The Redistributive Effects of Monetary Policy

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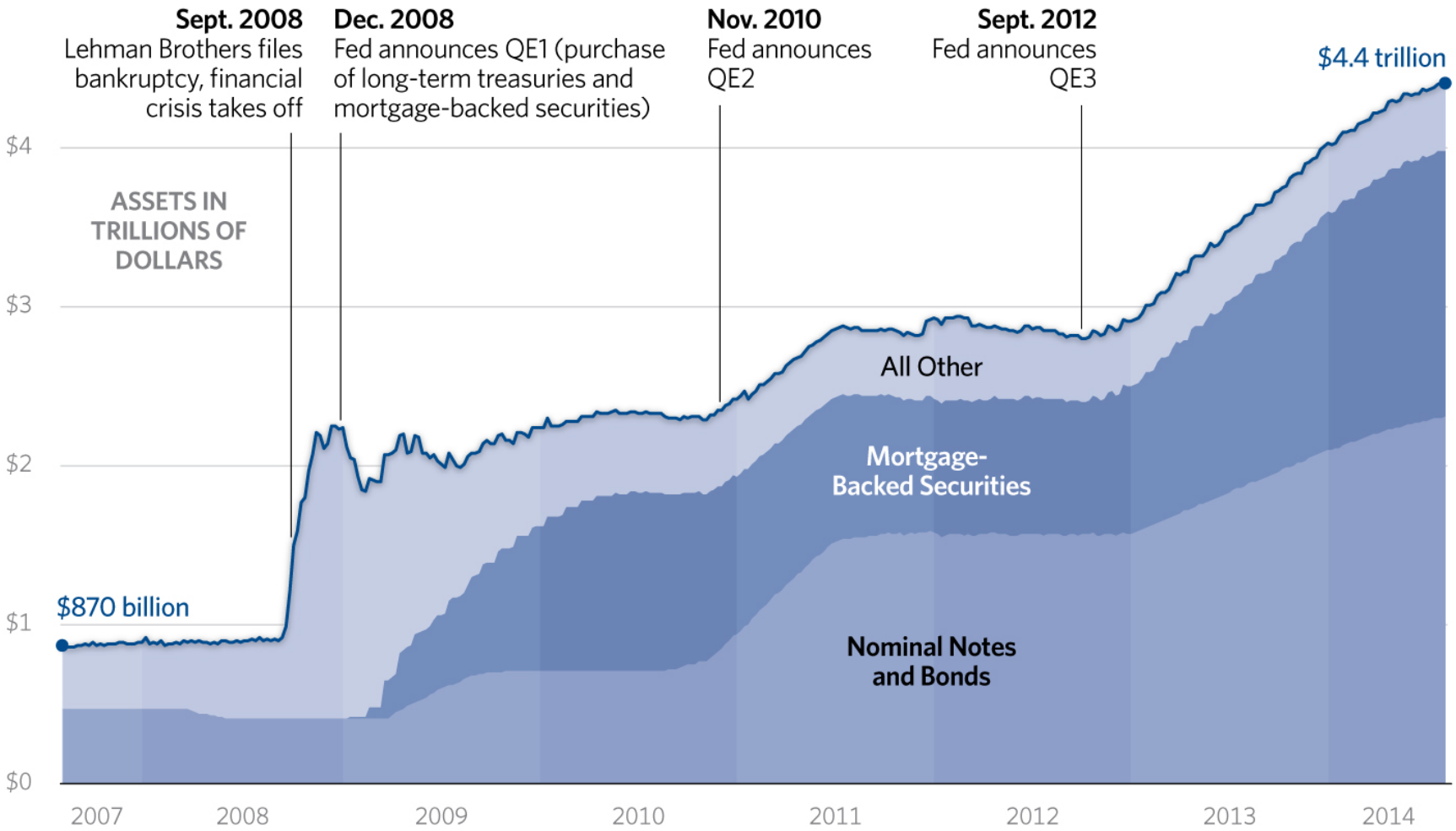
Quantitative Easing: The Fed's balance sheet

CHART 1

Federal Reserve Assets: Key Dates



Source: Board of Governors of the Federal Reserve System, "Credit and Liquidity Programs and the Balance Sheet: Total Assets of the Federal Reserve," http://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm (accessed August 5, 2014).

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Questions

- Monetary policy effects in the cross section?
- Redistributive effects?

Redistributive effects of monetary policy:

- Monetary expansions redistribute wealth:
  - From old to young agents (Bhattacharya, Haslag, and Martin, 2005)
  - From altruistic to selfish agents (Palivos, 2005)
  - From creditors to debtors (Romer and Romer, 1999)
  - From the rich to the poor (Shi, 1999)
  - From the poor to the rich (Erosa and Ventura, 2002)
  - From bond investors to "arbitrageurs" (Vayanos and Vila, 2009)

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- Various sources of heterogeneity:
  - Different income sources (wages vs. profits)
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  - **This paper: different "locations"**

The economy is a network

- Topological notions of **location**, **neighborhood**, and **closeness**
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- Related work:
  - Williamson (2008), Ozdagli and Weber (2016)
  - Redistributive effects of (un)conventional monetary policies: Coibion et al. (2012); Saiki and Frost (2014)
  - (Un)conventional monetary policies and bubbles: Schwartz (2003); Detken and Smets (2004); Bordo and Landon-Lane (2013); Gal (2013)
  - Acemoglu et al. (2012)

Model overview

- N agents and N different goods
- Agent j: endowed with one unit of good j and M units of money
- Optimization

$$\max_{m_j; x_{1j},\ldots,x_{Nj}} \left(\frac{m_j}{\sum_{k=1}^{N} m_k} \right)^{\beta} \times \prod_{i=1}^{N} x_{ij}^{\alpha_{ij}}$$

$$\text{subject to:} \quad m_j + \sum_{i=1}^{N} p_i x_{ij} \leq M + p_j$$

- Central Bank: injects Q into the economy and buys good 1 ($\frac{Q}{p_1}$ units)
- Market-clearing conditions (goods):

$$\sum_{j=1}^{N} x_{ij} = 1 - \delta_{i1} \frac{Q}{p_1} \qquad \forall i = 1, \ldots, N,$$

where $\delta_{i1} = 1$ for $i = 1$ and zero otherwise

The notion of **“Location”**

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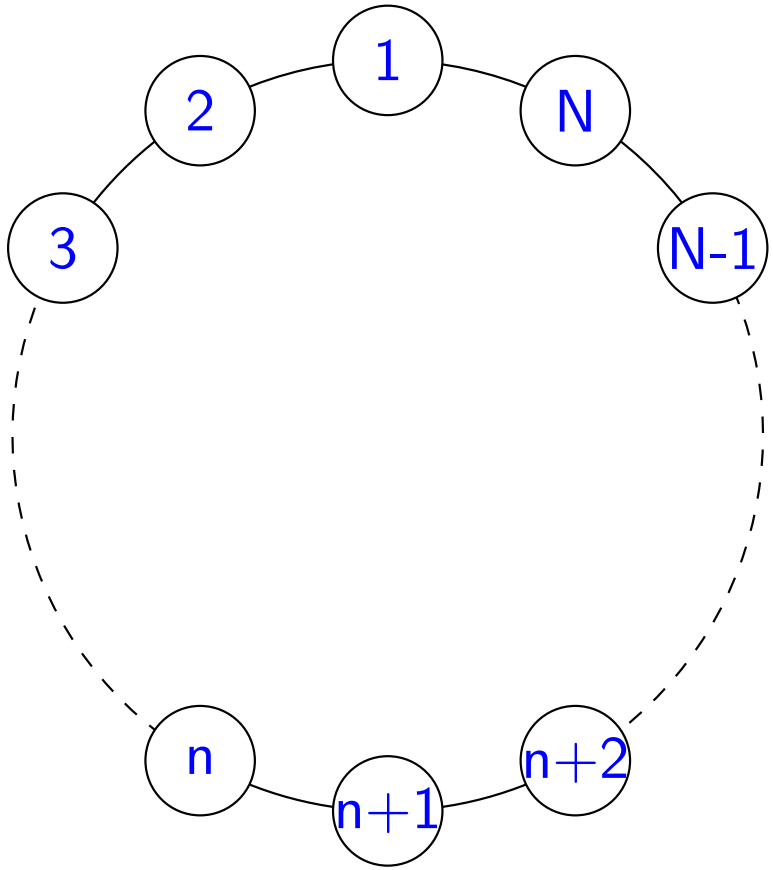

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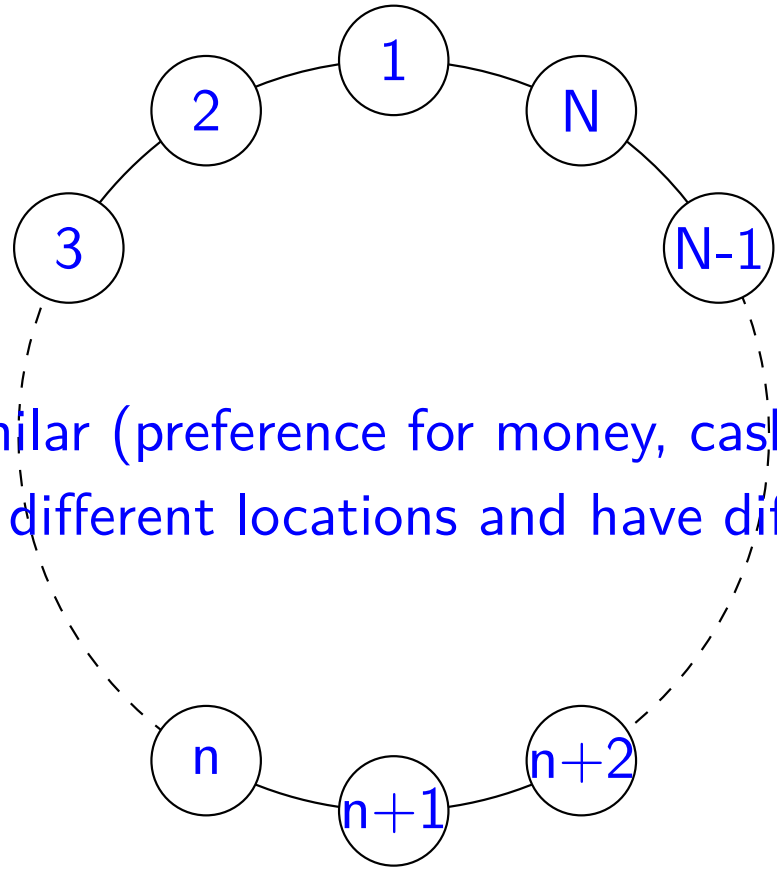
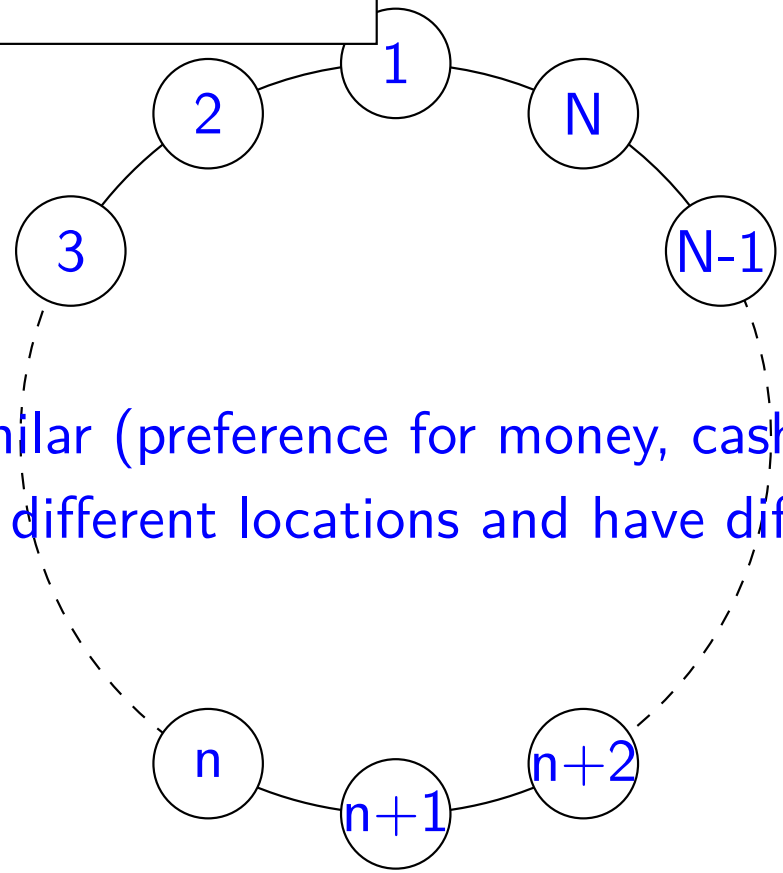


Agents are similar (preference for money, cash endowment),
but are situated in different locations and have different connections.

The notion of **"Location"**

Endowed with quantity of money M and and one unit of good 1



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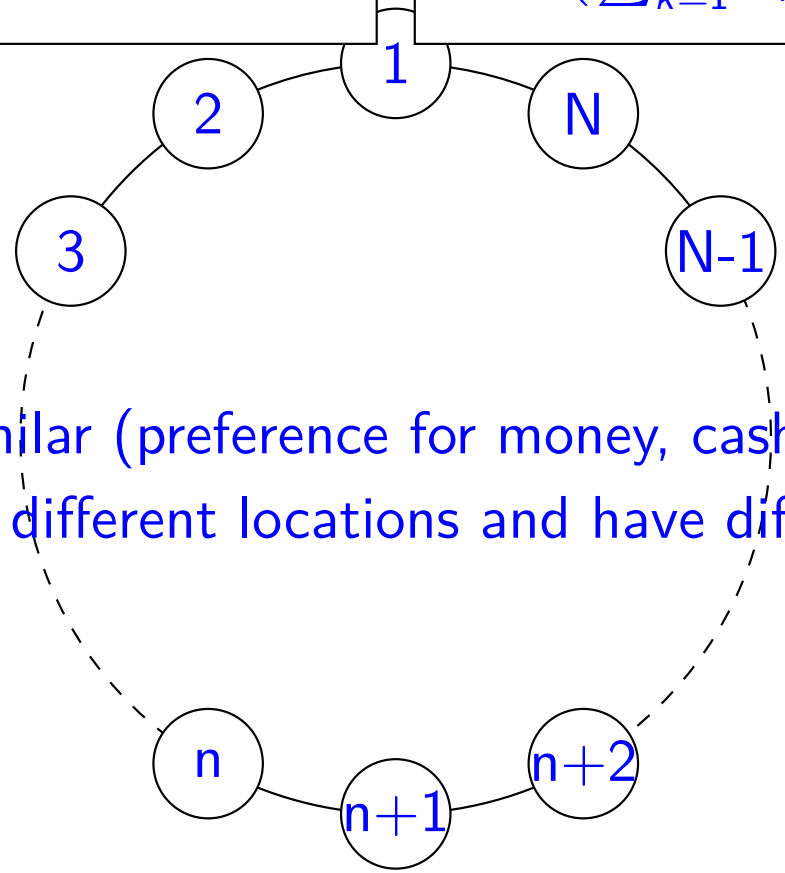

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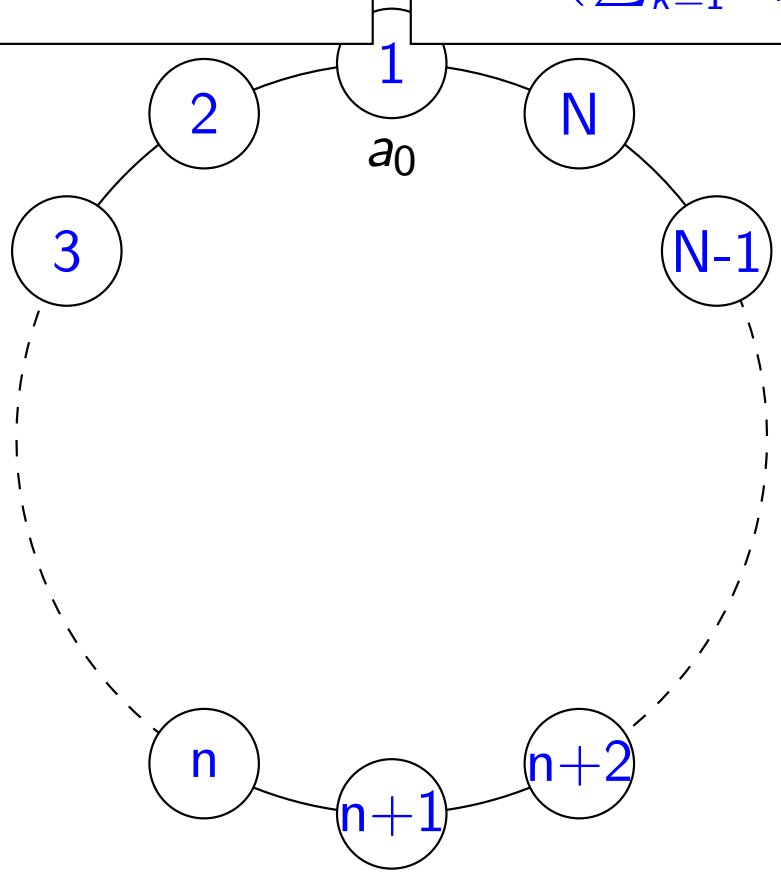

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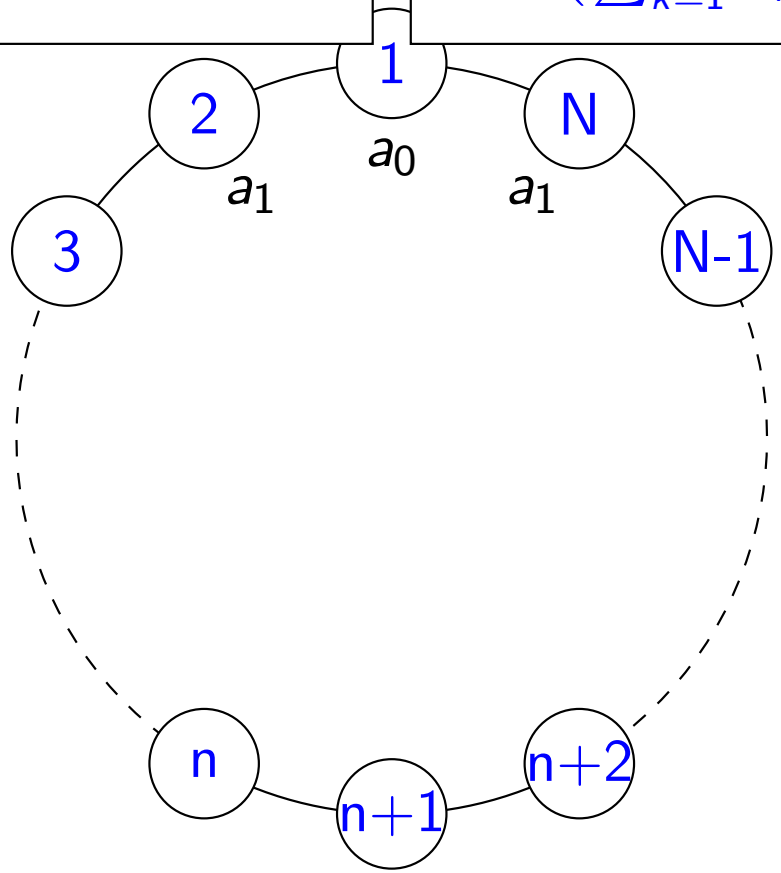

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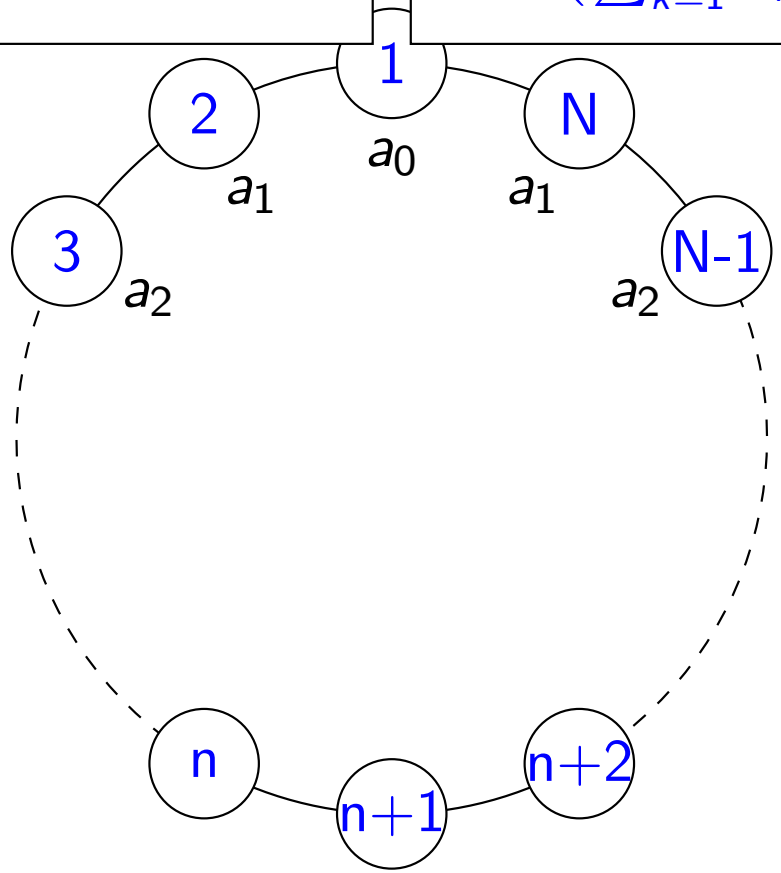

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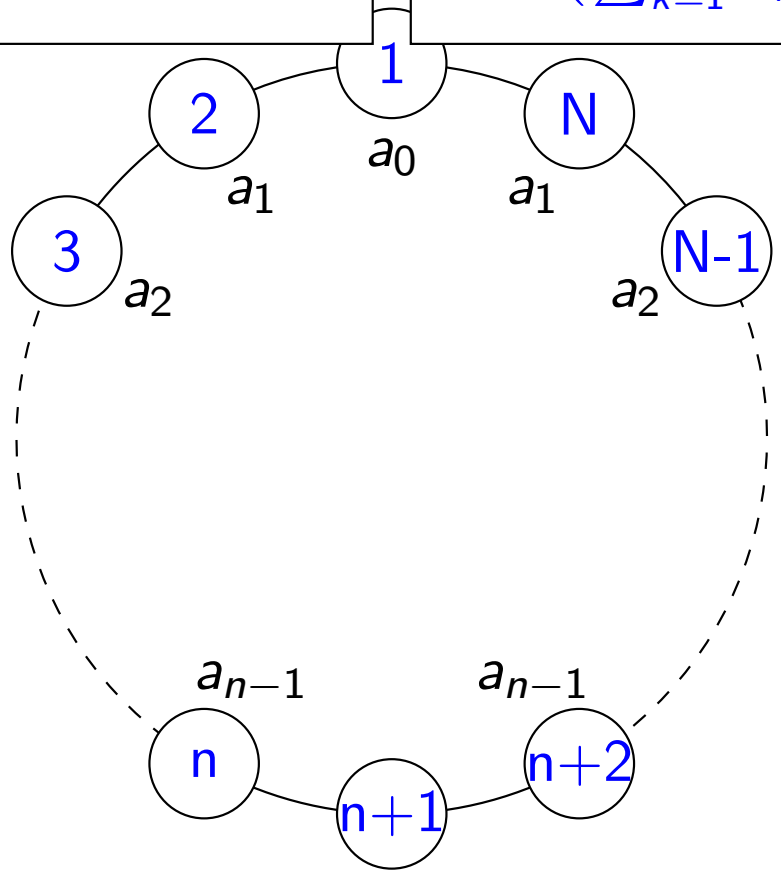

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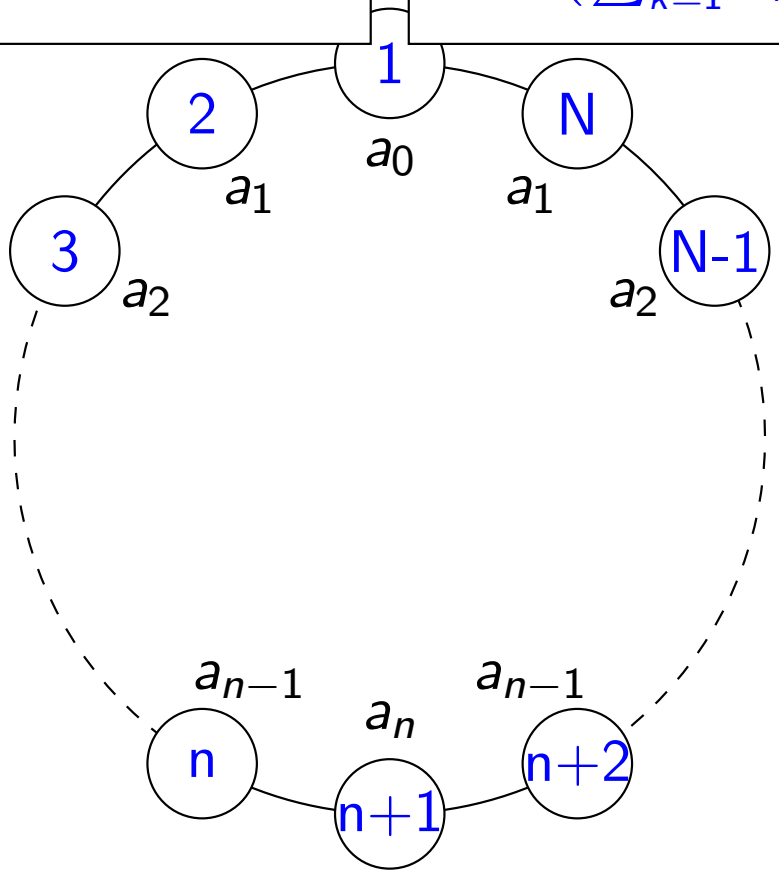

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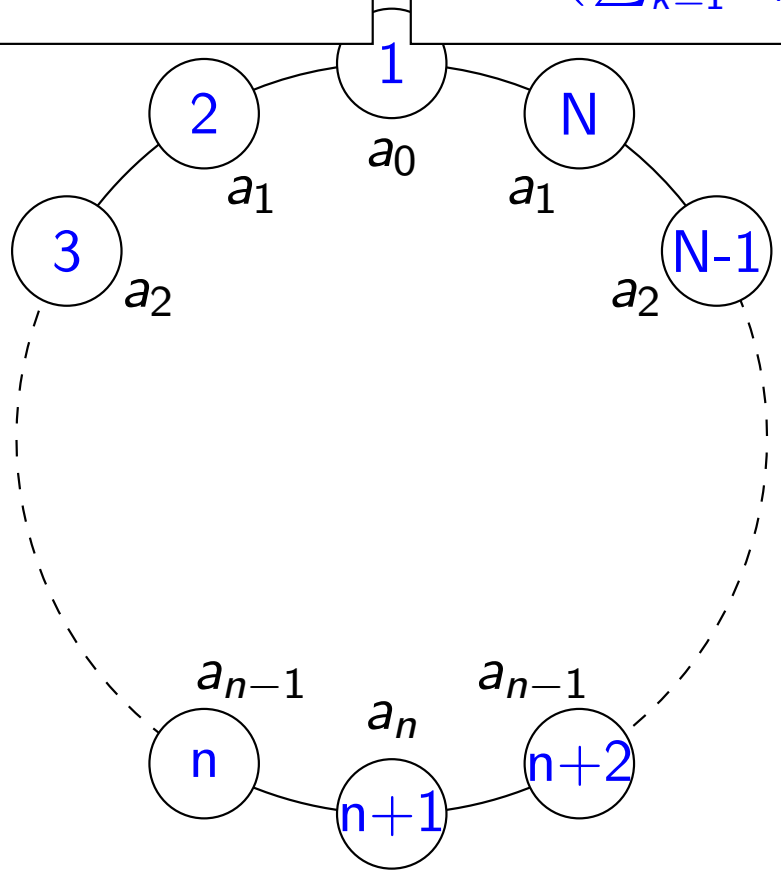

$$\underbrace{\begin{bmatrix} a_0 & a_1 & a_2 & \cdots & a_1 \\ a_1 & a_0 & a_1 & \cdots & a_2 \\ \vdots & & \ddots & & \\ a_1 & a_2 & a_3 & \cdots & a_0 \end{bmatrix}}_{\equiv A, \text{ (a "circulant matrix")}}$$

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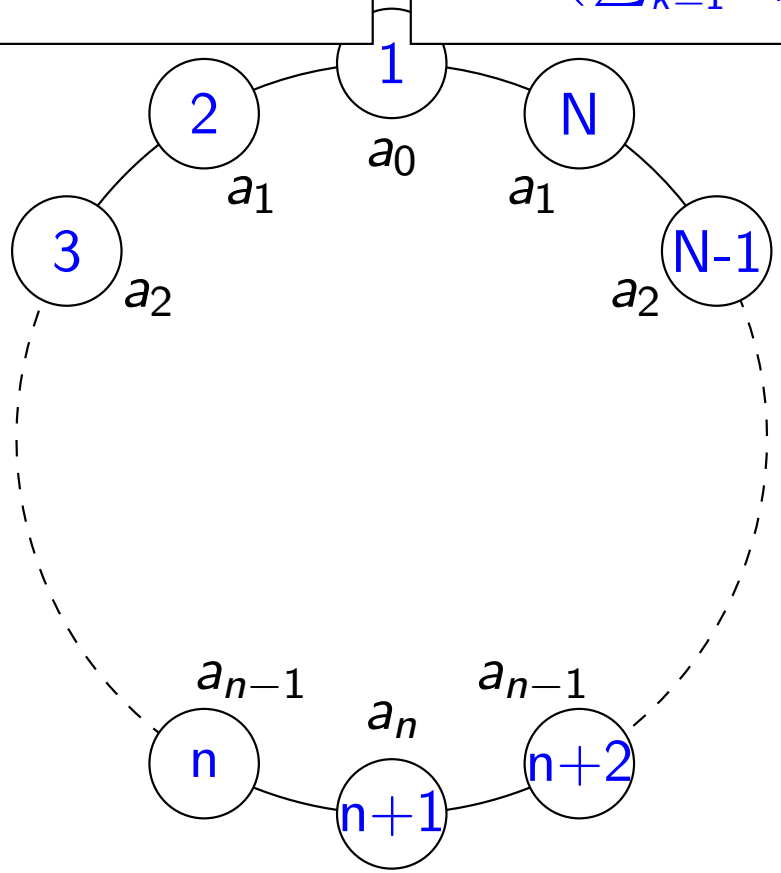

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Neighborhood Effects: $a_0 \geq a_1 \geq a_2 \geq ... \geq a_n$

(agents have closer economic ties to their immediate neighbors)

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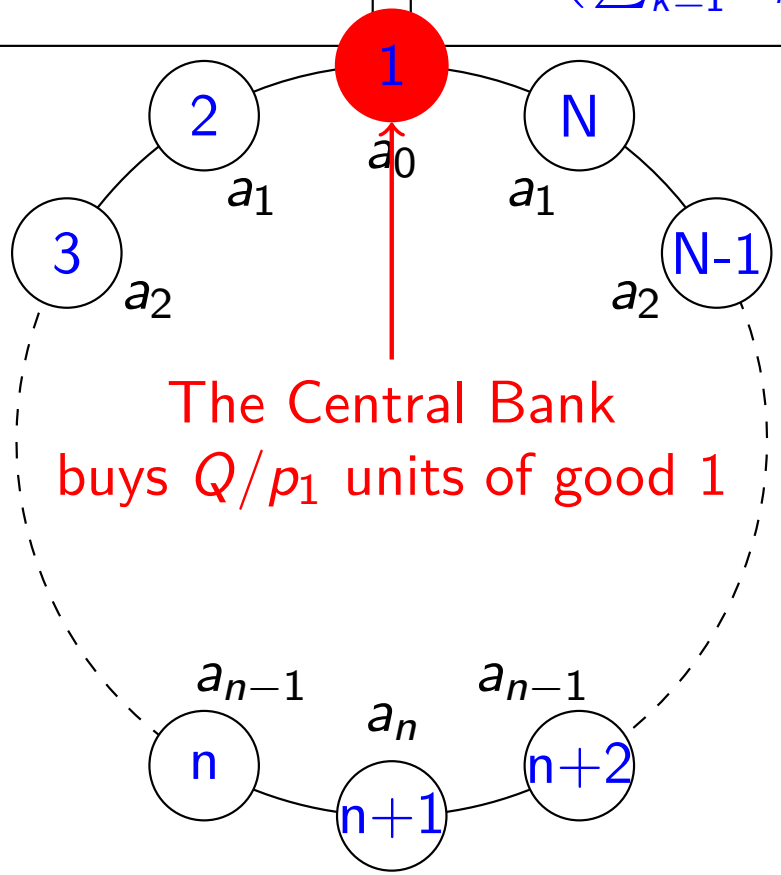

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Equilibrium prices

Theorems 1 and 2

Consider the matrix $\Lambda = (I - A)^{-1}$ *and denote by* Λ_1 *its first column. Then:*

$$\begin{bmatrix} p_1 \\ p_2 \\ \vdots \\ p_N \end{bmatrix} = \frac{1-\beta}{\beta} M \mathbb{1} + \Lambda_1 Q$$

where for $\lambda_{i1} \equiv \lambda_{N+2-i}$ *we have*

$$\lambda_{11} > \lambda_{21} > \ldots > \lambda_{n1} > 0$$

Example:

$$A = \begin{bmatrix} a_0 & a_1 & a_2 & a_1 \\ a_1 & a_0 & a_1 & a_2 \\ a_2 & a_1 & a_0 & a_1 \\ a_1 & a_2 & a_1 & a_0 \end{bmatrix} \quad \Lambda = \begin{bmatrix} \lambda_0 & \cdots \\ \lambda_1 & \cdots \\ \lambda_2 & \cdots \\ \lambda_1 & \cdots \end{bmatrix} \quad \begin{array}{ccccc} 0 & < & \lambda_0 & & \\ 0 & < & \lambda_1 & < & \lambda_0 \\ 0 & < & \lambda_2 & < & \lambda_1 \\ 0 & < & \lambda_1 & < & \lambda_0 \end{array}$$

Testable Implications

Corollary 1

1. $Q > 0 \Rightarrow p_1 > p_2 > ... > p_{n+1}$
2. $Q < 0 \Rightarrow p_1 < p_2 < ... < p_{n+1}$

Corollary 2

1. $Q > 0 \Rightarrow$ *Agent 1 strictly better off, agent* $n+1$ *strictly worse off*
2. $Q < 0 \Rightarrow$ *Agent 1 strictly worse off, agent* $n+1$ *strictly better off*

Evidence

Data

- Producer's Price Index (PPI) for 15 sectors — *from BEA*
- Consumer Price Index (CPI), Industrial Production Index (IP), Gross Domestic Product (GDP), money supply data — *from FRED*
- Unemployment rate — *from BLS*
- Stock returns, form industry portfolios — *from CRSP*
- Quarterly frequency, from 2005 to 2015

Economic Distance from the FED (EDF)

- First, estimate unanticipated monetary policy shocks

$$\Delta m_t = a + \sum_{l=1}^{L} b_l \Delta m_{t-l} + \sum_{l=1}^{L} c_l \Delta u_{t-l} + \sum_{l=1}^{L} d_l \Delta ip_{t-l} + \sum_{l=1}^{L} e_l \Delta gdp_{t-l} + e_t^m$$

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- Second, estimate sensitivity of price w.r.t. these shocks

$$\Delta p_{i,t} = \alpha_i + \beta_i e_t^m + \sum_{l=1}^{L} \beta_{i,l} e_{t-l}^m + \sum_{l=1}^{L} \gamma_{i,t-l} \Delta p_{i,t-l} + e_{i,t}^p$$

Economic Distance from the FED (EDF)

	(1) $\beta_{i,0}$	(2) $\tilde{\beta}_i \equiv \beta_{i,0} + \beta_{i,1}$	(3) Adj. R^2
Information	0.25^{***}	0.19^{**}	0.31
	[0.000]	[0.011]	
Retail trade	0.37^{***}	0.16	0.32
	[0.000]	[0.106]	
Wholesale trade	0.32^{***}	0.15^{*}	0.33
	[0.000]	[0.090]	
Educational services	0.25^{***}	0.11^{*}	0.35
	[0.000]	[0.057]	
Other services	0.24^{***}	0.11^{*}	0.31
(except public administration)	[0.000]	[0.073]	
Arts and entertainment	0.24^{***}	0.09	0.30
	[0.000]	[0.167]	
Professional, scientific,	0.25^{***}	0.08	0.33
and technical services	[0.000]	[0.157]	
Finance and insurance	0.24^{***}	0.04	0.38
	[0.000]	[0.431]	

p-values in square brackets
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Economic Distance from the FED (EDF)

	(1) $\beta_{i,0}$	(2) $\tilde{\beta}_i \equiv \beta_{i,0} + \beta_{i,1}$	(3) Adj. R^2
Construction	0.30***	0.03	0.40
	[0.000]	[0.660]	
Public administration	0.17***	-0.02	0.36
	[0.000]	[0.622]	
Transportation and warehousing	0.20***	-0.19**	0.36
	[0.026]	[0.037]	
Utilities	-0.04	-0.36*	0.13
	[0.811]	[0.057]	
Manufacturing	-0.03	-0.49***	0.29
	[0.840]	[0.001]	
Agriculture, forestry,	0.05	-0.57*	0.17
fishing and hunting	[0.858]	[0.051]	
Mining, quarrying,	-1.56***	-2.45***	0.38
and oil and gas extraction	[0.009]	[0.000]	

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Use this measure for EDF to test our model's predictions

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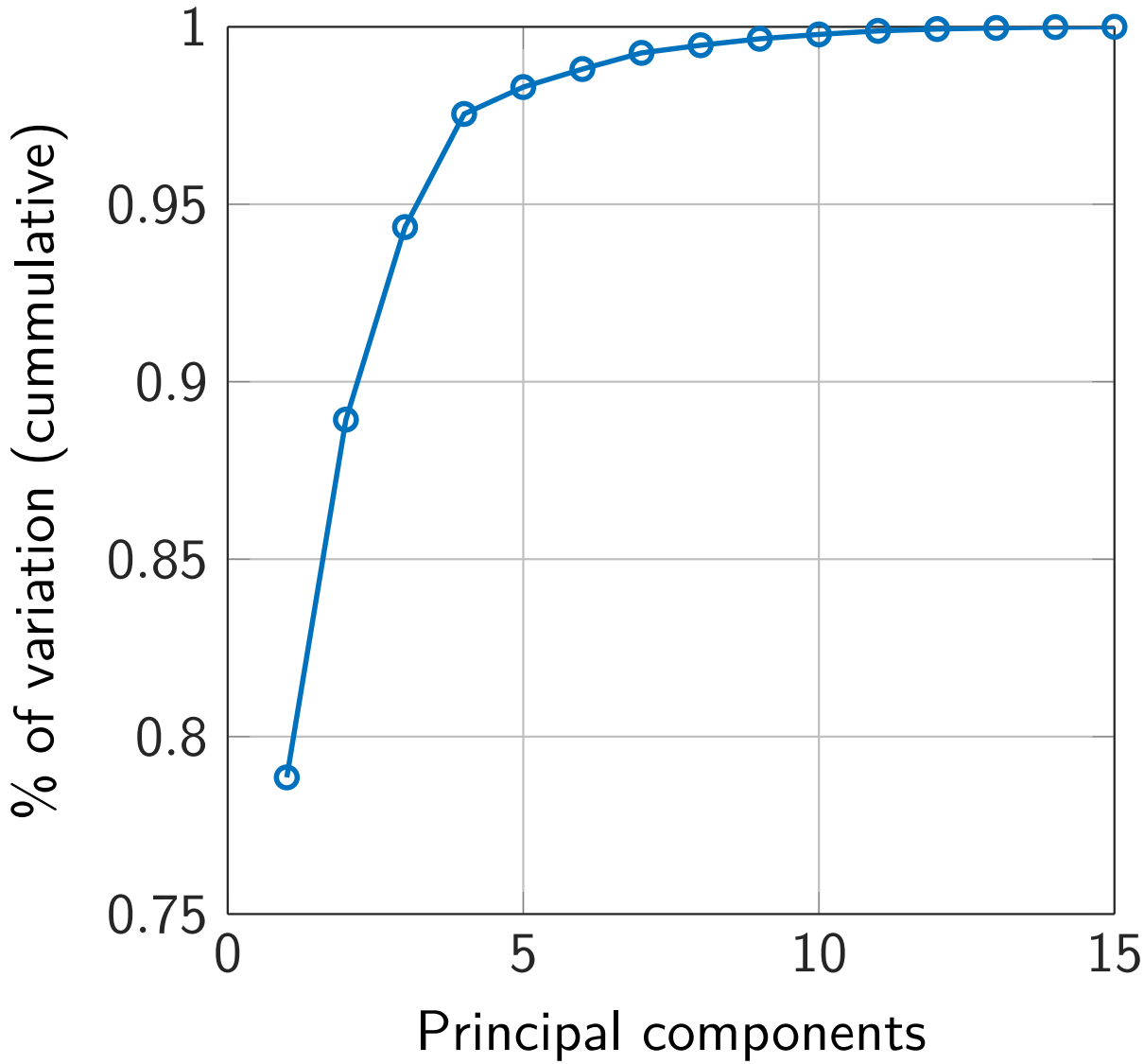
1. Implications for principal component of prices
   - Strong factor structure with a unique common factor
   - This common factor in prices is related to monetary shocks
   - Weights in the common factor align with EDF

2. Prediction for correlation matrix: diagonal structure

3. Welfare: sectors closer to the Fed benefit more from positive shocks

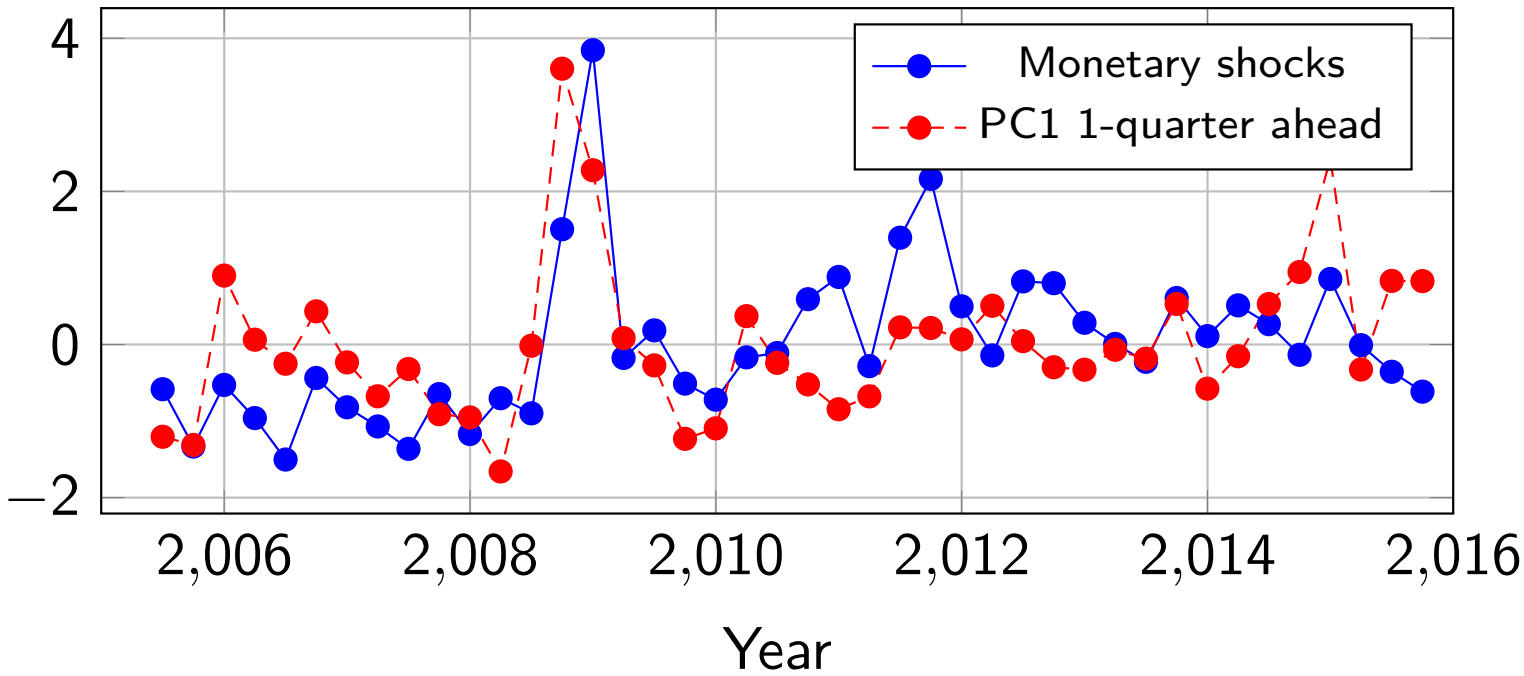
1. Implications for principal component of prices

The first principal component nearly 80% of the variation



1. Implications for principal component of prices

Monetary shocks today predict PC1 one quarter ahead

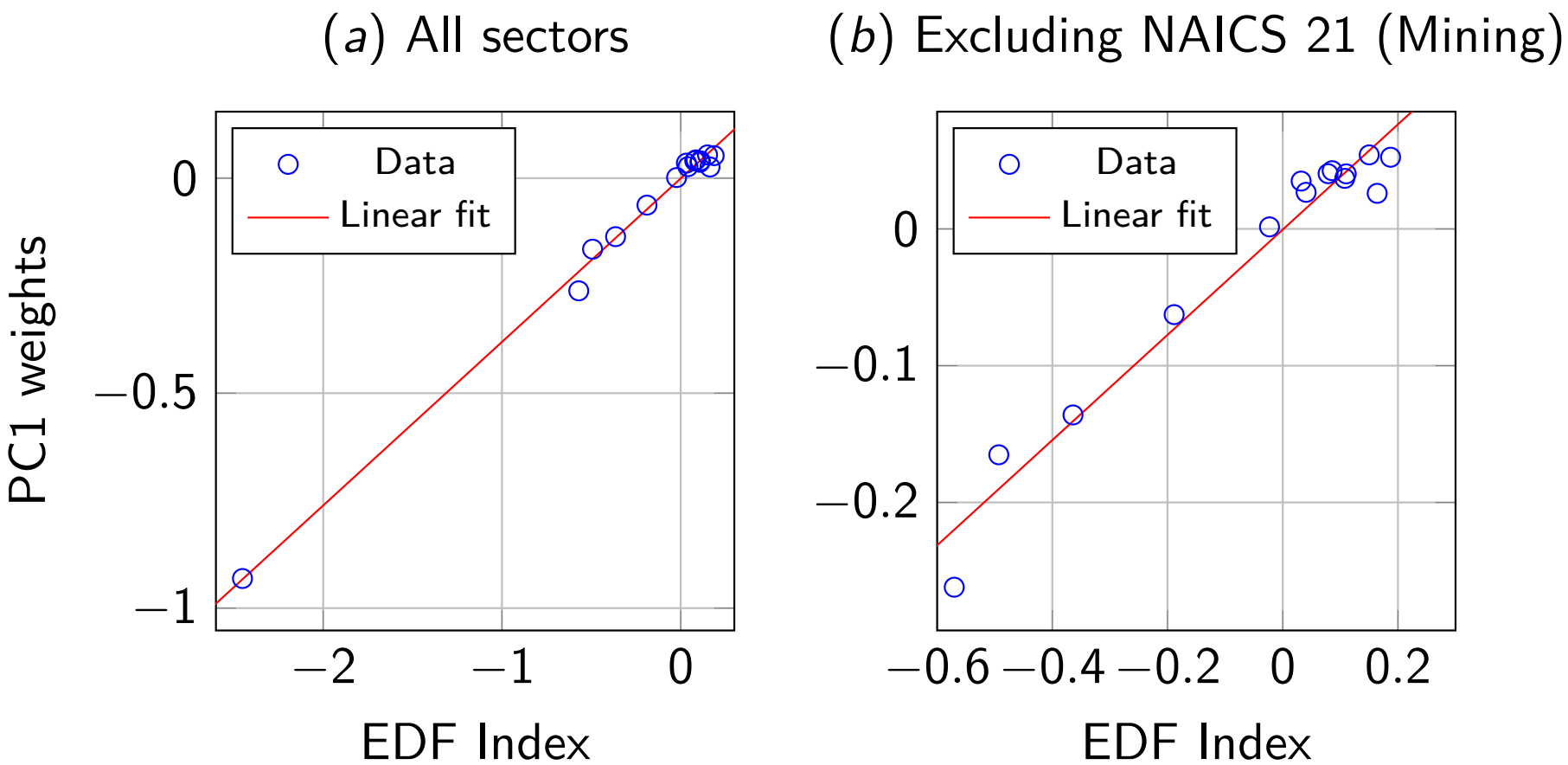


Clear positive relationship between the two series: 55% correlation

Regression: t-stat of 4.14 on the slope

1. Implications for principal component of prices

Weights in the common factor align with EDF



1. Implications for principal component of prices

According to the model:

- EDF measure (βs) is proportional to PC weights
- EDF vs Principal Component Weights:

$$\text{PC1 weight}_i = \eta_0 + \eta_1 \tilde{\beta}_i + \varepsilon,$$

	(1) With Mining	(2) Without Mining
Constant η_0	-0.001	-0.001
	(-0.115)	(-0.091)
Slope η_1	0.380^{***}	0.385^{***}
	(47.02)	(16.72)
R^2	0.994	0.955
Nb. Obs.	15	14

t-statistics in round brackets

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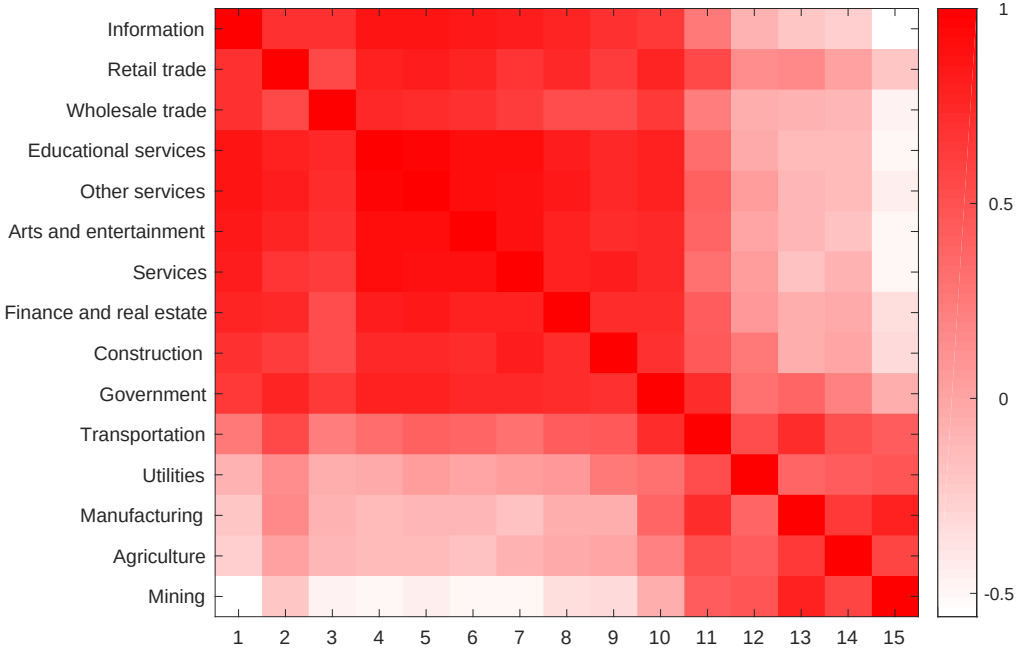
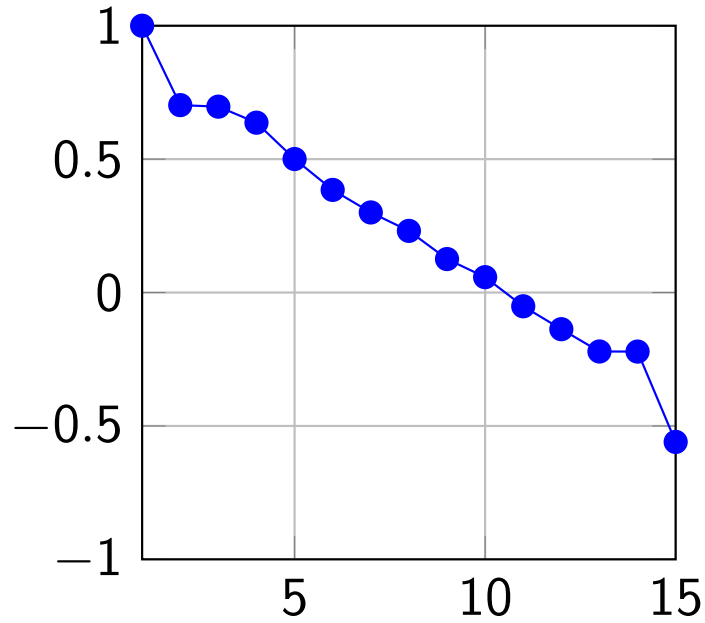
2. Prediction for correlation matrix: diagonal structure

(*a*) Correlation heatmap



(*b*) Average correlation



- Sectors ranked by EDF
- Declining avg. corr. on the diagonals of the correlation matrix

3. High-EDF sectors benefit more from positive shocks

Which sectors benefit more from positive monetary policy shocks?

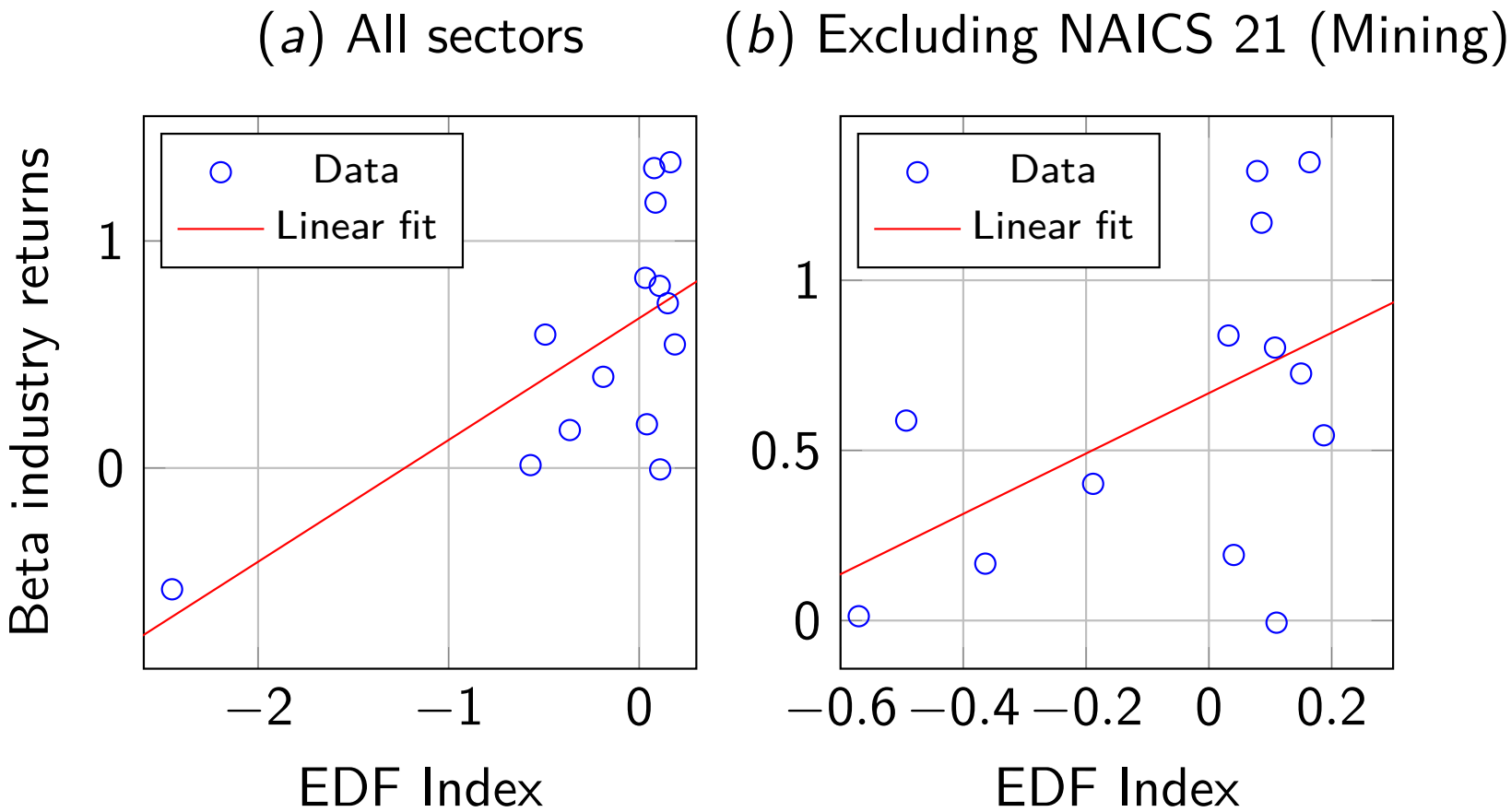
- Depends on the beta relative to the shocks:

$$r_{i,t} = \alpha_i^r + \beta_{i,0}^r \Delta M_t + \beta_{i,1}^r \Delta M_{t-1} + \gamma_{i,1}^r r_{i,t-1} + e_{i,t}^r$$

  Sum of betas: $\beta_{i,0}^r + \beta_{i,1}^r$

3. High-EDF sectors benefit more from positive shocks

Compare sensitivity of returns and EDF:



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Compare sensitivity of returns and EDF:

$$\tilde{\beta}_i^r = \eta_0 + \eta_1 \tilde{\beta}_i + \varepsilon,$$

	(1) With Mining	(2) Without Mining
Constant η_0	0.660^{***}	0.668^{***}
	(5.620)	(5.589)
Slope η_1	0.536^{***}	0.887^{*}
	(3.201)	(1.909)
R^2	0.416	0.181
Nb. Obs.	14	13

t-statistics in round brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Remarks

- Model economy as a social network
- Redistributive effects of monetary policy
- Economic mechanism depends on agents' interconnections
- Monetary policy propagates along economic linkages.
- Evidence
  - Principal component structure of prices
  - Intersectoral correlation of prices
  - Who benefits from redistribution

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