has come out

BloombergBusiness News Markets Insights Video

Morgan Stanley Oil Tankers Raise Market Power Concern at Hearing

Don't Miss Out —

July 23 (Bloomberg) -- Morgan Stanley's involvement in an oil tanker business, petroleum transportation service and crude markets raised concerns at a Senate hearing today that the owner of the world's largest brokerage wields too much market power.

Morgan Stanley's ownership stake in tanker operator Heidmar Inc. and fuel distributor and marketer TransMontaigne Inc. could be giving the bank an advantage over others trading oil, Sherrod Brown, an Ohio Democrat and chairman of the Senate's Subcommittee on Financial Institutions and Consumer Protection, said in a hearing. Brown's panel took testimony at the meeting on whether banks should control commodities assets.

"You scale back the number of those tankers delivering oil, and you're also in a position to wager on oil prices," Brown said. "Is that a concern to you?"

United States Senate
PERMANENT SUBCOMMITTEE ON INVESTIGATIONS
Committee on Homeland Security and Governmental Affairs

Carl Levin, Chairman
John McCain, Ranking Minority Member

WALL STREET BANK INVOLVEMENT WITH PHYSICAL COMMODITIES

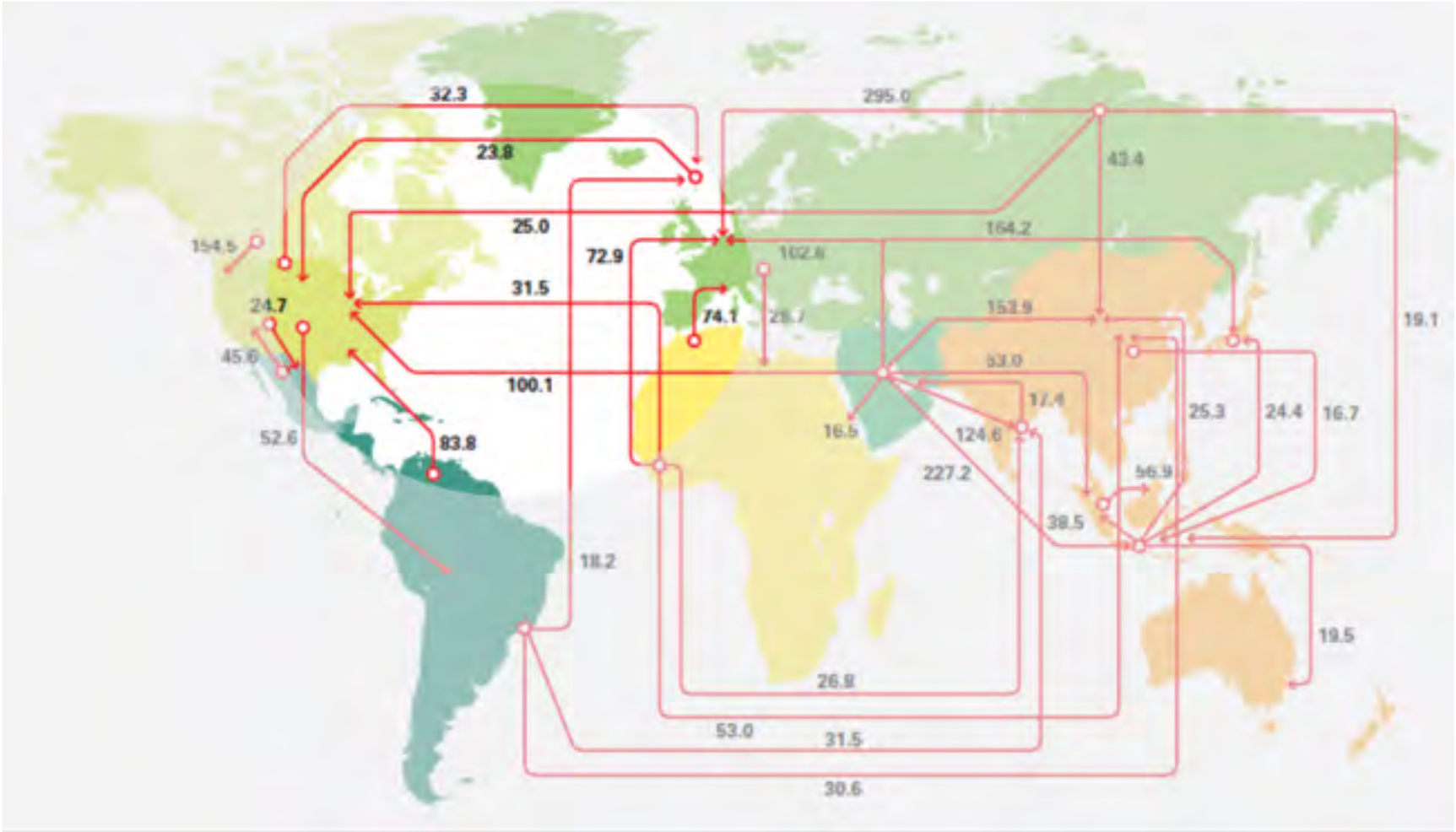
MAJORITY AND MINORITY STAFF REPORT

PERMANENT SUBCOMMITTEE ON INVESTIGATIONS

UNITED STATES SENATE

RELEASED IN CONJUNCTION WITH THE PERMANENT SUBCOMMITTEE ON INVESTIGATIONS NOVEMBER 20 AND 21, 2014 HEARING

The facts: Where does the U.S. import its crude oil and energy products from by sea?



Graphics: BP Statistical Review of World Energy, June 2014.

The facts (cont.): When crude oil and oil products are imported into the US by sea, a document is created.

Bill of Lading – evidence of a contract for the carriage and delivery of goods sent by sea.

BILL OF LADING

Page 1

SHIP FROM

Name: ABC Company
Address: 1000 ABC Drive
City/State/Zip: Any City, AB, 10000
SCAC:
FOB: ☐

Bill of Lading Number: _0614141234567890_

SHIP TO

Name: XYZ Company Location # _0669_
Address: 9000 XYZ Drive
City/State/Zip: Some City, ZY 90000
SCAC:
FOB: ☐

CARRIER NAME: _LTL Transportation_
Trailer number:
Seal number(s):
SCAC: ABCD
Pro number: 12345678901234567890

THIRD PARTY FREIGHT CHARGES BILL TO:

Name:
Address:
City/State/Zip:

Freight Charge Terms: (freight charges are prepaid unless marked otherwise)
Prepaid: _____

SPECIAL INSTRUCTIONS:

☐ Collect _X_ 3rd Party
☐ Master Bill of Lading with attached underlying Bills of Lading

CUSTOMER ORDER INFORMATION

CUSTOMER ORDER NUMBER		WEIGHT	PALLET	ADDITIONAL SHIPPER INFO
4501234569B	350 ctns	1750 lbs	Y	
6805673	50 ctns	250 lbs	Y	
GRAND TOTAL	400 ctns	2000 lbs		

CARRIER INFORMATION

HANDLING UNIT QTY	HANDLING UNIT TYPE	PACKAGE QTY	PACKAGE TYPE	WEIGHT	H.M. (X)	COMMODITY DESCRIPTION	LTL ONLY NMFC #	LTL ONLY CLASS
5	pltz	100	ctns	500 lbs		Sport Accessories	154855.00	70
		250	ctns	1250 lbs		Video, Tape Recording	156858.03	92.5
		50	ctns	250 lbs		Recordings, Sound, Disc, Tape	155547.01	100
5		400		2000 lbs		GRAND TOTAL		

COD Amount: $ _____
Fee Terms: Collect: ☐ Prepaid: ☐
Customer check acceptable: ☐

NOTE: Liability Limitation for loss or damage in this shipment may be applicable. See 49 U.S.C. § 14706(c)(1)(A) and (B).

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

_____ Shipper
Signature

SHIPPER SIGNATURE / DATE

Trailer Loaded: ☐ By Shipper ☐ By Driver
Freight Counted: ☐ By Shipper ☐ By Driver/Pallets said to contain ☐ By Driver/Pieces

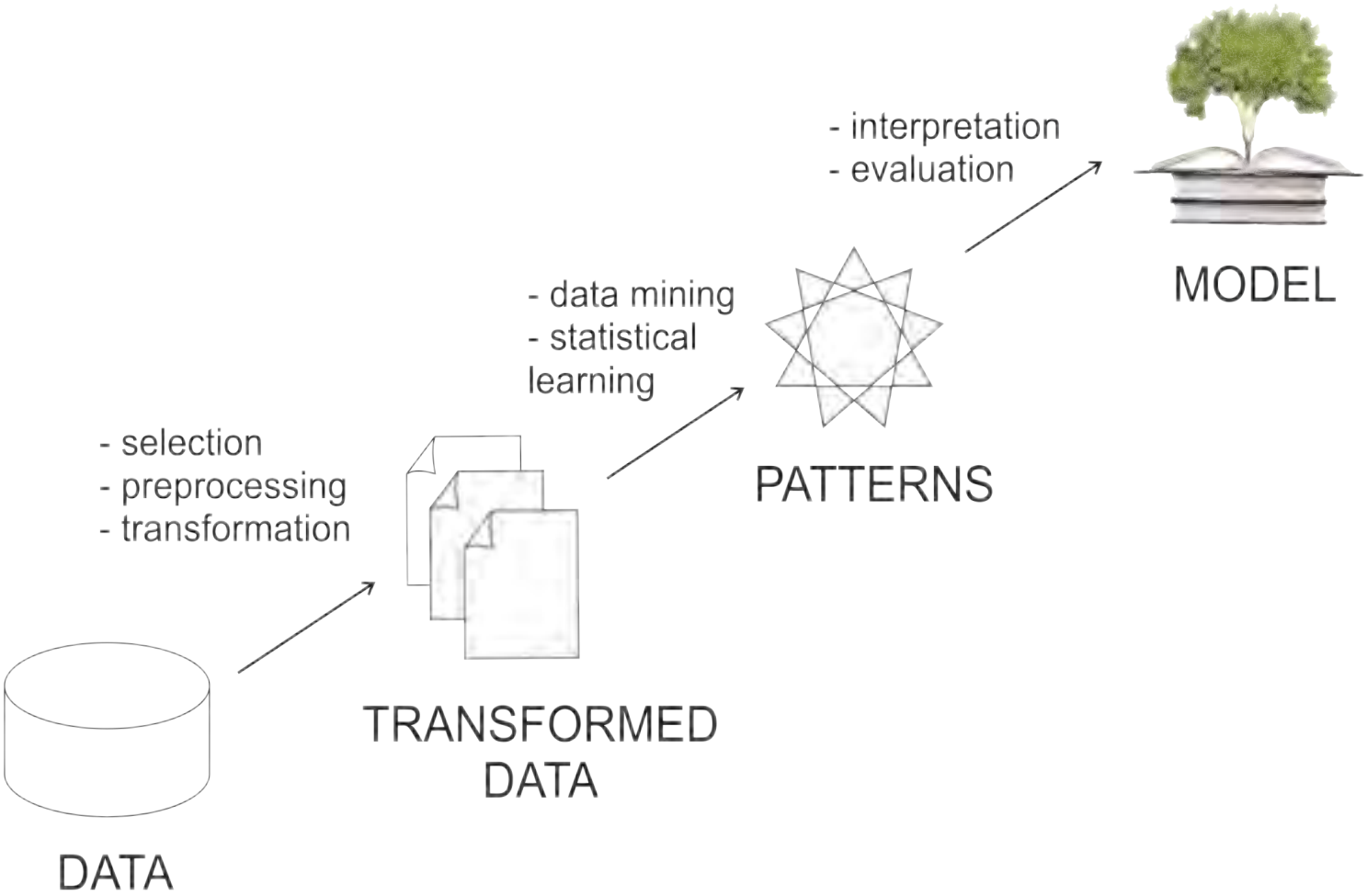
CARRIER SIGNATURE / PICKUP DATE

- Source data contains 232,907 Bills of Lading for energy products imported into the US during 2008–2012.
- BoLs are mandatorily reported to the U.S. Customs and Borders Protection Agency.
- The data covers 100% of the seaborne crude oil and oil products imported into the US during 2008–2012.
- During 2008–2012, seaborne crude oil provided up to 70% of import refinery receipts and accounted for about 50% of the crude oil supply.

The facts (cont. yet): What is and is not in a BoL?

- Bill of Lading contains:
  - Names of the buyer and seller
  - Product description
  - Date of arrival in a US port
  - Name of the transportation company, the vessel, the route, etc.
- Bill of Lading does NOT contain:
  - Volume of floating storage
  - Date of departure
  - Price

The Plan

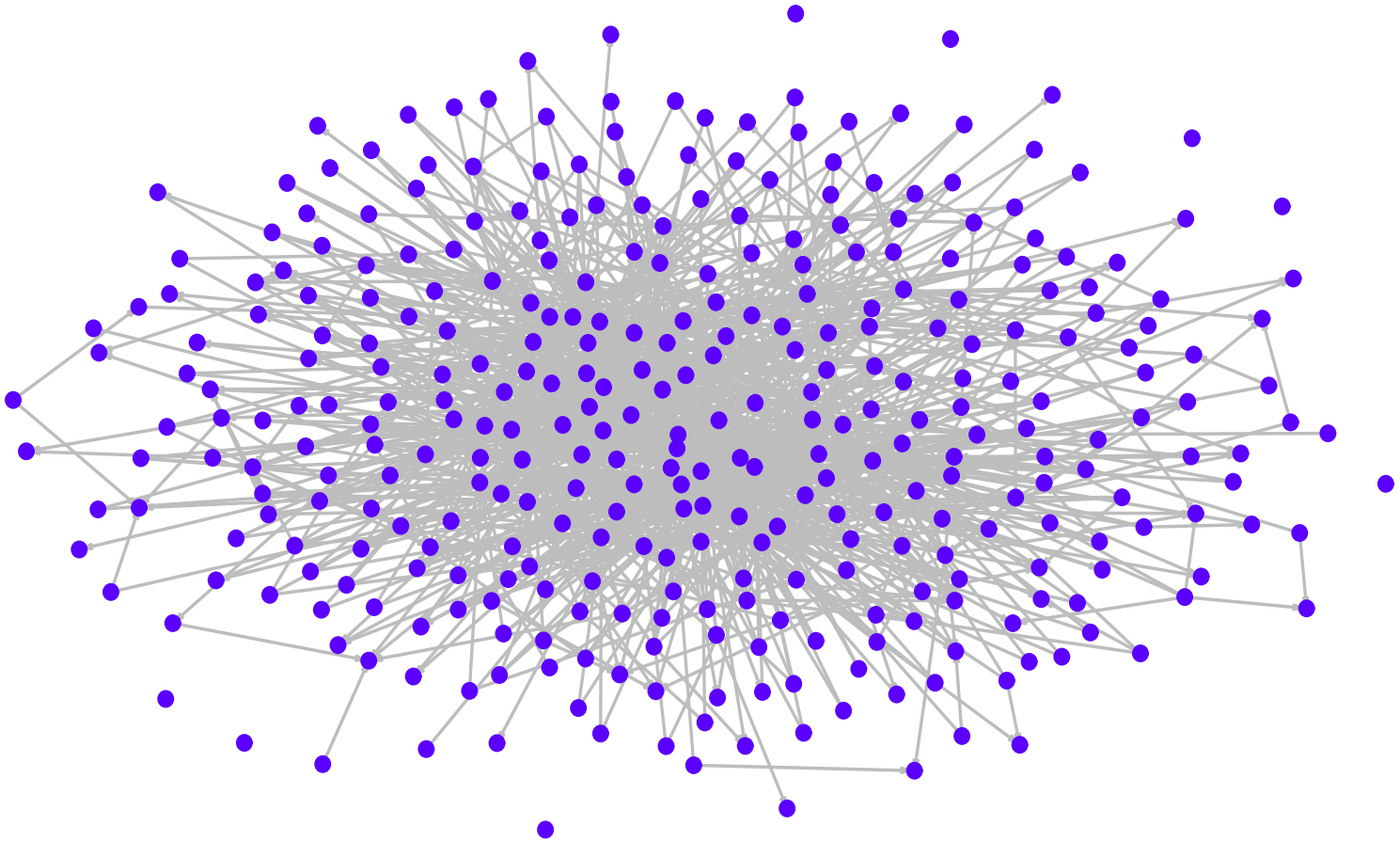

- interpretation
- evaluation
MODEL
- data mining
- statistical learning
PATTERNS
- selection
- preprocessing
- transformation
TRANSFORMED DATA
DATA

Data selection, preprocessing, and transformation

- We select data by filtering target products as they appear in a BoL: crude oil and oil products.
- We minimally preprocess data by dealing with spelling errors etc.
- We transform data into a network representation:
  - Nodes are a shipper or a receiver.
  - A directed edge as a BoL shipment from a shipper node to a receiver node.
  - The edges are not weighted by barrels shipped or frequency of shipments.

Transformed Data: First Pass

A directed acyclic graph representing shipments of U.S. seaborne crude oil in 2011.



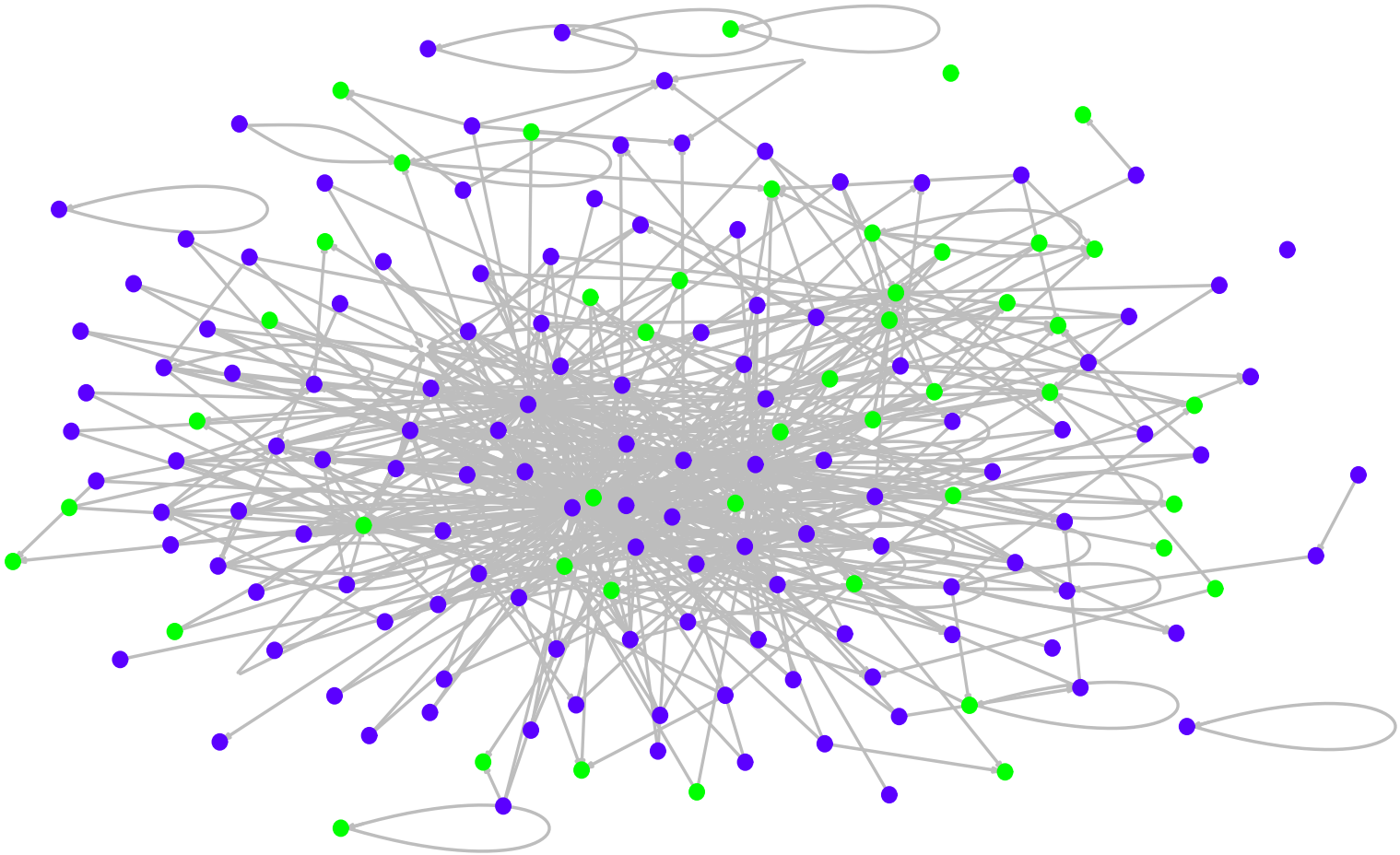
Nodes are BoL shippers and receivers.
Edges are BoL shipments.

Node transformation: aggregation and coloring

- We build a reference database, which contains:
  - Observable ownership structure of US and international companies
  - Addresses of US companies
  - Industry SIC classification for US and international companies
- We use this database to assign all unique company IDs (children) owned by the same entity into a single node.
- We use the SIC industry classification to "color" nodes into two types:
  - Producers (P)
  - Finance & Trading Firms (T)
- BP and BP Trading are colored differently.

Transformed Data (Nodes): Second Pass

A directed acyclic graph with loops.

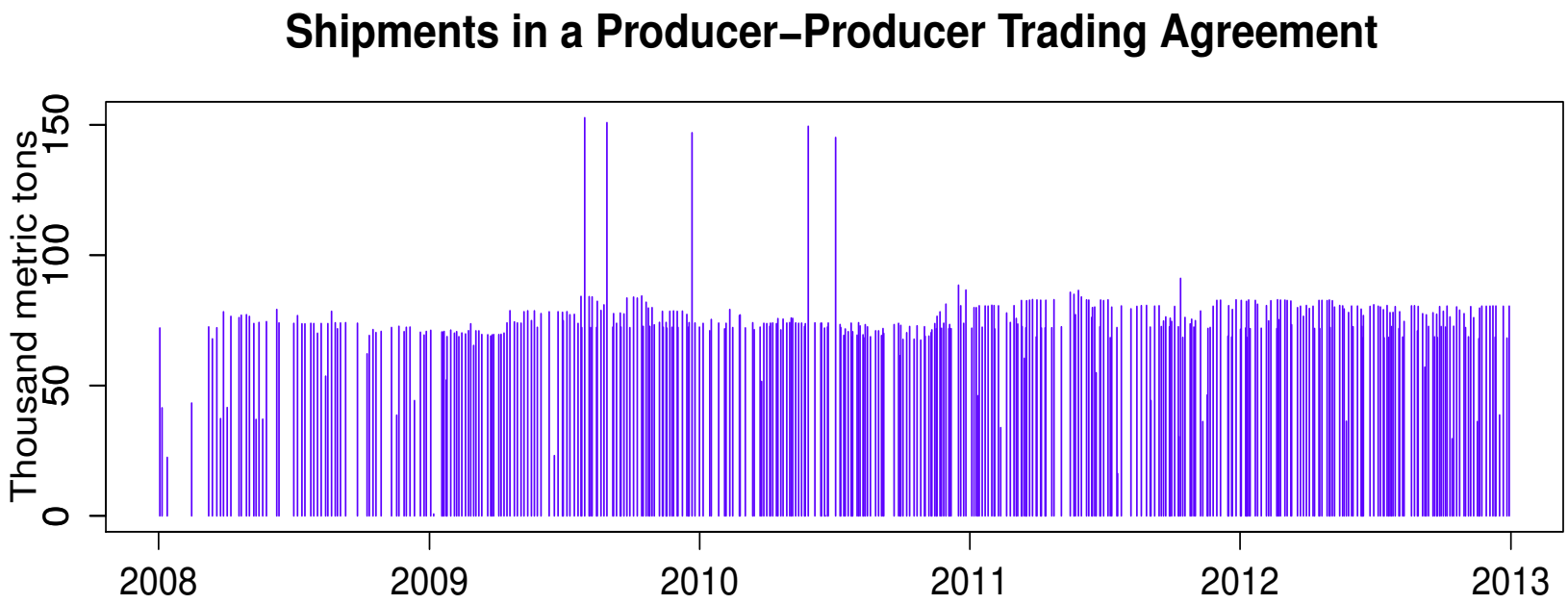


Blue Nodes are Producers (P) and Green Nodes are Traders (T).
Edges are BoL shipments.

Edge transformation: trading agreements

- We aggregate time series of periodic shipments between the same shipper and receiver into *trading agreements*.
- Intuition: According to a *trading agreement*, a seller agrees to deliver a specified total quantity of a specified blend of crude oil to a buyer within a specified period of time (e.g., one year), into a specified US port, with a certain periodicity (e.g., 10 metric tons every month).
- Actual trading agreements are not observed directly from the BoL data.
- We construct *trading agreements* by using:
  - unique ID for a US buyer (consignee) with US port of arrival;
  - unique ID for an international seller (shipper);
  - product custom code group;
  - quantity (in metric tons);
  - date of arrival.

An Example of a Data Pattern that Gives Rise to a *Trading Agreement*



Shipments from one P node to another P node during 2008–2012.

Trading agreements and prices

- *Trading agreements* that we construct do not contain prices, because BoL data does not contain prices.
- However, each *trading agreement* is associated with over 240 different brands and blends of crude oil within the product code HS 2709.
- We use available price data for each brand and blend of crude oil at each date in each location to put a price on each arrival.
- We then calculate average price for each trading agreement and validate this information against customs data provided by the US Census.

Further Transformed Data (Nodes and Edges): Third Pass

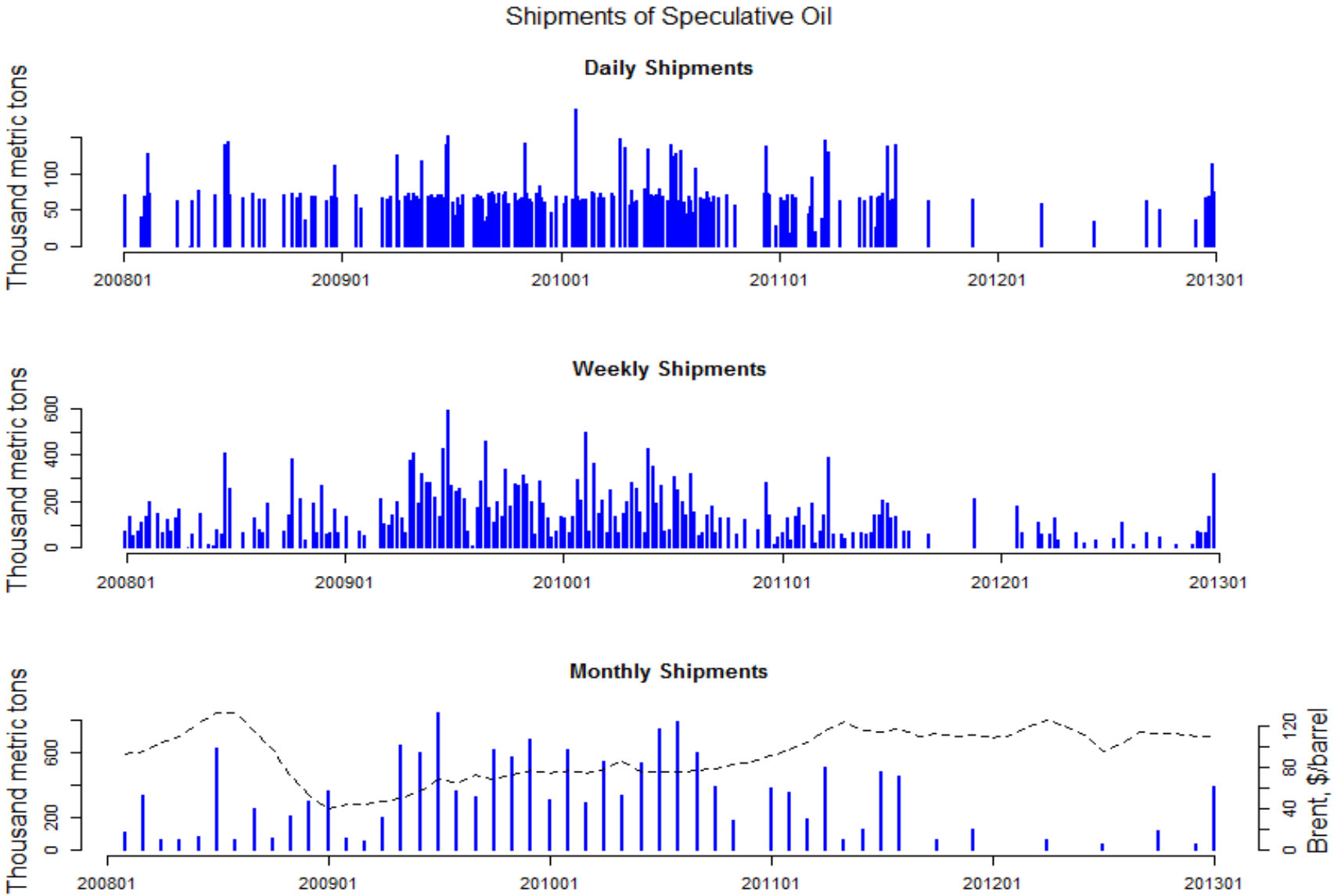
Three types of patterns in a directed acyclic graph with loops.

- Trader–Trader Edges
- Trader–Trader Loops
- Producer–Producer Edges
- Producer–Producer Loops
- Producer–Trader and Trader–Producer Edges

Speculative Oil

Speculative Oil is a subset of T–T loops such that no other entity needs to be notified about the arrival of shipment.

The Time Series of Speculative Oil

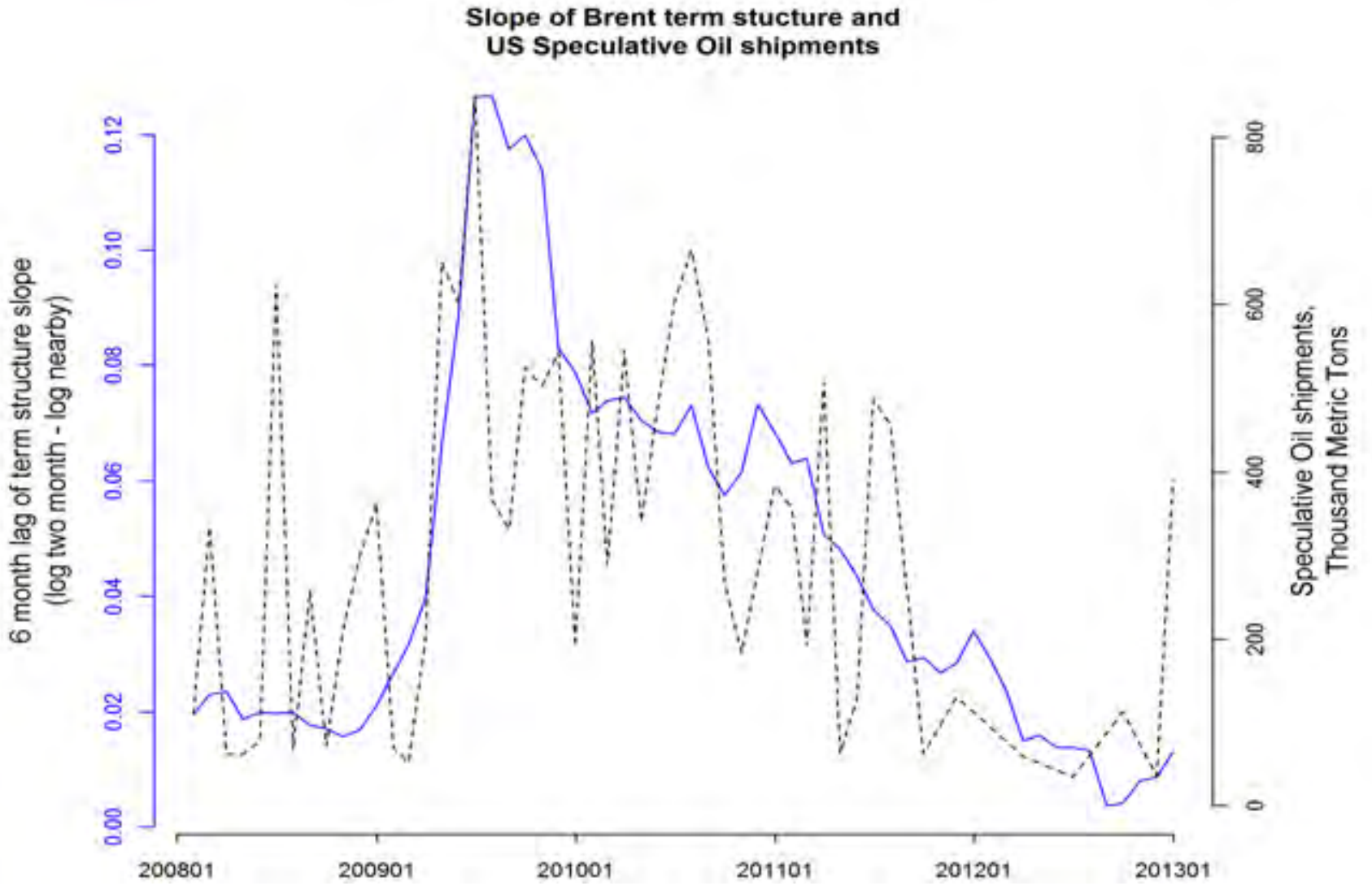


A Statistical Model of Speculative Oil

- Log differences of monthly time series of SO (in thousand metric tons) follows an AR(3) process:

$$y_t = \underset{(0.1191)}{-0.51}\, y_{t-1} - \underset{(0.1316)}{0.36}\, y_{t-2} - \underset{(0.1212)}{0.51}\, y_{t-3} + \epsilon_t$$

Speculative Oil and the Term Structure of Brent Futures Prices



A Statistical Relationship Between Speculative Oil and the Term Structure of Brent Futures Prices

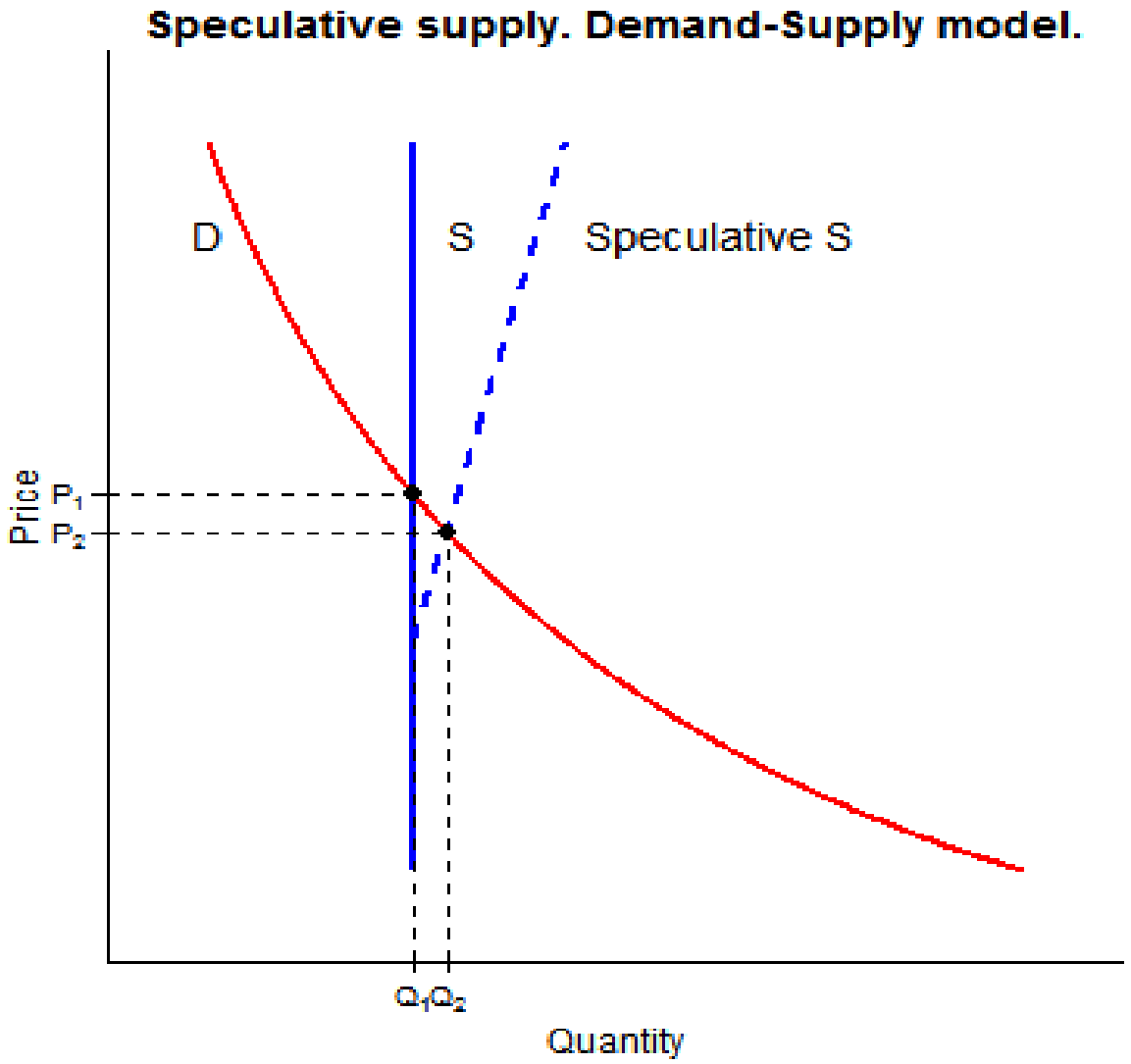
- A regression of log speculative oil, so_t, on the slope of the lagged term structure of Brent futures prices (log two months out minus log nearby), $slope_{t-6}$ (lagged six months):

$$so_t = \underset{(35.4)}{82.1} + \underset{(633.4)}{4263.9} slope_{t-6} + \epsilon_t$$

- Adjusted R-squared: 0.429. F-statistic: 45.3. p-value: 8.3e-09.

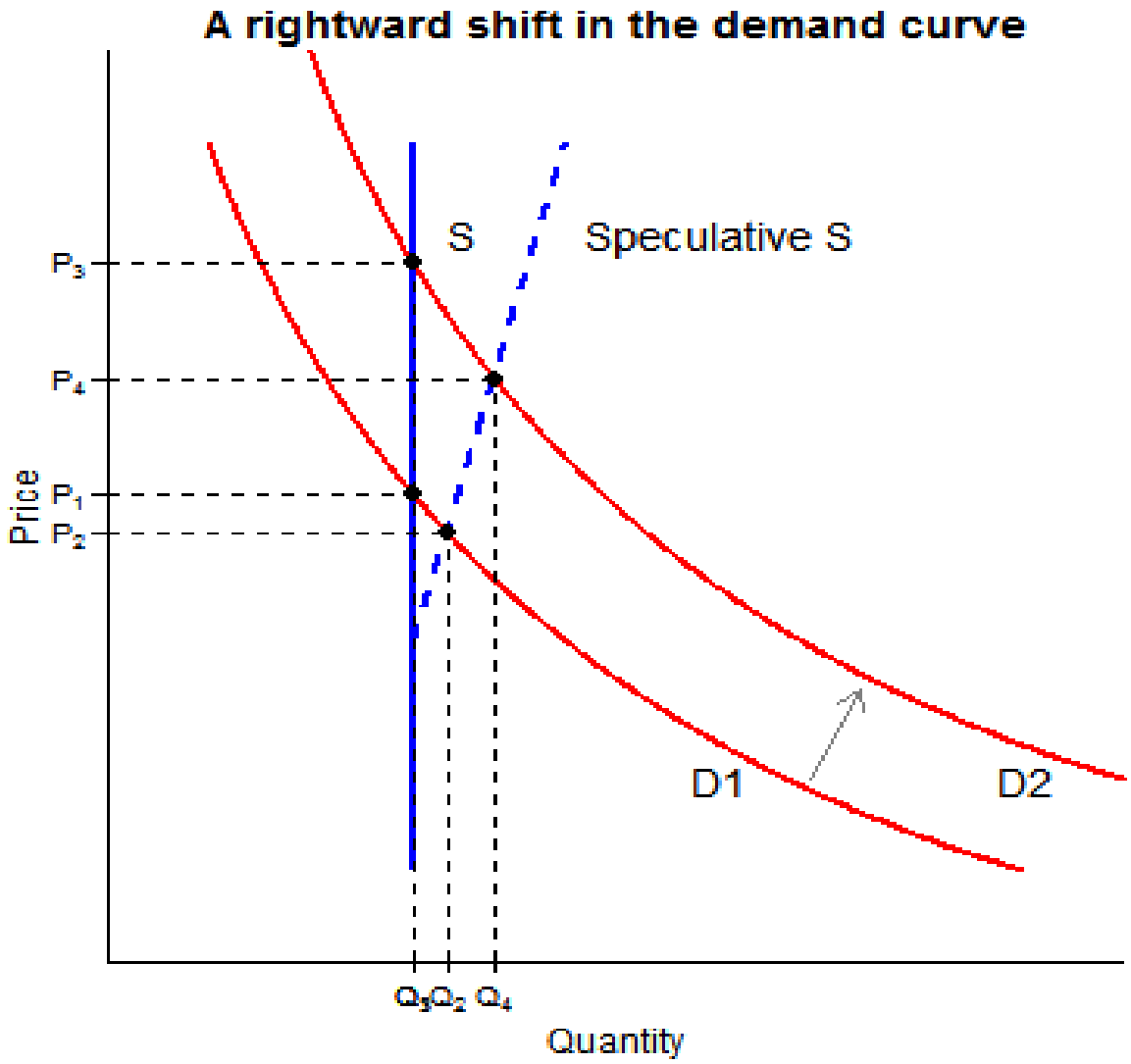
An Economic Model.

Fundamental and Speculative Supply.



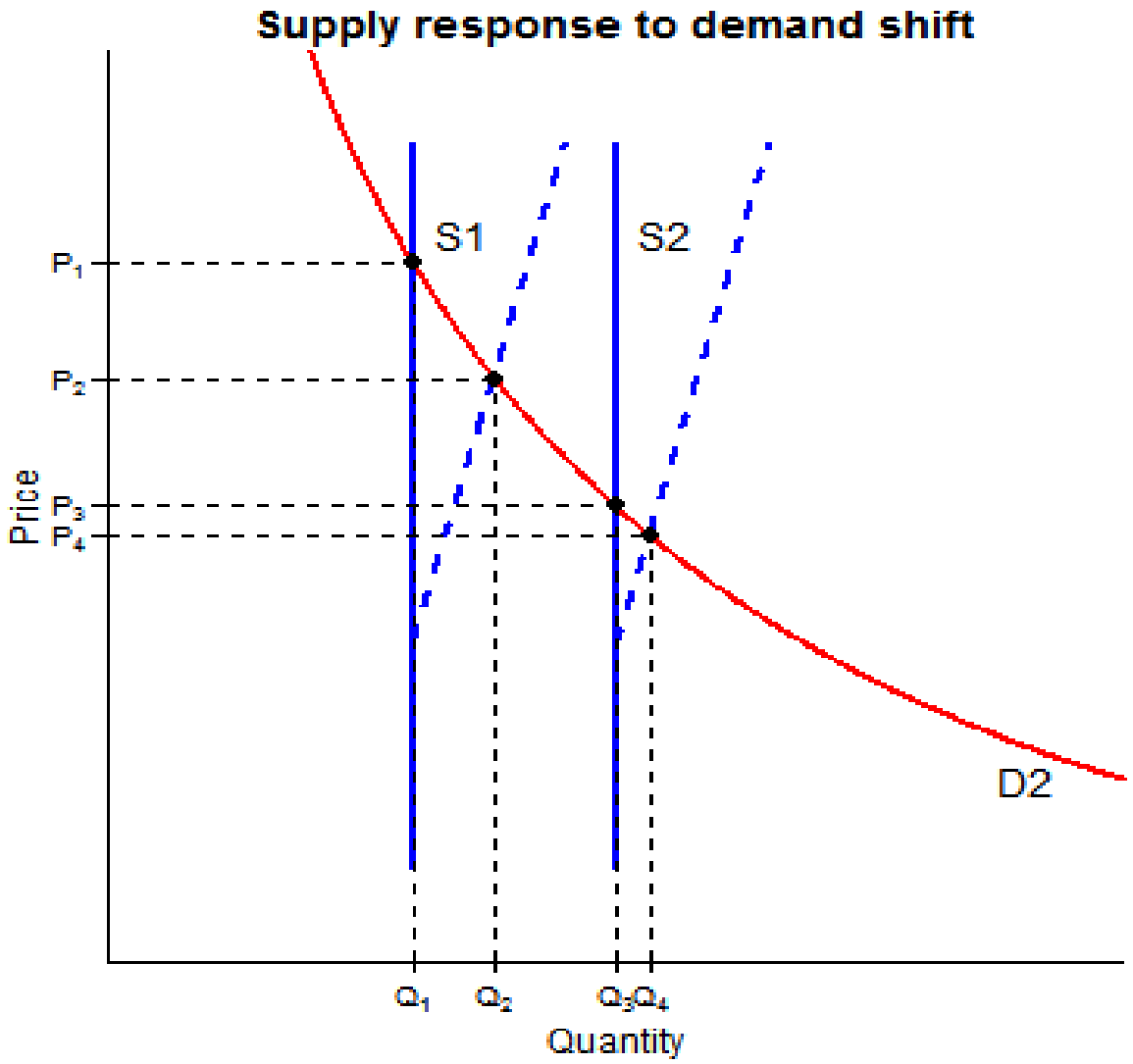
Positive demand shock.

Prices expected to rise in the future. Speculative supply increases.



Fundamental supply response.

Prices expected to fall in the future. Speculative supply decreases.



Negative demand shock.

Prices expected to fall in the future. Speculative supply decreases.