The Behavior of Small and Large Firms over the Business Cycle

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Credit Market View

- Credit market frictions central in propagating the cycle
- Theory
  - Kiyotaki-Moore, Bernanke-Gertler, Cooley-Marimon-Quadrini and dozens more
- Evidence:
  - small firms more sensitive to cycle: Gertler-Gilchrist, Sharpe
  - balance sheet effects: Fazzari, Hubbard, Peterson
  - inventories: Kashyap, Lamont and Stein

Credit Market Frictions View

- "Long standing tradition in macroeconomics beginning with Fisher and Keynes that gives a central role to credit markets conditions in the propagation of aggregate fluctuations" (Bernanke, Gertler and Gilchrist, 1999)

- "Although the underlying theories [of credit market frictions] are diverse, a common prediction is that **differences in cyclical behavior should emerge across firms depending on their respective access to capital markets**" (Gertler, Gilchrist, 1994)

- Kockerlakota's (2000) survey of theory: Credit constraints are mechanisms for turning small shocks into large, persistent movements in aggregate income

Our Question

Do small firms decline more than large ones in downturns?

Idea: small firms have less access to capital markets than large firms

Outline

- Postwar Data
  - Manufacturing (QFR)
    - Start with Gertler-Gilchrist (RR dates)
    - Contrast with Business Cycle dates
  - All Sectors (CBP)
- Great Depression Data
  - Moody's data on individual firms
  - Census data
- Theory
  - help interpret results

Most Influential Evidence: Gertler-Gilchrist

- QFR data on sales, loans, inventories by asset size
- Size is a good measure of financial markets access
- Small firms hurt more by monetary contractions (RR dates)
  - small firms sales and inventories fall more than large
  - small firms debt rises less than large

Quarterly Financial Reports for Manufacturing Corp

- Data
  - sales, inventories, loans by eight size classes of nominal assets
- Advantages
  - Quarterly, long (1958-2006)
  - All firms in manufacturing
- Limitations
  - Repeated cross-section
  - Use size as proxy for access to financial markets

Example of data from QFR

Sales, Inventories, and Loans by Asset Size, 1986:4

	Asset size							
	< 5m	5 10m	10 25m	25 50m	50 100m	100 250m	250 1000m	> 1000m
Sales	57,319	20,821	30,149	22,785	21,412	34,504	67,175	310,291
Inv	23,377	10,900	17,374	13,221	12,919	21,042	39,164	172,748
Loans	7,232	3,572	4,878	3,679	3,172	3,857	8,072	41,319

Gertler-Gilchrist Procedure with QFR

- Definition of small firms
  - rank firms by asset size from smallest to largest
  - cumulate sales of ranked firms till hit 30% of total sales
  - large firms are the rest

Gertler-Gilchrist (QFR)

Percent of Manufacturing Sales by Cumulative Asset Size

	Asset size						
Year	$5m	$10m	$25m	$50m	$100m	$250m	$1b
1960	0.26	0.31	0.38	0.44	0.52	0.65	0.85
1970	0.21	0.24	0.29	0.34	0.39	0.49	0.70
1980	0.13	0.16	0.21	0.24	0.28	0.34	0.47
1990	0.12	0.15	0.19	0.22	0.26	0.32	0.44
2000	0.06	0.09	0.12	0.15	0.18	0.22	0.32

- 38% of 1960 sales by firms with assets $\leq$ 25m

Most Influential Evidence: Gertler-Gilchrist

- QFR data on sales, loans, inventories by asset size
- Size is a good measure of financial markets access

Small Firms Rely Heavily on Bank Loans

Composition of Debt Finance by Asset Size, 1986:4

Type of debt as	Asset size (in millions of dollars)				
percentage of total	All	<50	50-250	250-1000	>1000
% of bank loans	**0.30**	**0.68**	**0.55**	**0.40**	**0.17**

Size good measure financial market access

- Small firms rely heavily on bank loans
- Consistent with firm level studies
  - Studies sort firms by direct access to financial markets "likely to be constrained" firms smaller (Kashyap, Lamont, Stein)
- Size controls not capturing industry effects

Size controls not capturing industry effects

- Durable and nondurables have similar size distribution

Ratio of Durable/Total Manufacturing Sales 1986:4

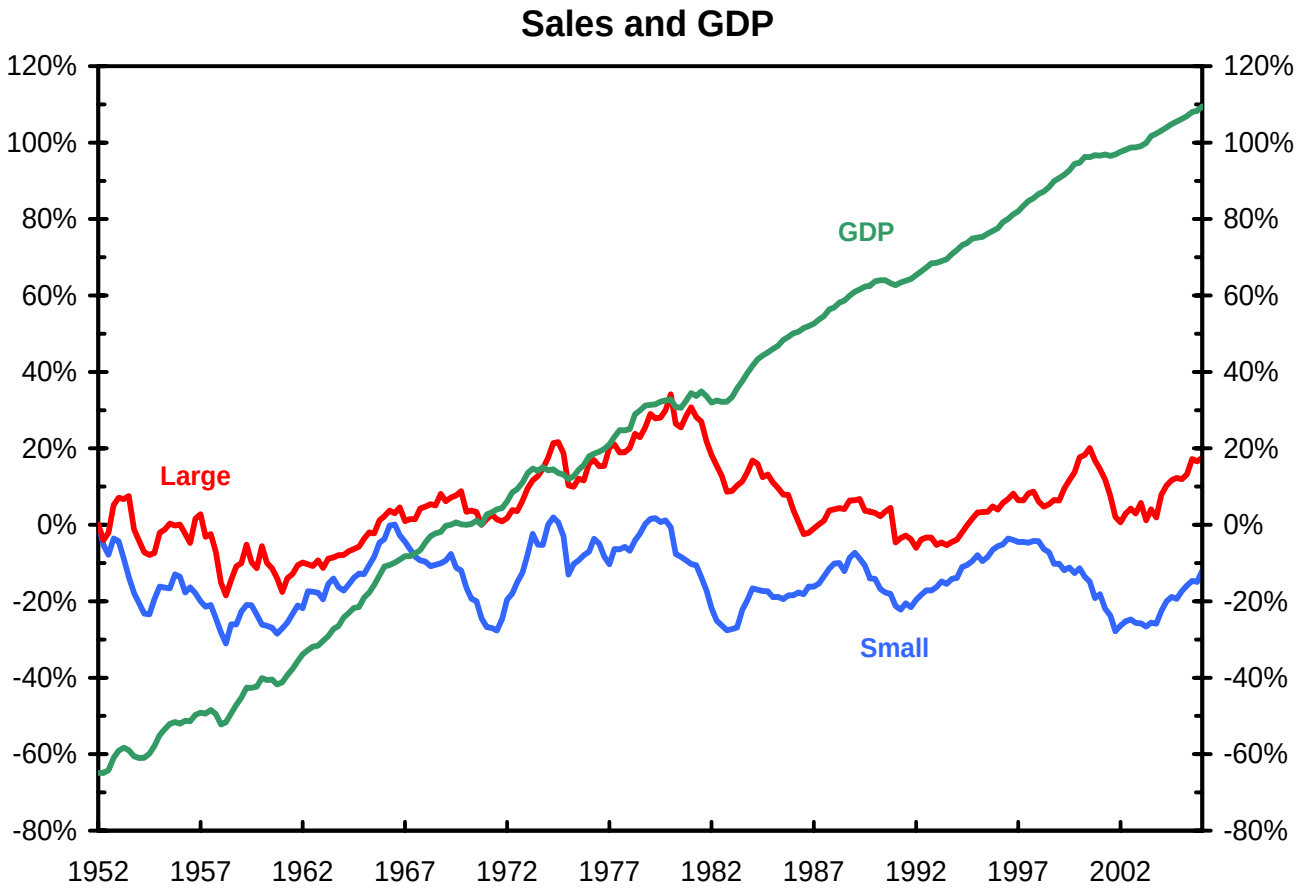
	<25	<50	<250	<1000	All mfg.
Durables/ total sales	.52	.52	.52	.50	.51

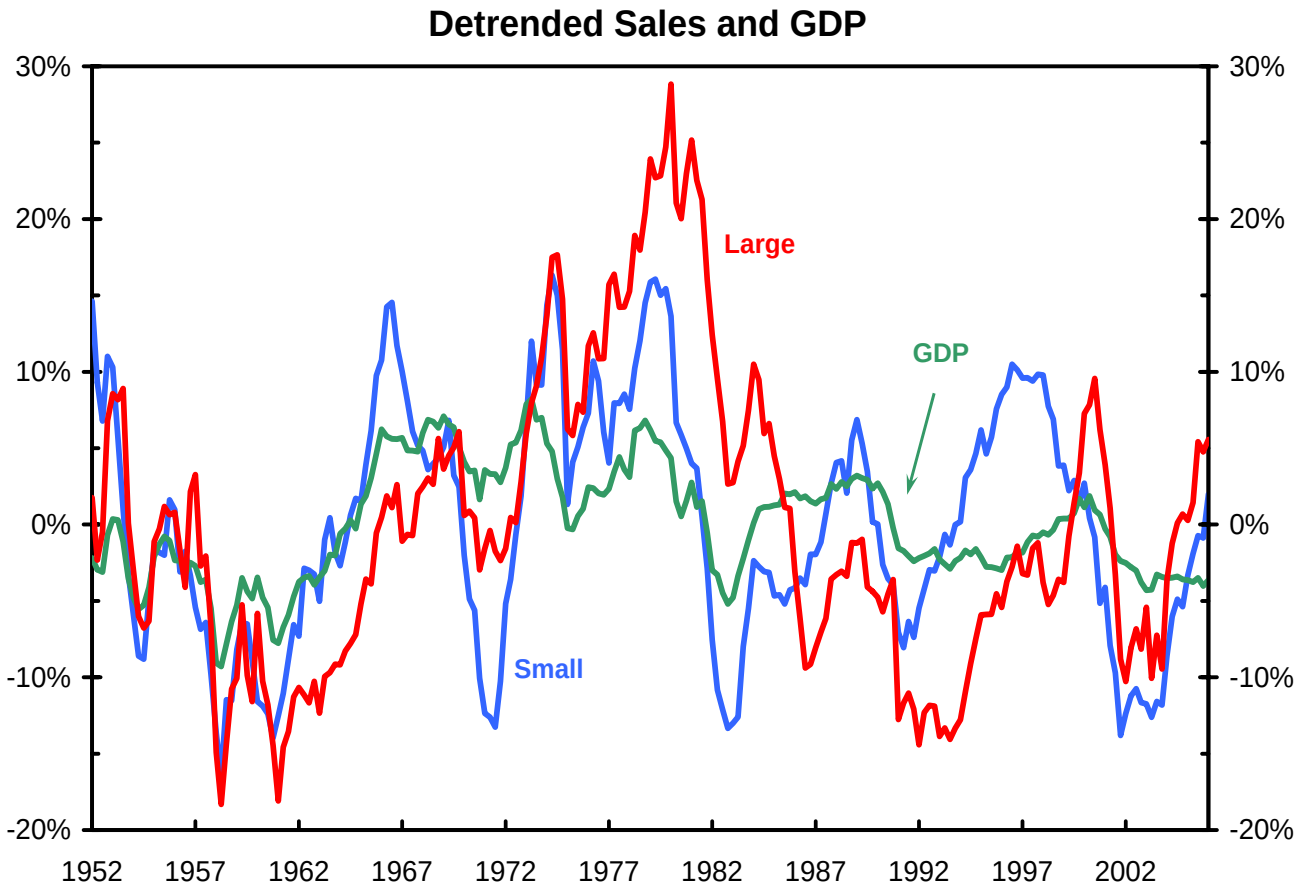
Analysis of QFR data

- Small and Large firms
  - Sales
  - Inventories
  - Loans
- Popular Belief: small firms hurt more in recessions
  - Sales and inventories fall more than large
  - Small able to borrow less than large

Start with Sales

- Overview of data
- Episodic analysis
  - Romer-Romer Dates (6 monetary contractions)
  - Business Cycle Dates (9 NBER peaks)


Sales and GDP
120%
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
1952
1957
1962
1967
1972
1977
1982
1987
1992
1997
2002
GDP
Large
Small

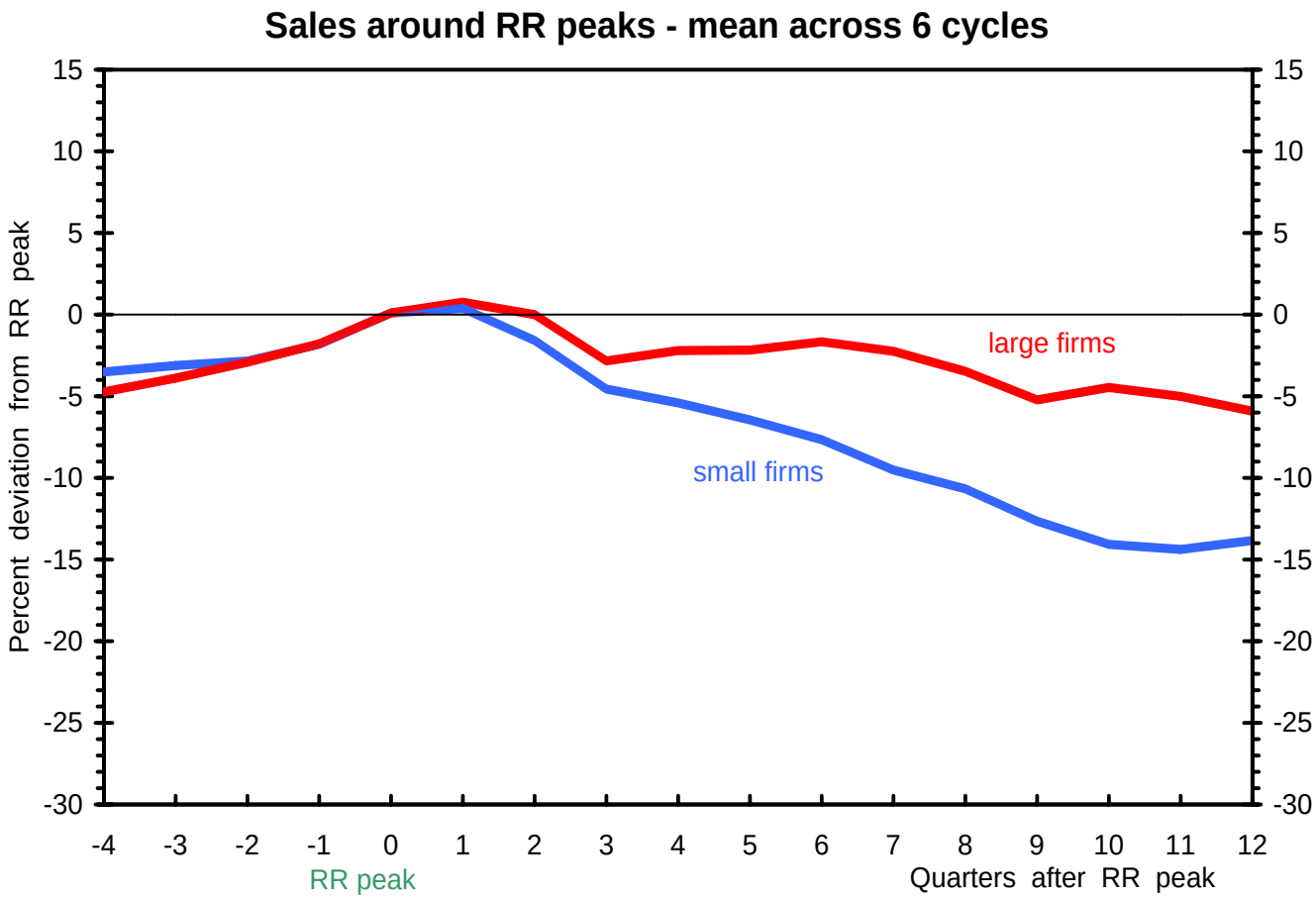


std dev (sales small)/ std dev (GDP) = 2.1

std dev (sales large)/ std dev (GDP) = 2.6

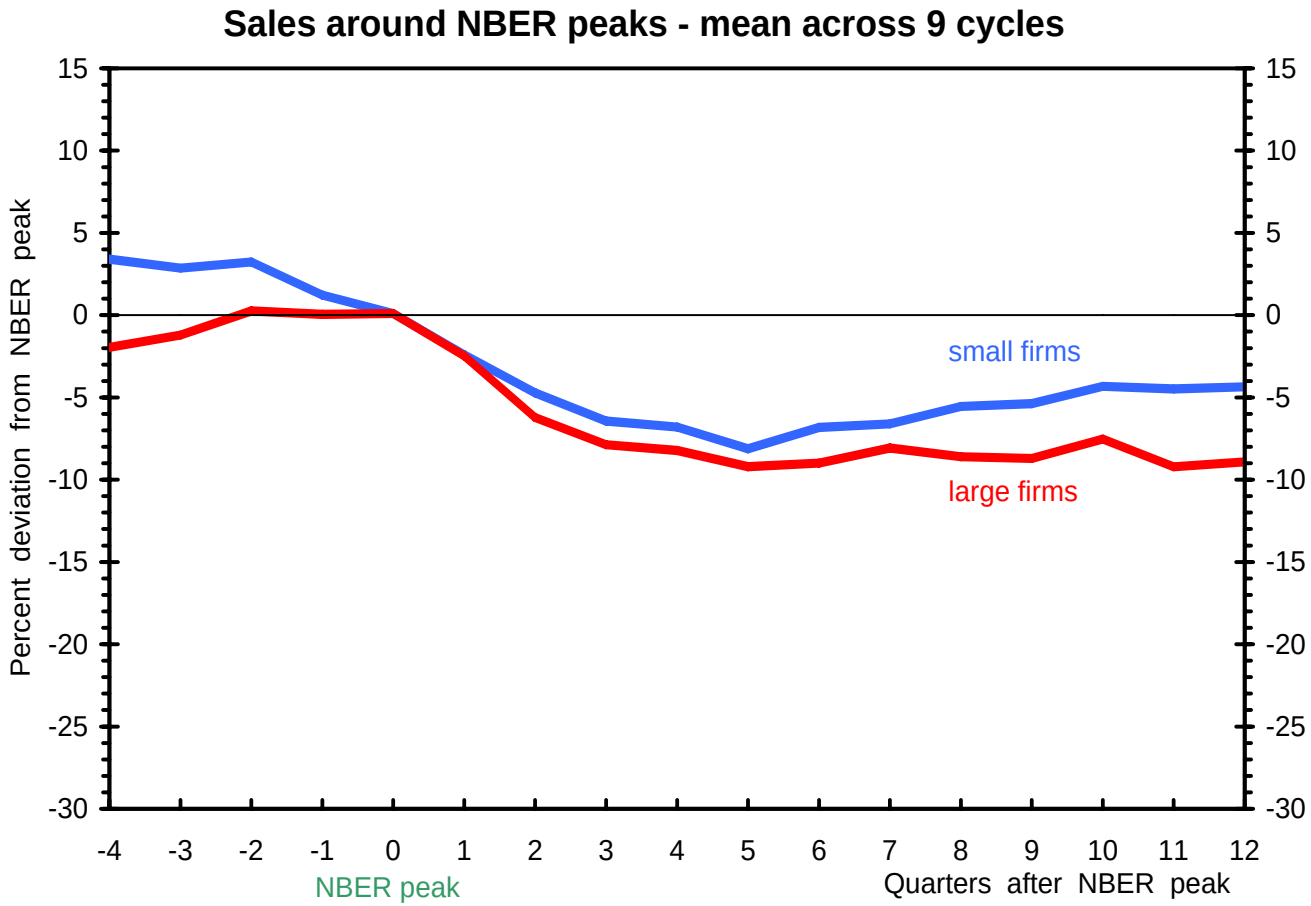
Start with Sales

- Overview of data
- Episodic analysis
  - Romer-Romer Dates (6 monetary contractions)


Sales around RR peaks - mean across 6 cycles
Percent deviation from RR peak
15
10
5
0
-5
-10
-15
-20
-25
-30
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
RR peak
Quarters after RR peak
large firms
small firms

Start with Sales

- Overview of data
- Episodic analysis
  - Romer-Romer Dates (6 monetary contractions)
  - Business Cycle Dates (9 NBER peaks)

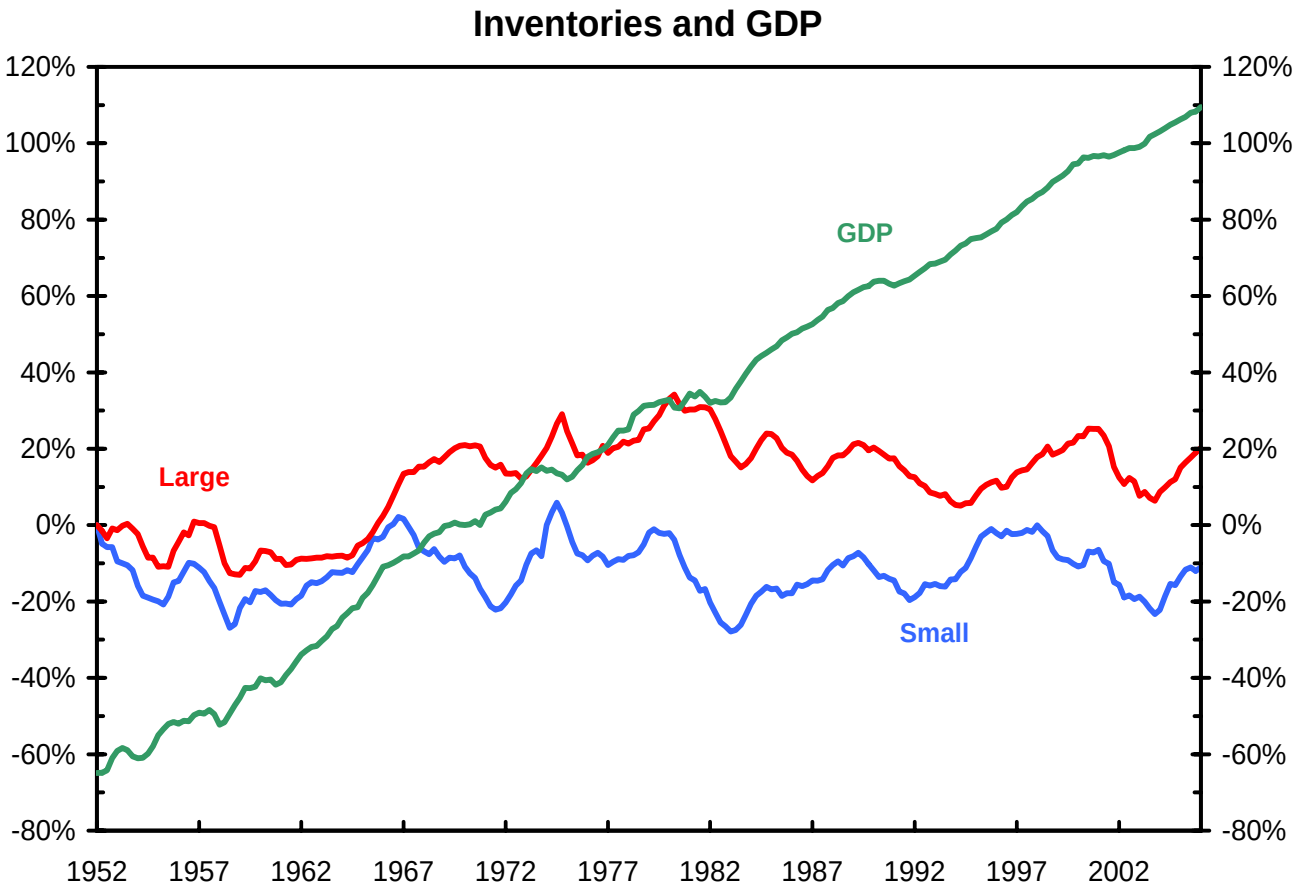

Sales around NBER peaks - mean across 9 cycles
Percent deviation from NBER peak
15
10
5
0
-5
-10
-15
-20
-25
-30
small firms
large firms
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
NBER peak
Quarters after NBER peak

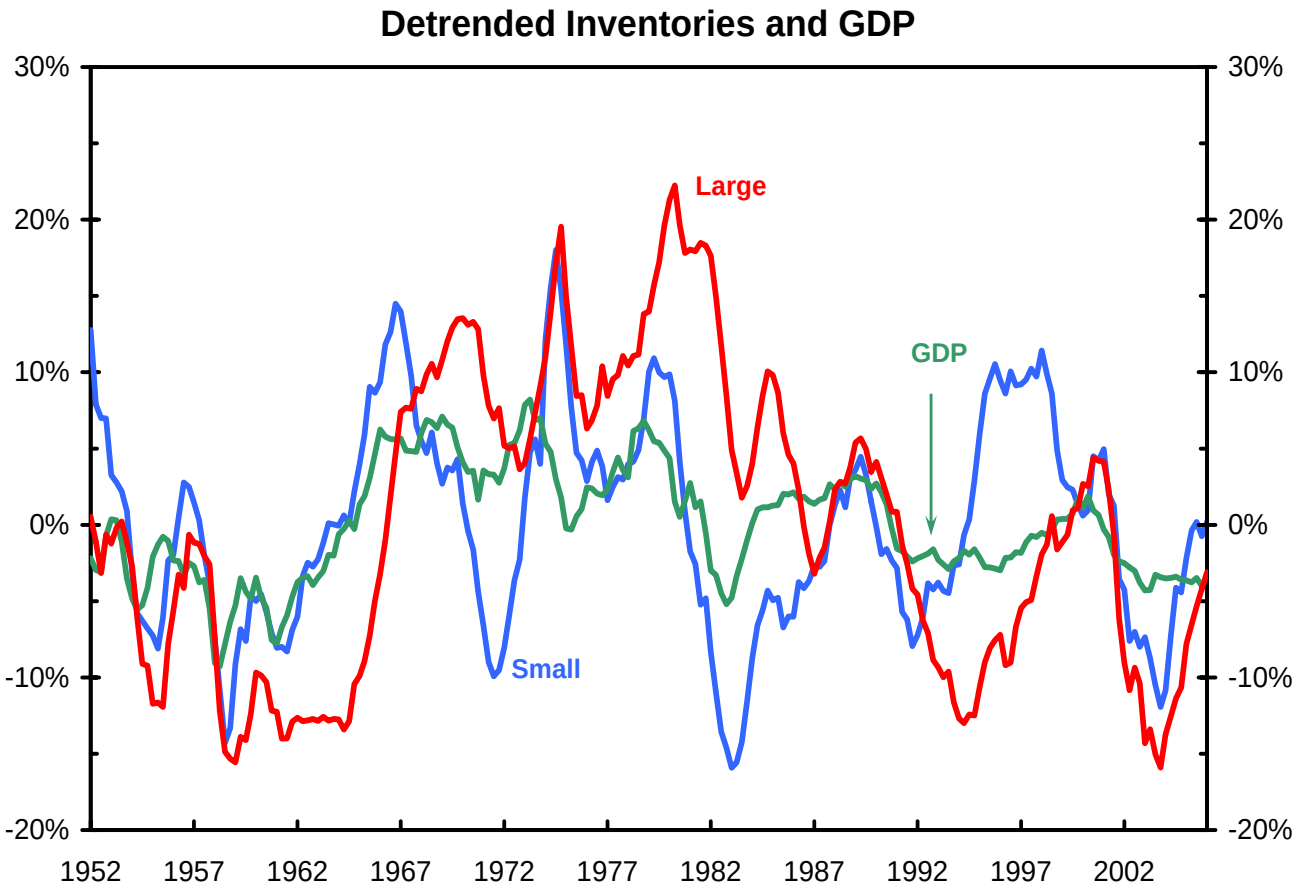
Sales Summary

- Small firms's sales
  - **May well** fall more than large after monetary contractions
  - Do **not** fall more than large in recessions

Inventories

- Overview of data
- Episodic analysis
  - Romer-Romer Dates
  - Business Cycle Dates


Inventories and GDP
120%
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
1952
1957
1962
1967
1972
1977
1982
1987
1992
1997
2002
GDP
Large
Small

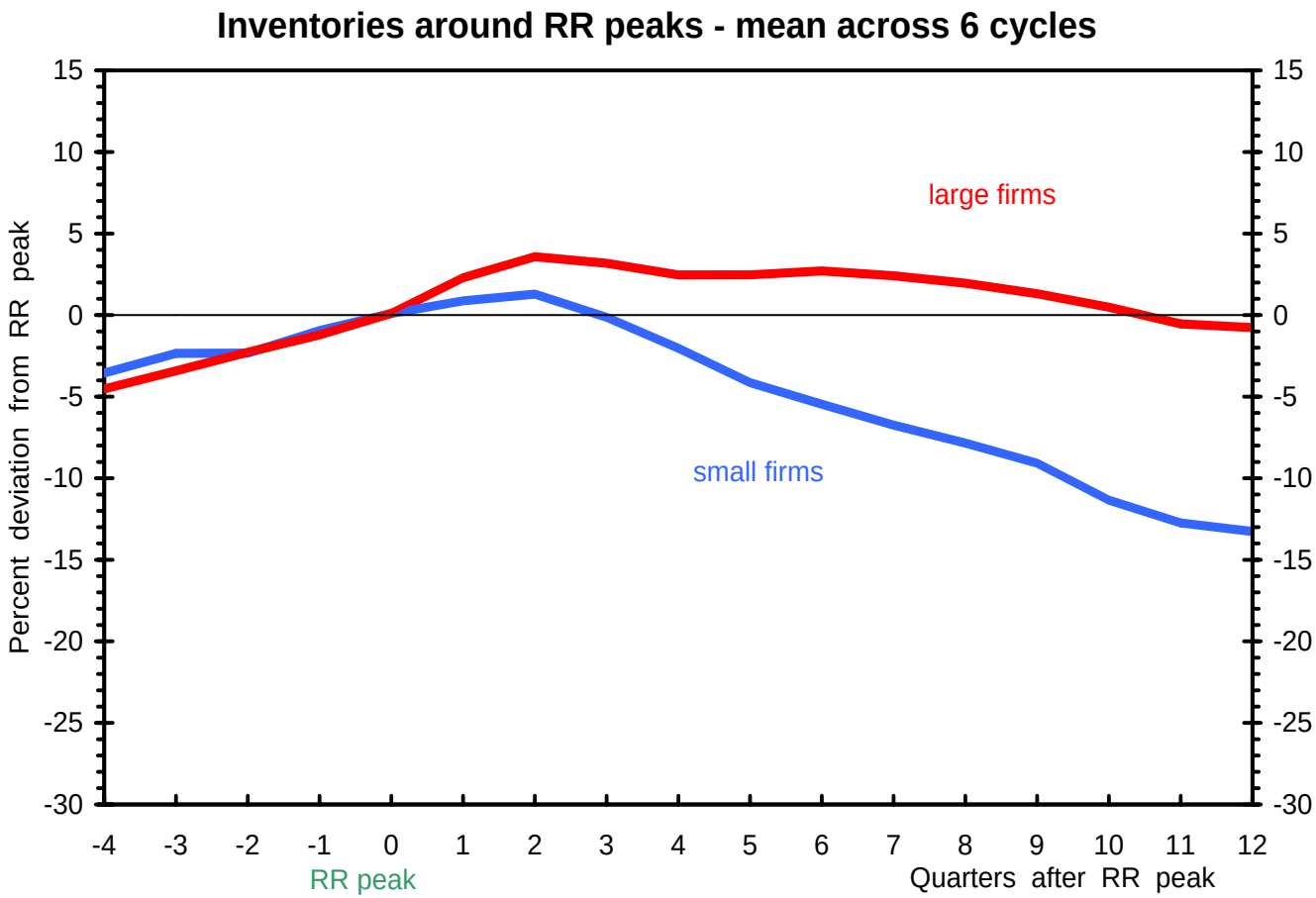


std dev (inv small)/ std dev (GDP) = 1.9

std dev (inv large)/ std dev (GDP) = 2.6

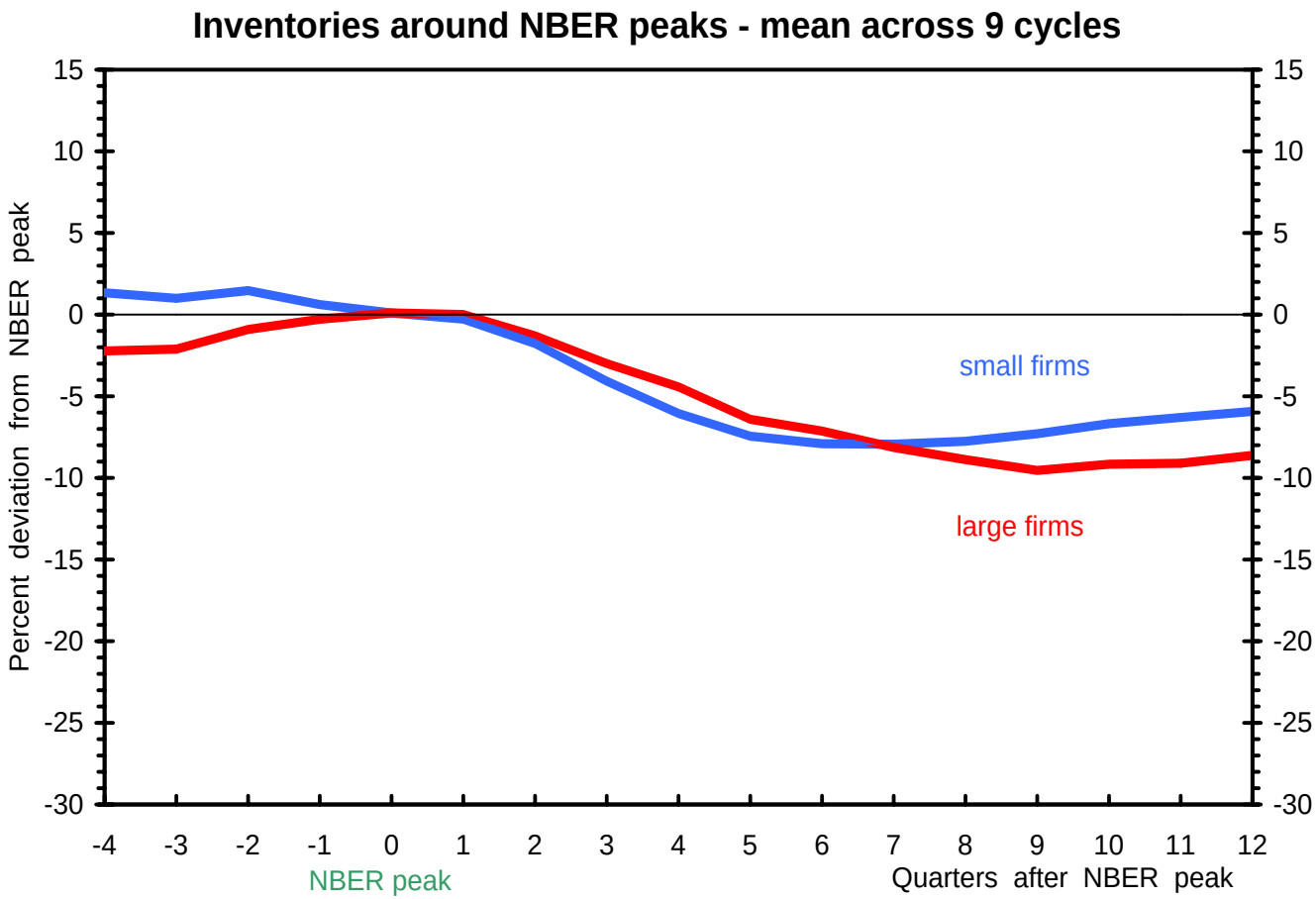
Inventories

- Overview of data
- Episodic analysis
  - Romer-Romer Dates


Inventories around RR peaks - mean across 6 cycles
large firms
small firms
Percent deviation from RR peak
15
10
5
0
-5
-10
-15
-20
-25
-30
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
RR peak
Quarters after RR peak

Inventories

- Overview of data
- Episodic analysis
  - Romer-Romer Dates
  - Business Cycle Dates

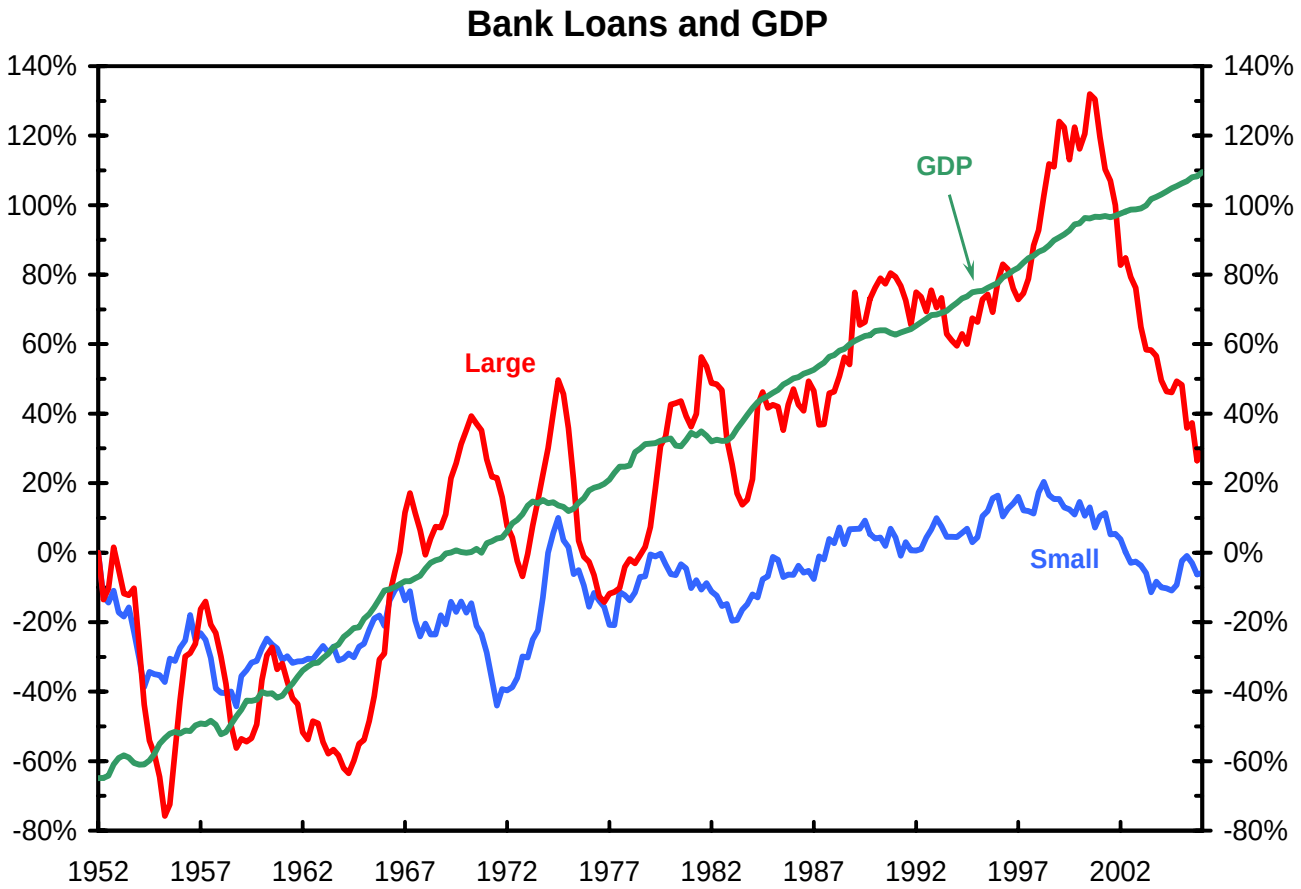

Inventories around NBER peaks - mean across 9 cycles
Percent deviation from NBER peak
15
10
5
0
-5
-10
-15
-20
-25
-30
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
NBER peak
Quarters after NBER peak
small firms
large firms

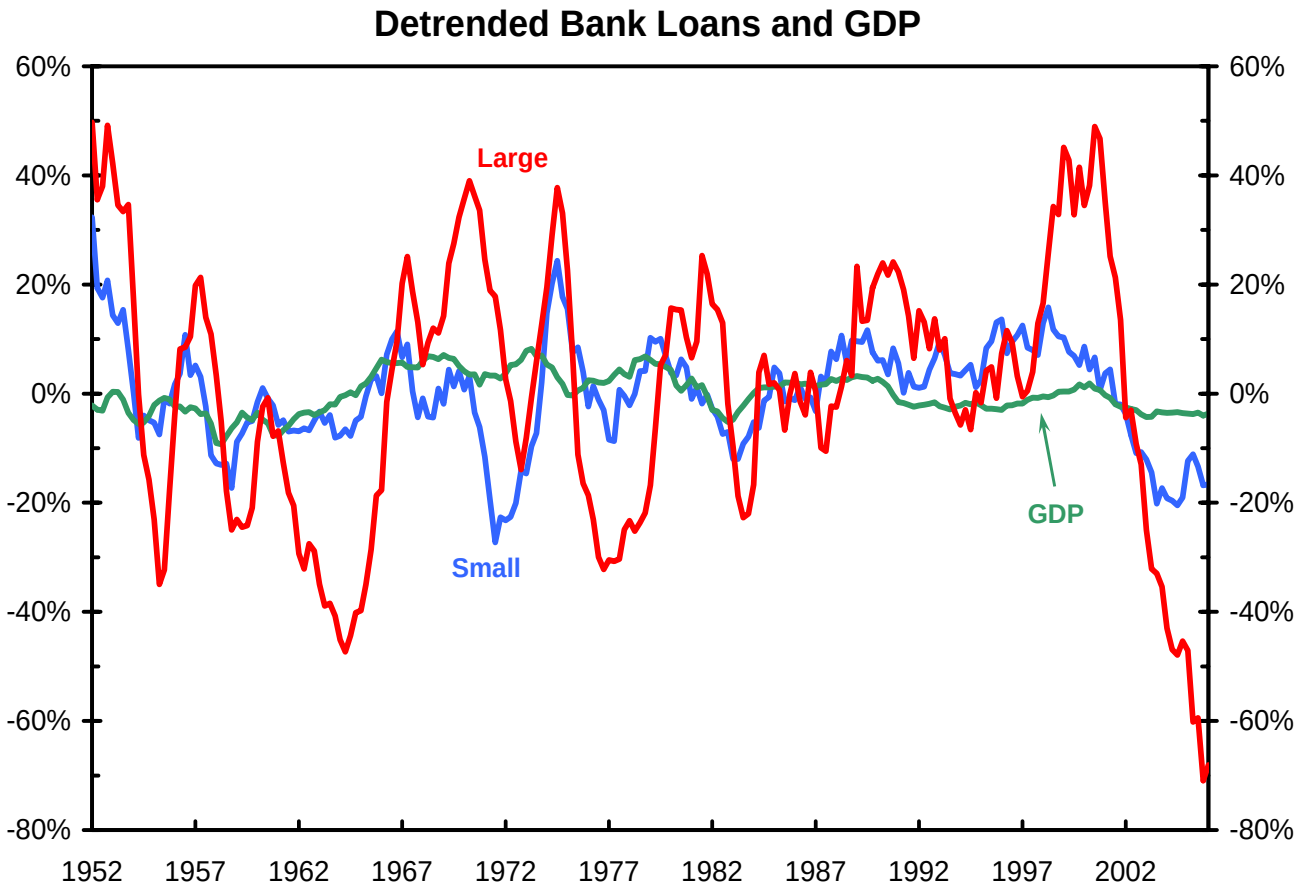
Inventories Summary

- Small firms's inventories
  - **May well** fall more than large after monetary contractions
  - Do **not** fall more than large in recessions

Short term debt

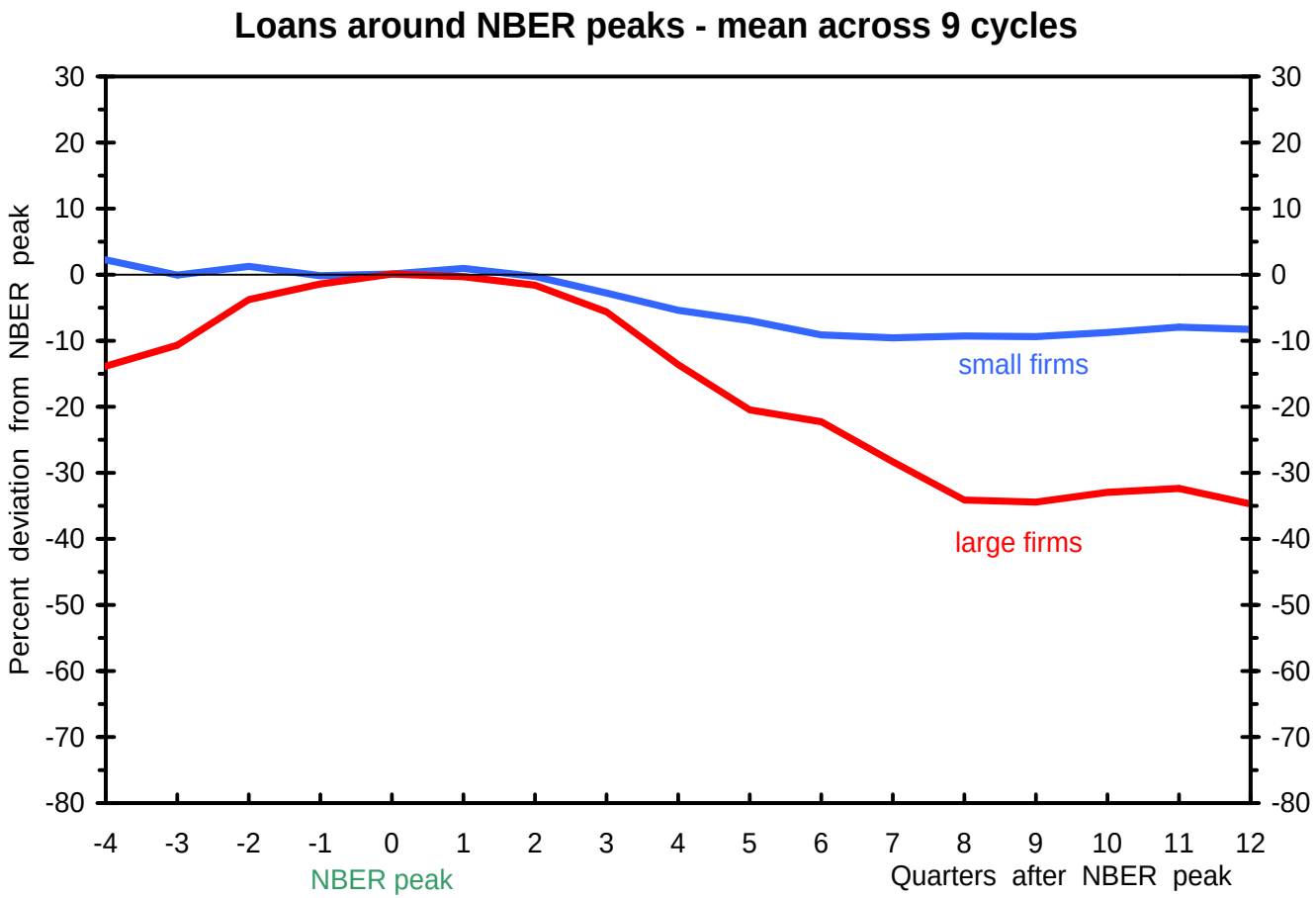
- Overview of data
- Episodic analysis
  - Romer-Romer Dates
  - Business Cycle Dates


Bank Loans and GDP
140%
120%
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
1952
1957
1962
1967
1972
1977
1982
1987
1992
1997
2002
GDP
Large
Small



std dev (loans small)/ std dev (GDP) = 2.6

std dev (loans large)/ std dev (GDP) = 6.6


Loans around NBER peaks - mean across 9 cycles
Percent deviation from NBER peak
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
NBER peak
Quarters after NBER peak
small firms
large firms

Short term debt Summary

- Small firms's short term debt
  - **May well** expand less than large after monetary contractions
  - Do **not** fall more than large in recessions

Limitation of QFR

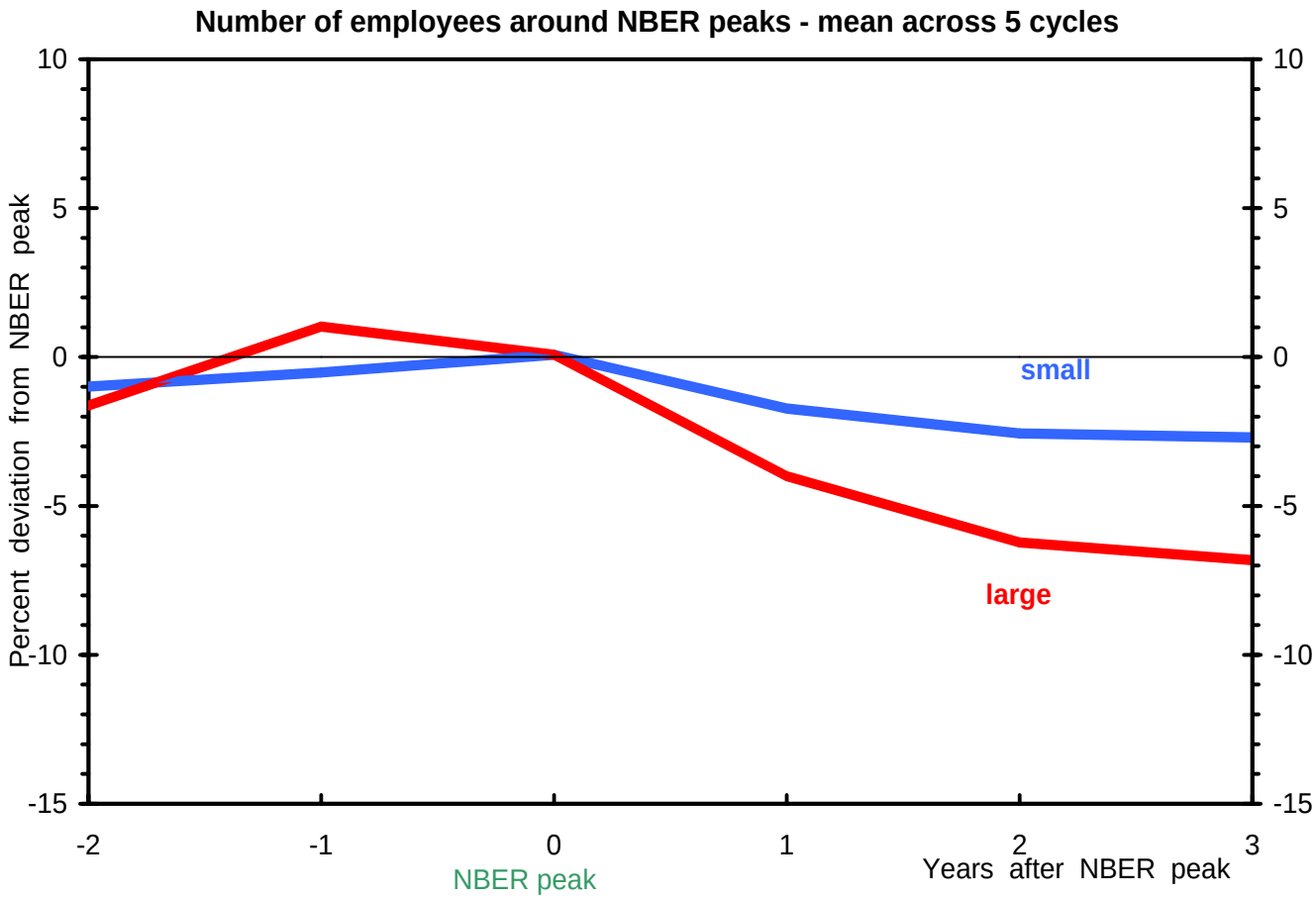
- QFR is just manufacturing
- Does similar pattern hold for the rest of the economy?
- To answer: use County Business Patterns data

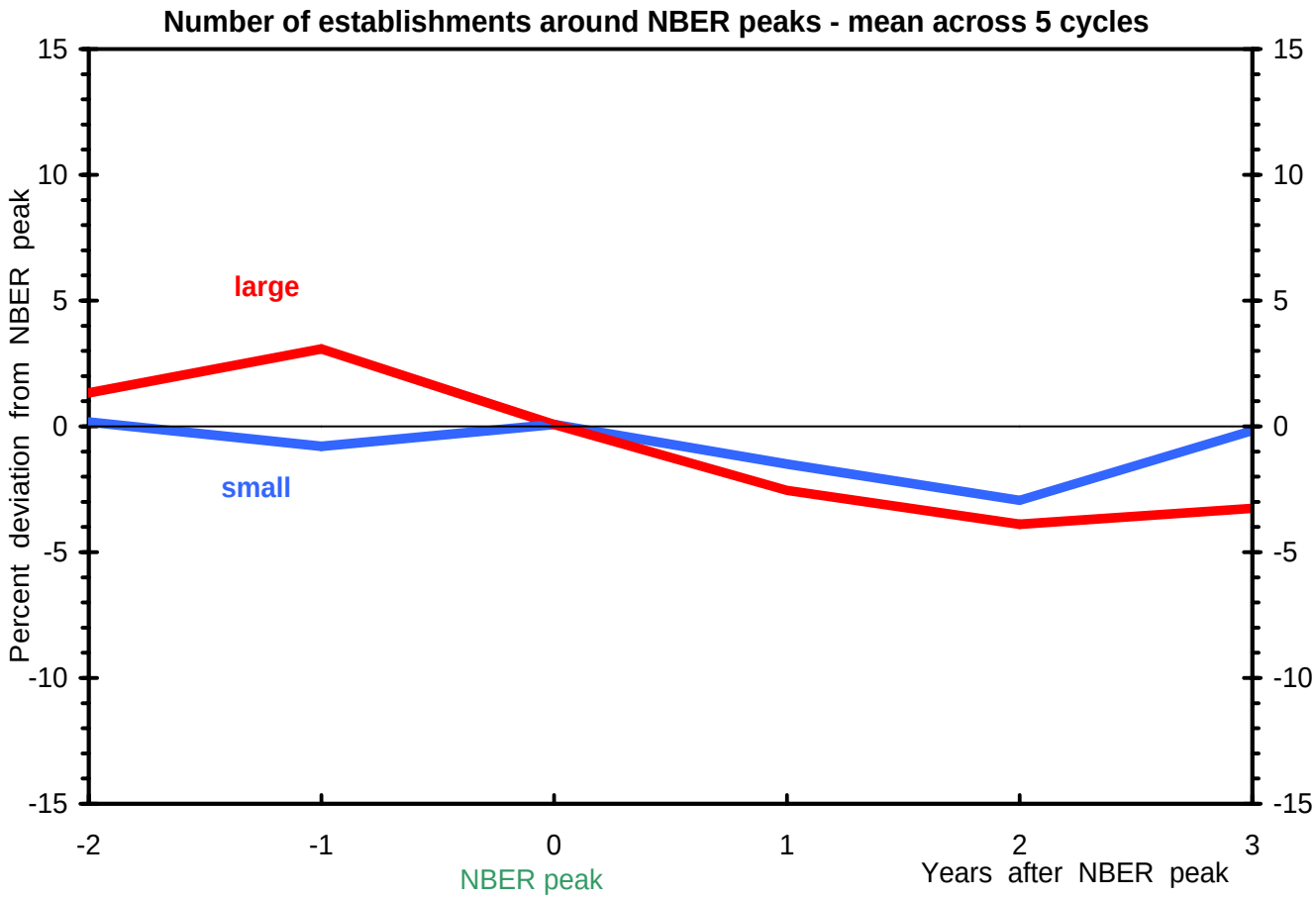
County Business Patterns

- Benefits
  - All of economy
  - Not just manufacturing
- Limitations
  - Annual
  - Only data is employees and establishments
  - Establishments not firm level

County Business Patterns

- Definition of small firms
  - Rank establishments by employees from smallest to largest
  - Add up establishments till get 30% of all employees
  - Large establishments are the rest
- Two variables
  - Employment in small firms
  - Number of establishments of small firms


Number of employees around NBER peaks - mean across 5 cycles
Percent deviation from NBER peak
10
5
0
-5
-10
-15
-2
-1
0
1
2
3
NBER peak
Years after NBER peak
small
large


Number of establishments around NBER peaks - mean across 5 cycles
Percent deviation from NBER peak
15
10
5
0
-5
-10
-15
large
small
-2
-1
0
1
2
3
NBER peak
Years after NBER peak

Limitations of Both QFR and CBP

- Cannot track individual firms (not panel)
- Postwar recession not that large
- Address these issues

  Moody's Data on individual firms in Great Depression

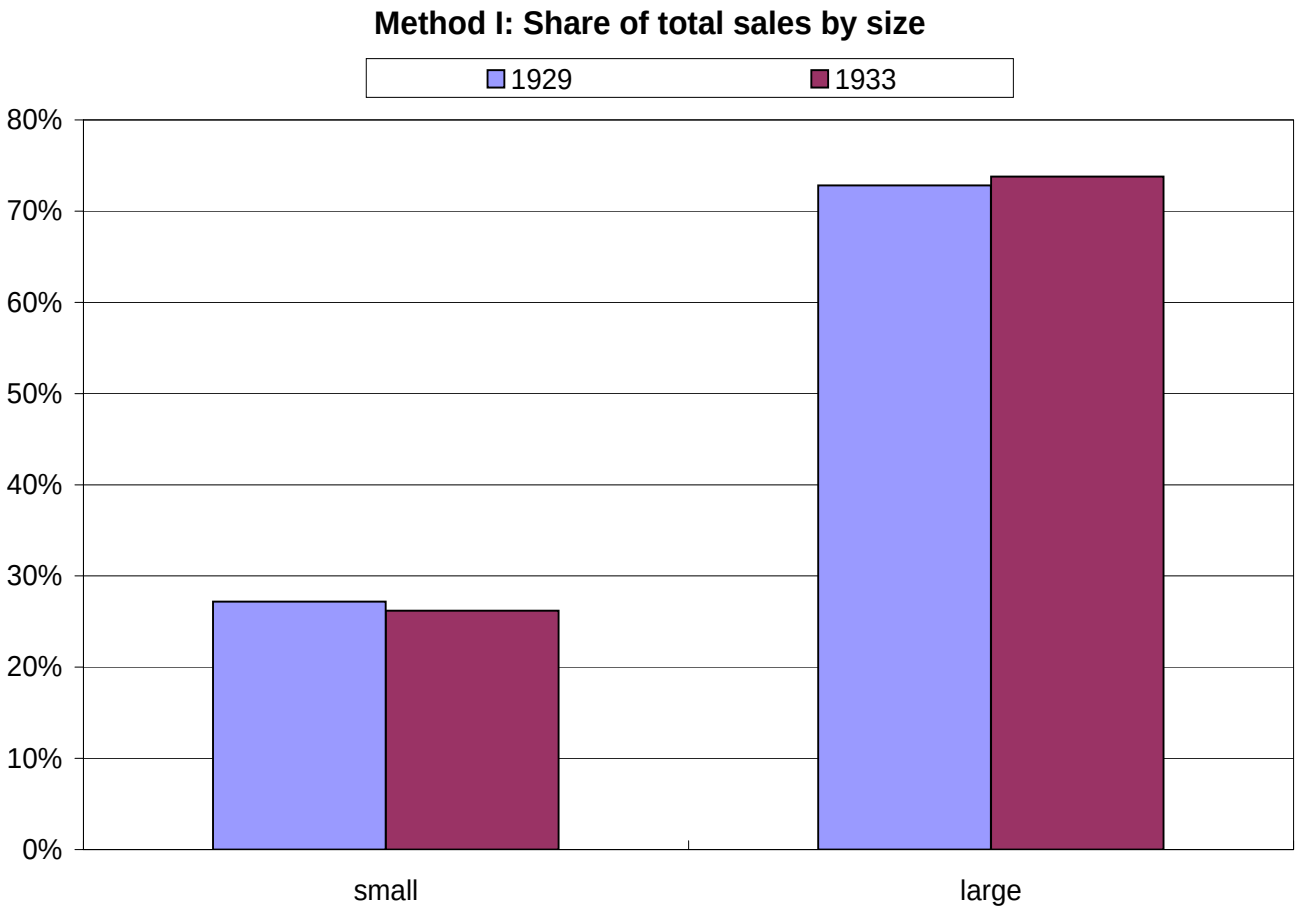
Analysis of Moody's Data: Use Panel Features

- Definition of small firms
  - order firms by assets
  - cumulate firms's sales so that sum of sales is 30%
  - defines small firms in 1929
  - small firms sales in 1933
    - find same firms from 1929
    - plus all 1933 entrants
    - use panel not just repeated cross-section

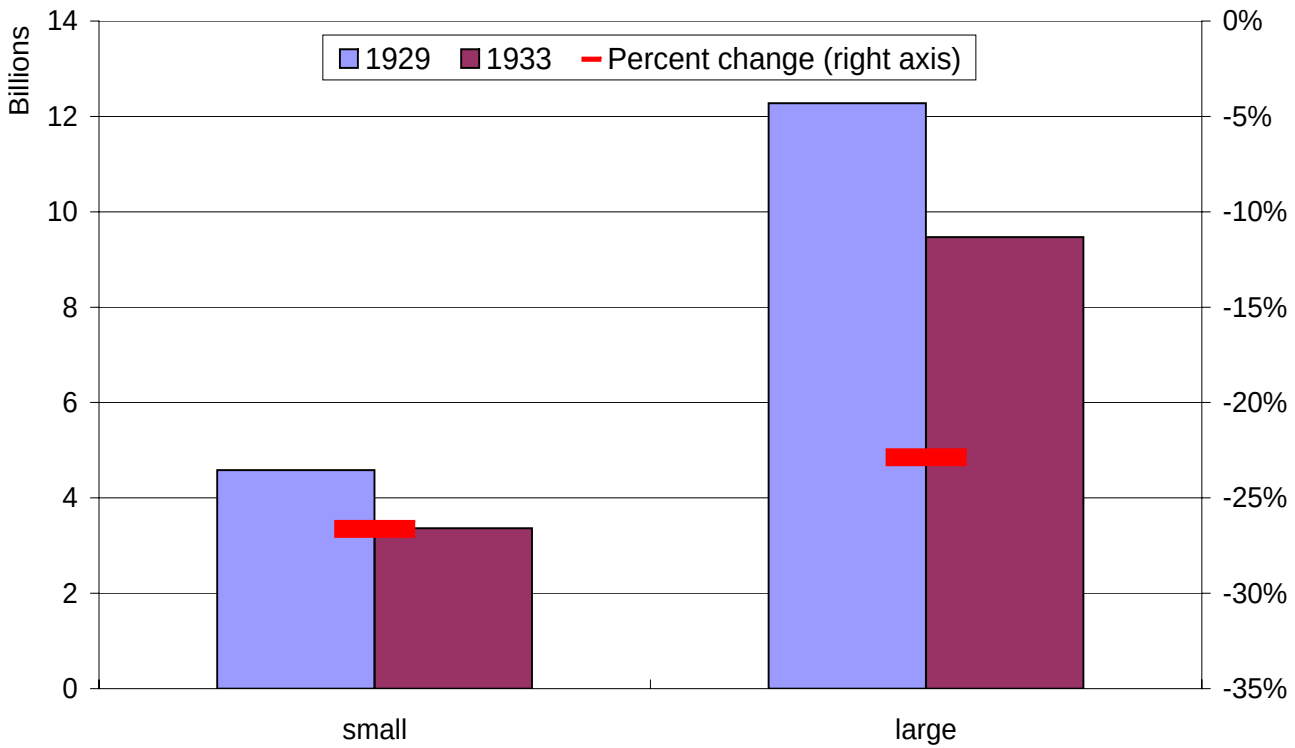
Example of Moody's Data

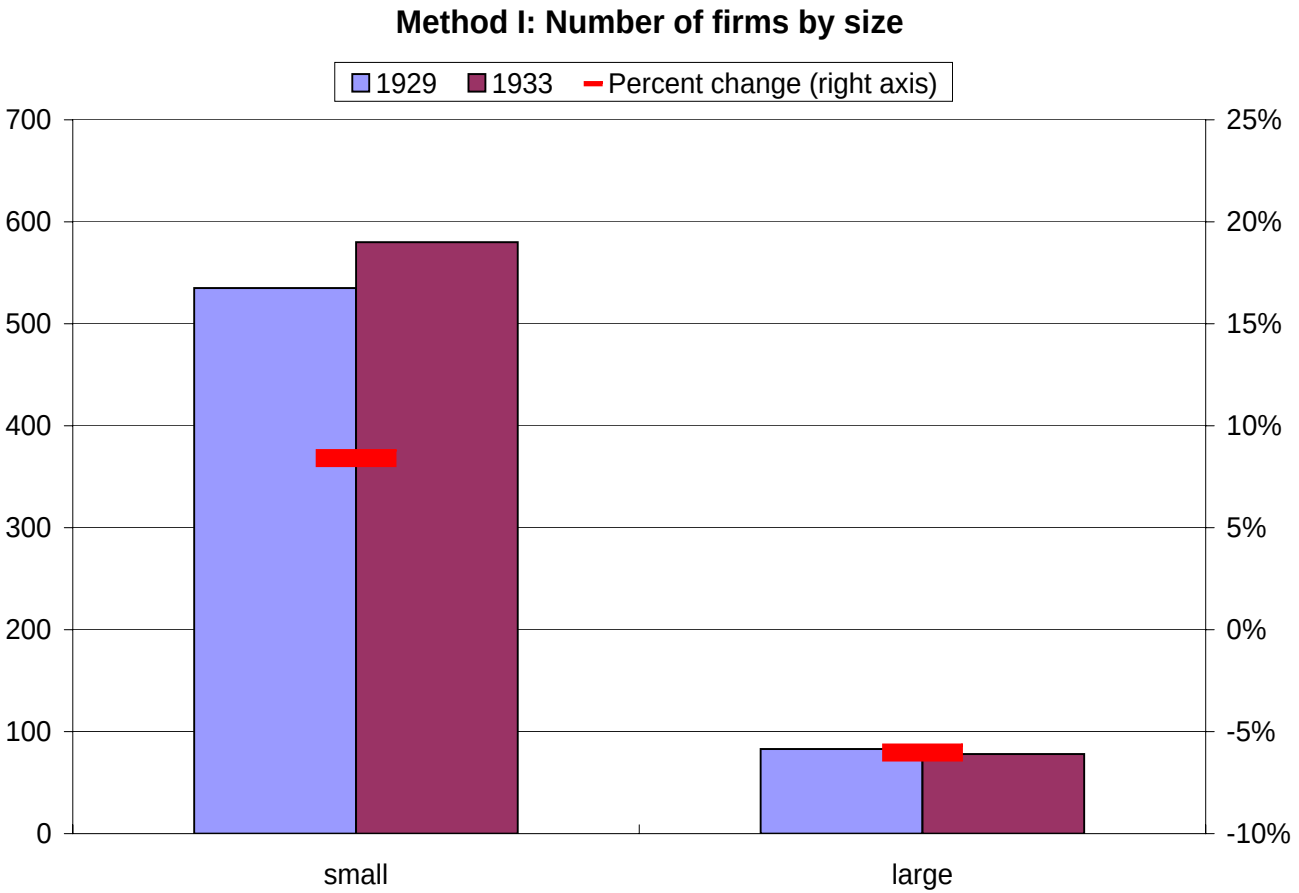
Sales and Assets by Establishment (in dollars)

	General Motors Corp.	Champion Hardware Co.
Assets in 1929	1,324,889,764	573,526
Assets in 1933	1,183,674,005	422,855
Sales in 1929	1,504,404,472	625,494
Sales in 1933	569,010,542	345,227


Method I: Share of total sales by size
1929
1933
80%
70%
60%
50%
40%
30%
20%
10%
0%
small
large

Method I: Sales by size
(ordered by 29 assets, add across firms so that sum of sales is 30% in 29, find same firms in 33; treat entrants as small)




Method I: Number of firms by size
1929
1933
Percent change (right axis)
700
600
500
400
300
200
100
0
25%
20%
15%
10%
5%
0%
-5%
-10%
small
large

Issues with Repeated Cross-section (like QFR)

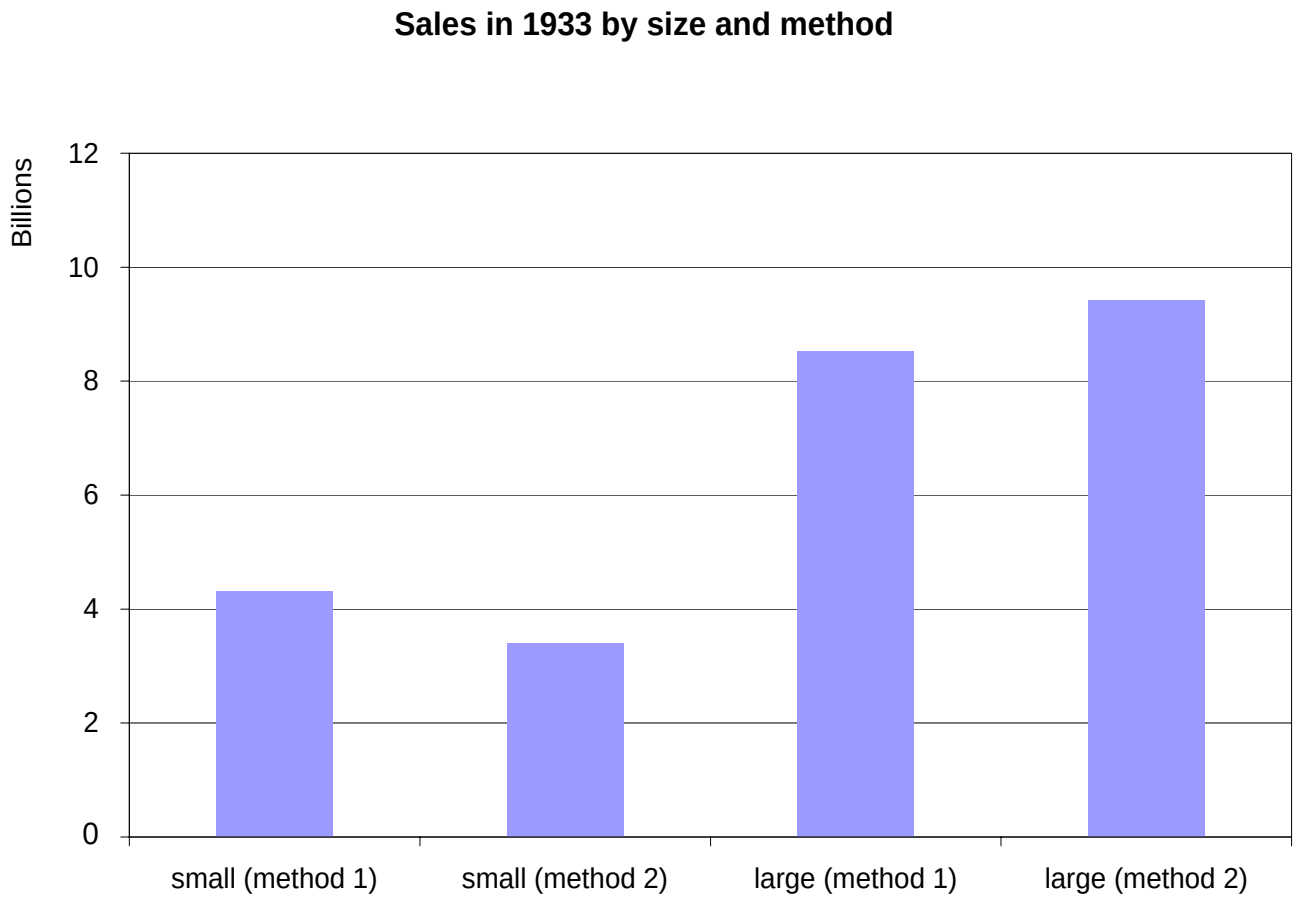
- Potential bias due to bin-jumping
- Small firms sales decline
  - overstated if many small winners (jump up bin)
  - understated if many large losers (jump down bin)
- Use panel aspect of Moody's to investigate this bias

Is Bin-Jumping a Big Problem?

- Treat data as repeated cross-section ($\approx$ QFR)
- Apply QFR method (II) to Moody's data
- Does answer from method II differ from tracking firms (I)?
- Answer: not much

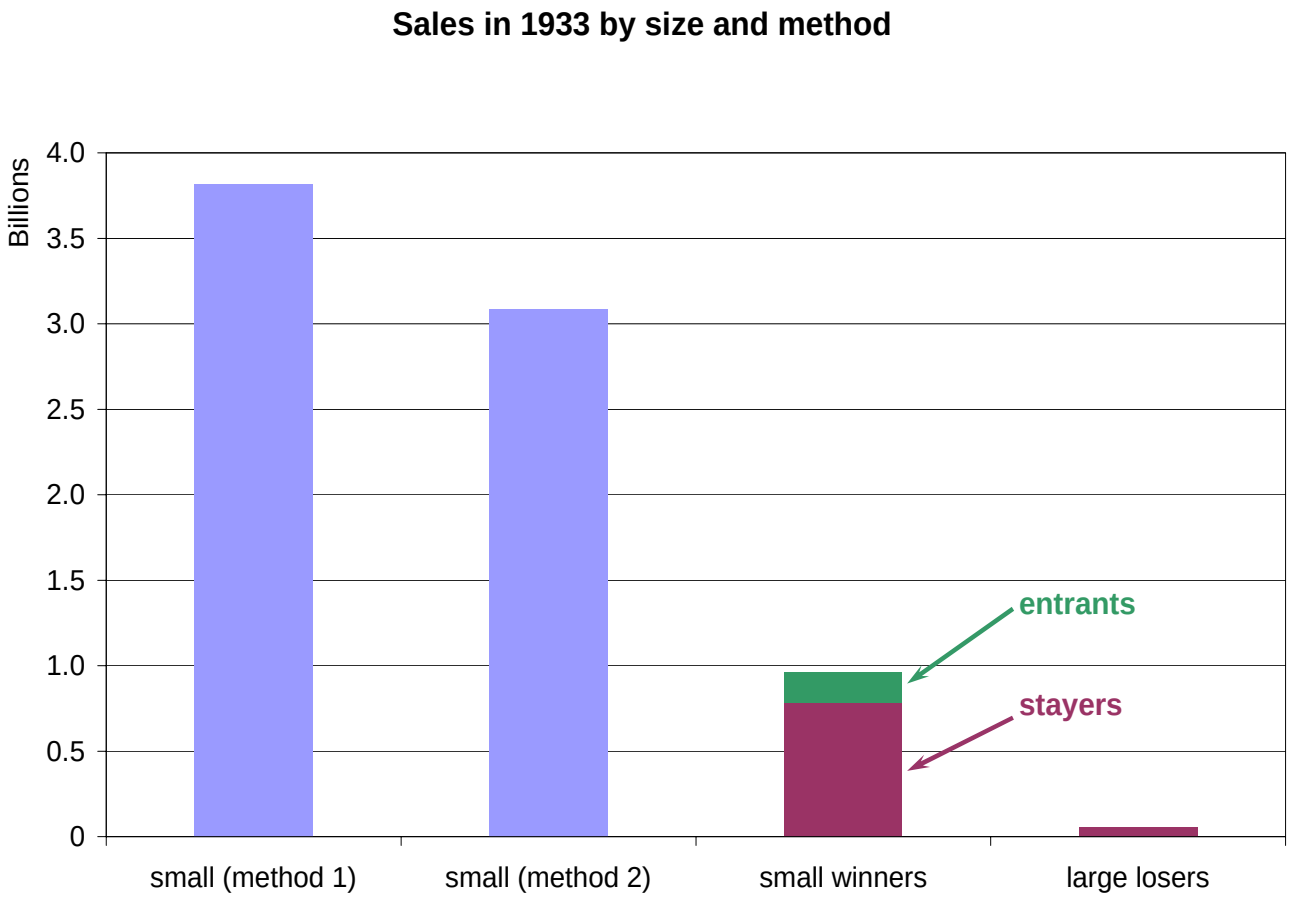
Method II: Only Use Cross Section Information

- Definition of small firms in 1929 same as method I
  - rank firms by 1929 assets
  - cumulate firms's sales so that sum of sales is 30%
- Definition of small firms in 1933 differs
  - whoever has real assets less than 1929 cutoff
- Large in II could be small "winners" in I
- Small in II could be large "losers" in I



- Cross section method:

  overstates decline of small, understates decline of large


Sales in 1933 by size and method
Billions
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
entrants
stayers
small (method 1)
small (method 2)
small winners
large losers

Summary of Bin-Jumping Investigation

- Small firms decline overstated with cross-section
- Large firms decline understated with cross-section
- Suggests our earlier results robust to bin-jumping

Summary

- Variety of data sources and time periods
  - **Is** evidence that small firms hurt more than large by monetary contractions
  - **No** evidence that small firms hurt more than large in recessions
- Contribution

  Show popular belief is a myth
- Where to go from here?

How to interpret these results?

- Option 1: Dismiss evidence from Romer-Romer dates
  - no objective criterion for choice of dates
  - therefore, stop working on financial friction models
- Option 2: Accept evidence from Romer-Romer dates
  - Find financial friction model consistent with both business cycle evidence and financial-tightness evidence

Pursuing Option 2

- Want model
  - small firms contract more after financial-tightening
  - small and larger firms similar in business cycle downturns
- Ingredients
  - firms born small, grow, stochastically die
  - small firms financially constrained, large not
  - business cycle shocks different from financial shocks
    - symmetric response to business cycle shocks (both hurt)
    - asymmetric response to financial shocks (small hurt more)

Pursuing Option 2

- General setup (generic financial constraint model)
  - Two types of agents
    - managers (entrepreneurs) and workers
    - abstract from workers and stochastic death
  - Enforcement constraints on managers
    - can abscond with fraction of firm's capital stock
  - Two types of shocks
    - productivity shocks A_t (business cycle shocks)
    - enforcement constraint shocks θ_t (financial shocks)

Infinite Horizon Deterministic (A_t, θ_t)

Manager

$$\max \sum_{t=1}^{\infty} \beta^t c_t$$

Budget constraint

$$k_1 + \sum_{t=1}^{\infty} \beta^t [c_t + k_{t+1}] \leq \sum_{t=1}^{\infty} \beta^t A_t F(k_t)$$

Enforcement constraint

$$\begin{aligned} \beta c_1 + \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta \theta_1 k_1 \\ \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta^2 \theta_2 k_2 \\ \beta^3 c_3 + \ldots &\geq \beta^3 \theta_3 k_3 \end{aligned}$$

Non-negativity

$$c_t \geq 0$$

Infinite Horizon Deterministic

Proposition: Under sufficient conditions, there exists T such that

1. $c_t = 0, \qquad t = 1, ..., T$ (backloading is optimal)
2. $k_{t+1} = \begin{cases} \frac{\theta_t}{\beta\theta_{t+1}} k_t & t < T \\ k^*(A_{t+1}) & t \geq T \end{cases}$

where $k^*(A_t)$ is unconstrained level of capital: $\beta F_k(k^*(A_t)) = 1$

- Small firms run along constraint: only θ_t matters for invest.
  Large firms unconstrained: θ_t irrelevant for investment

Implications

- Financial shocks θ_t asymmetric
  - affect small firms
  - no affect large firms
- Business cycle shocks A_t symmetric
  - direct effect on both small and large sales $A_t F(k_t)$

Spirit of Assumption Needed in Proposition

- Unconstrained level of capital: $\beta F_k(k^*) - 1 = 0$

- Payments to managers: marginal product of labor

$$\begin{aligned}\beta c_1 + \beta^2 c_2 + ... &= [\beta F(k_1^*) - k_1^*] + \beta[\beta F(k_2^*) - k_2^*] + ... \\ &= [\beta F_k(k_1^*) - 1]k_1^* + \beta F_l(k_1^*) + \beta[\beta F_k(k_2^*) - 1]k_2^* + \beta^2 F_l(k_1^*) + ... \\ &= \beta F_l(k_1^*) + \beta^2 F_l(k_1^*) + ...\end{aligned}$$

- Assume: unconstrained level of capital not enforceable

$$\sum_{t=1}^{\infty} \beta^t c_t = \sum_{t=1}^{\infty} \beta^t F_l(k^*) < \beta\theta k_1^*$$

- Assume: A_t not vary too much

Why backloading optimal: intuition with A and θ constant

- Budget constraint pins down p.v. of c_t

$$\sum_{t=1}^{\infty} \beta^t c_t = \sum_{t=1}^{\infty} \beta^t [A_t F(k_t) - k_{t+1}] - k_1 \equiv S$$

- Try to support k^* in earliest possible period

$$\begin{aligned} S = \beta c_1 + \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta\theta k \\ \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta^2 \theta k \\ \beta^3 c_3 + \ldots &\geq \beta^3 \theta k \end{aligned}$$

- Suppose enforcement binds at $t+1$ but $c_t > 0$
  - decrease c_t (put in bank)
  - increase $c_s, \quad s > t$ (take out later)

Why backloading optimal: intuition with A and θ constant

- Budget constraint pins down p.v. of c_t

$$\sum_{t=1}^{\infty} \beta^t c_t = \sum_{t=1}^{\infty} \beta^t [A_t F(k_t) - k_{t+1}] - k_1 \equiv S$$

- Try to support k^* in earliest possible period

$$\begin{aligned} S = \beta c_1 + \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta\theta k \\ S = \beta^2 c_2 + \beta^3 c_3 + \ldots &\geq \beta^2\theta k \\ S = \beta^3 c_3 + \ldots &\geq \beta^3\theta k \end{aligned}$$

- Suppose enforcement binds at $t+1$ but $c_t > 0$
  - No change in p.v. of consumption (still S)
  - But relaxes incentive constraints (timing)

Why backloading optimal: intuition with A and θ constant

- Budget constraint pins down p.v. of c_t

$$\sum_{t=1}^{\infty} \beta^t c_t = \sum_{t=1}^{\infty} \beta^t [A_t F(k_t) - k_{t+1}] - k_1 \equiv S$$

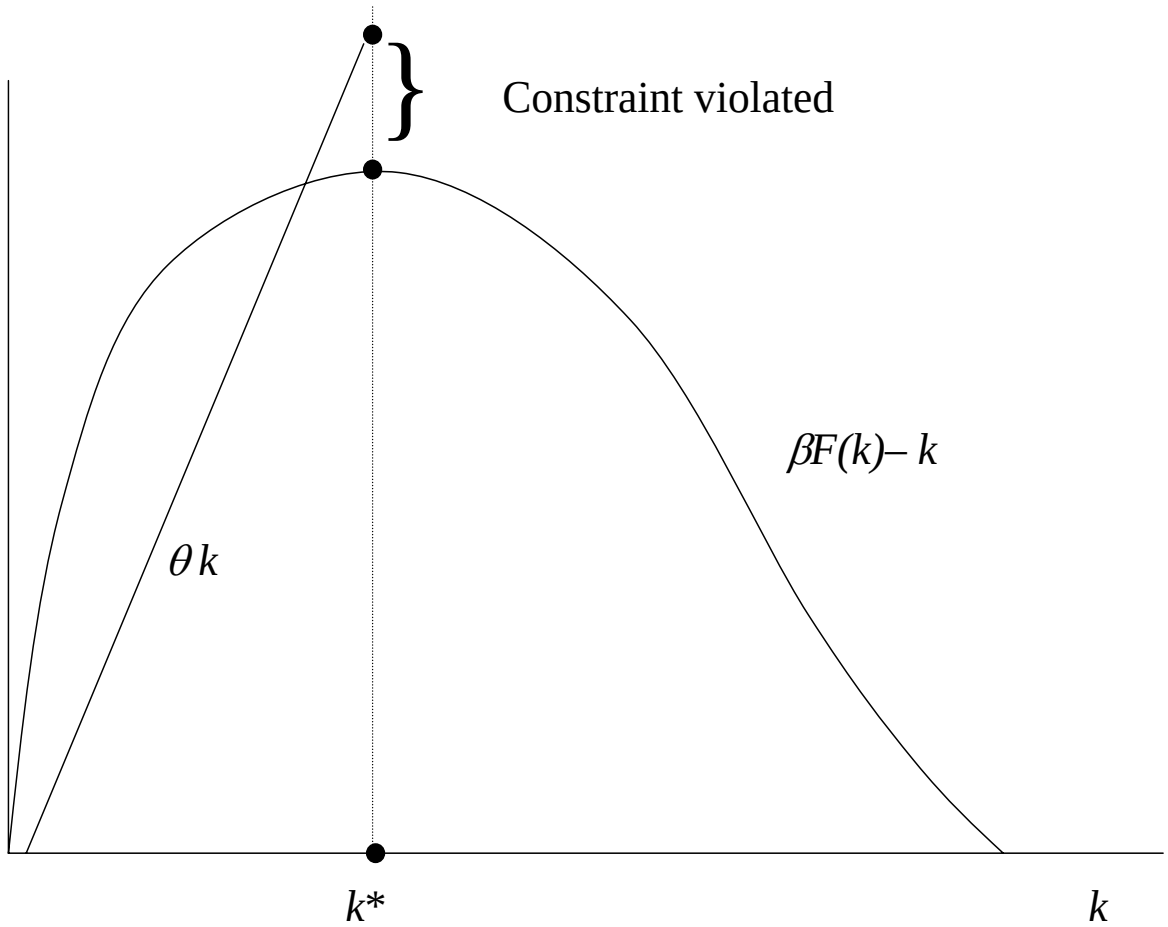
- Try to support k^* in earliest possible period

$$\begin{aligned} S &= \beta c_1 + \beta^2 c_2 + \beta^3 c_3 + ... \geq \beta\theta k \\ S &= \beta^2 c_2 + \beta^3 c_3 + ... \geq \beta^2\theta k \\ S &= \beta^3 c_3 + ... \geq \beta^3\theta k \end{aligned}$$

- Suppose enforcement binds at $t+1$ but $c_t > 0$
- Within finite time T: $c_t = 0, \quad t = 1, ..., T$

$$S \geq \beta^T \theta k^*$$

How is constrained level determined?



How Enforcement Constraint Determines Capital Stock

Conclusion

- Show popular belief is a myth
- Suggested positive research agenda