Monetary Policy and the Firm: Some Empirical Evidence[1]

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[1]The views expressed are those of the presenter and not necessarily those of the Bank of England, the MPC, the FPC or PRA Board.

What We Do in this Paper

- How does the individual firm respond to a monetary policy shock?
  - how does the response compare to aggregate dynamics?
  - how do firm characteristics govern the extent of this response?
    - Focusing on size and age

- In this paper we:
  - answer these questions with microdata on a panel of UK firms covering 1990-2015.
  - monetary policy shocks identified using high frequency market surprises (Miranda-Agrippino [2016]).

What We Find

- Monetary policy has a much more **persistent effect on incumbent firms**
  - aggregate economy returns to normal after 5 years;
  - after 5 years firm response is hitting its peak.
- **New entrants can reconcile this.**
  - With delay, monetary policy increases size at entry.
  - And, eventually, rates of entry.
- **Who is most affected by policy?**
  - Large firms more than small firms & young firms more than old.
  - Young, large firms the most.
- monetary policy redistributes activity from recent (large) entrants to future entrants (by making them bigger).
- **Work in progress.**
  - Cleansing vs scarring (Caballero and Hammour [1994], Ouyang [2009]).
  - What mechanism explains the persistence?

The Literature

- **Persistent effect of recessions on entrants:** Moreira [2017] (hholds: Baker et al. [1994], Kahn [2010], Oreopoulos et al. [2012])
- **Which types of firms are more sensitive to the aggregate shocks?**
  - Monetary policy: Gertler and Gilchrist [1994], Bougheas et al. [2006].
  - Size and Business Cycle: Moscarini and Postel-Vinay [2012], Chari et al. [2013], Kudlyak and Sanchez [2017]. Age & size: Fort et al. [2013]
- **Entry and monetary policy:** Bergin and Corsetti [2008], Kobayashi [2011]
- **Recent macro literature on heterogeneity and monetary policy (mainly focusing on households):** Auclert [2015], Cloyne et al. [2016], Kaplan et al. [2016]
- **Macro-evidence on monetary policy propagation:**
  - Christiano et al. [1999], Romer and Romer [2004], Ramey [2016]
  - Gurkaynak et al. [2005], Nakamura and Steinsson [2013], Gertler and Karadi [2015]

Firm Data

Overview

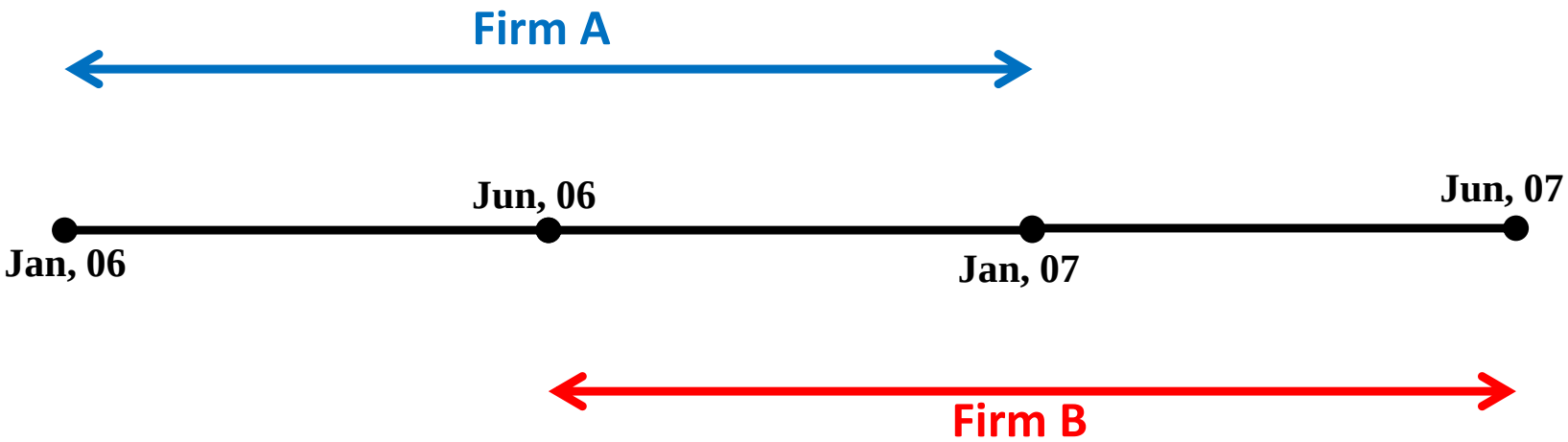
Accounting Data: Bureau van Dijk (BVD) based on filings at Companies House (UK registrar)

- Annual data covering ~4.0 million UK firms annual company house filings.
- BVD is a live database, which leads to several limitations, most importantly: **selection issue, firms that die leave the database after ~ 5years.**
  - Illustrating the Selection Effect
- To circumvent this issue, we use archived data sampled at a six monthly frequency to capture information when it was first published.

Data

Treatment of Firms

- Sample selection:
  - we exclude companies that have a parent with an ownership stake greater than 50%.
  - operate in finance, utilities or public sectors.
  - Firms must be active, have operated for at least three years and report variables of interest.
- Sample period is 1990-2015 (95% obs in 1998-2014).
- Annual data but firms have different accounting periods.



Two Samples

Sample I: Firms who report Number of Employees

Variable	Mean	Median	25%tile	75%tile	N	Histogram
Firms that report *Number of Employees* (105,610 unique firms)						
Total Assets (£'000s)	61718	2326	157	6909	465444	chart
Number of Employees	303	28	4	91	467816	chart
Employment Growth Rates (conditional on survival)						
1-year	0.011	0.000	-0.026	0.065	467816	chart
3-year	0.027	0.000	-0.100	0.190	282028	chart
5-year	0.074	0.013	-0.160	0.340	143259	chart
10-year	0.150	0.130	-0.210	0.560	50047	chart

Note: Firms are counted as reporting total assets/number of employees if they report either for three consecutive years or two consecutive years non-consecutively. Growth rates are calculated for firms who file all accounts in a regular annual pattern (observations for which there is an accounting period that is not annual are excluded). Nominal asset growth is converted into real terms using the UK CPI at the month of filing.

Two Samples

Sample II: Firms who report Total Assets

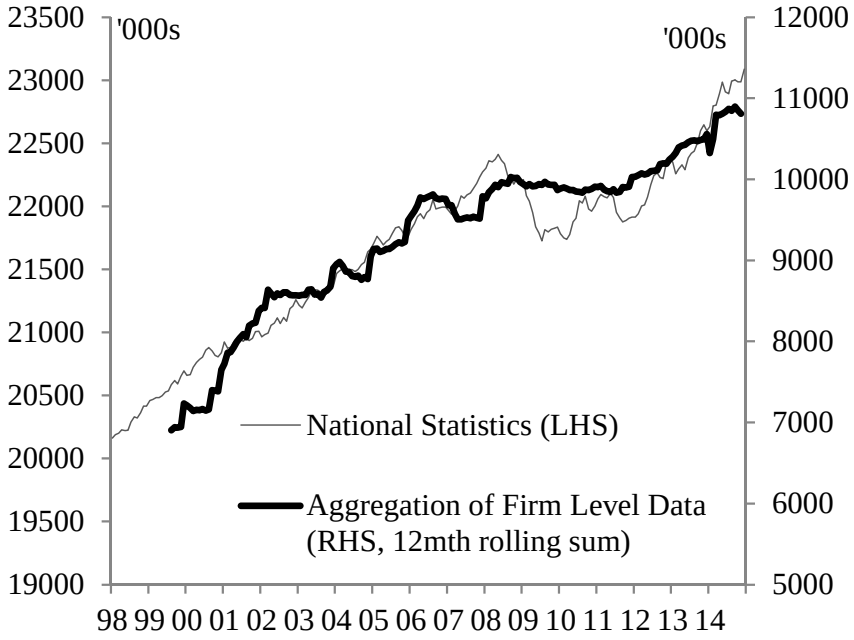
Variable	Mean	Median	25%tile	75%tile	N	Histogram
Firms that report *Total Assets* (3,744,718 unique firms)						
Total Assets (£'000s)	2779	55	15	225	12050499	chart
Real Asset Growth (conditional on survival)						
1-year	0.022	0.000	-0.160	0.220	12050499	chart
3-year	0.068	0.031	-0.260	0.430	8072643	chart
5-year	0.160	0.120	-0.310	0.670	4462878	chart
10-year	0.330	0.300	-0.270	0.990	1366788	chart

Note: Firms are counted as reporting total assets/number of employees if they report either for three consecutive years or two consecutive years non-consecutively. Growth rates are calculated for firms who file all accounts in a regular annual pattern (observations for which there is an accounting period that is not annual are excluded). Nominal asset growth is converted into real terms using the UK CPI at the month of filing.

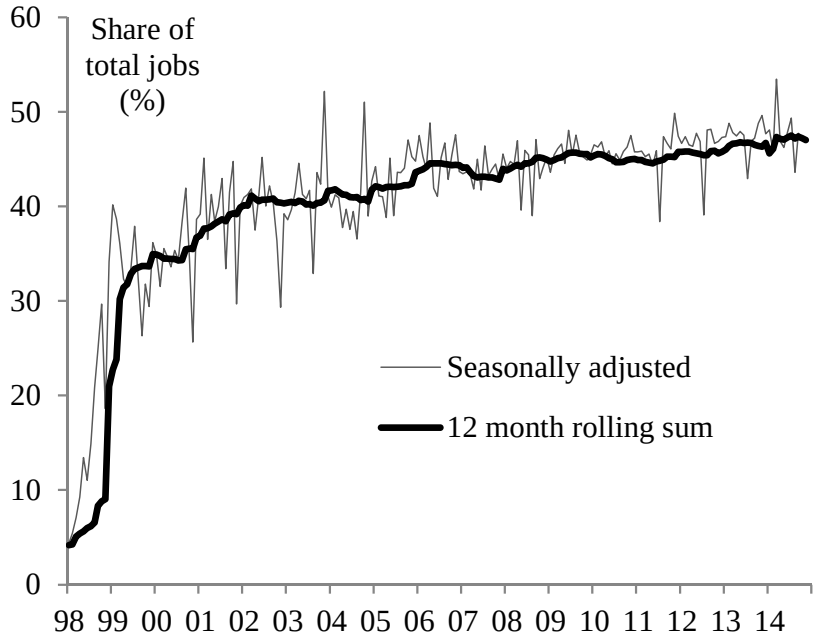
Descriptive Statistics

Firm vs Aggregate Growth

Total Employment (Relevant Industries)



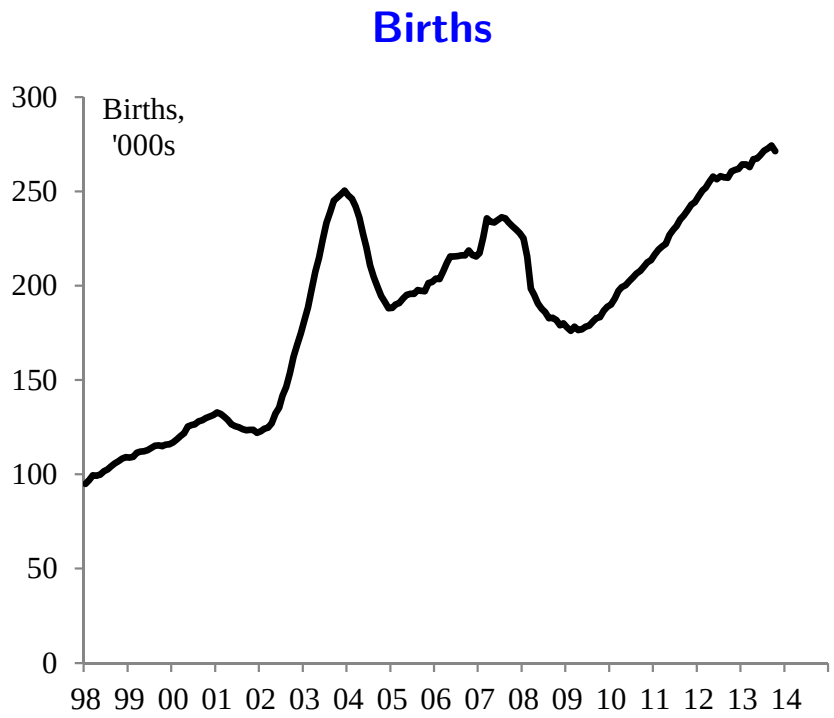
Labour market coverage

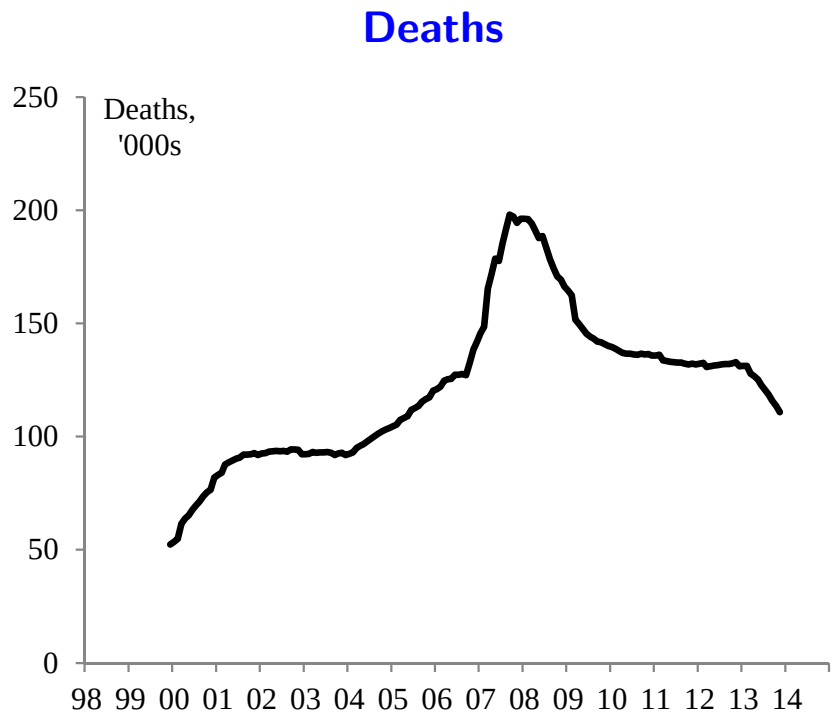


Notes: (i) *left panel:* Thick black line (aggregation of firm level data) is the sum of the employment of all companies that file in particular month expressed as a 12 month moving sum. Thin black line (national statistics) is employment in the relevant industries as sourced from the UK ONS. (ii) *right panel:* thick black line (12 month rolling sum) is the ratio between the two lines in the top left panel. Thin black line (seasonally adjusted) is the constructed by taking the sum of all firms that file in a particular month, seasonally adjusting the time series and multiplying it by 12 dividing by the thin black line in the left panel.

Descriptive Statistics

Birth and Death





Notes: (i) *left panel:* number of firms with *incorporation date* in a rolling 12 month window. (ii) *right panel:* number of firms with a *statement date* where the *company status* was first listed as dissolved in a rolling 12 month window.

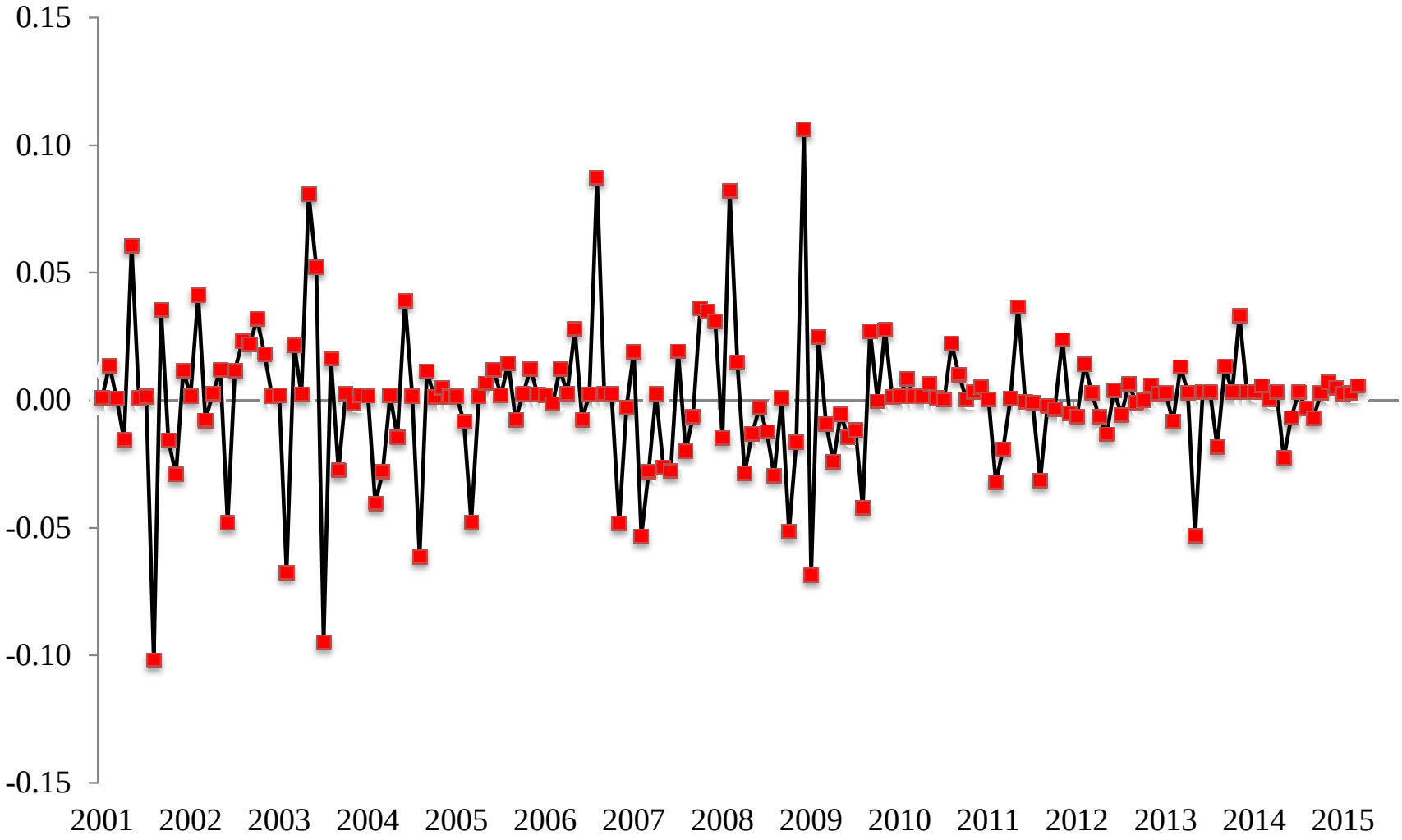
Identifying Monetary Policy Shocks

Miranda-Agrippino (2016)

- We use the monetary policy shock series from Miranda-Agrippino [2016]. (2001m1-2015m2)
- High frequency short sterling futures (3 mth) market reaction to monetary policy announcements. **But: these reactions can be predicted**
  - Private information of policymakers.
  - Time varying risk premia.
- **Solution:** project the raw surprises on CB forecasts, measures of risk premia and past rate decisions; extract the residuals.
- We extend the sample and normalise the size of the shock by extracting the residuals from a proxy SVAR estimated over 1980-2015.
  - VAR series: 1-year gilts, IP, employment, CPI.
  - The estimated shock is what goes into our firm level regression.

Identifying Monetary Policy Shocks

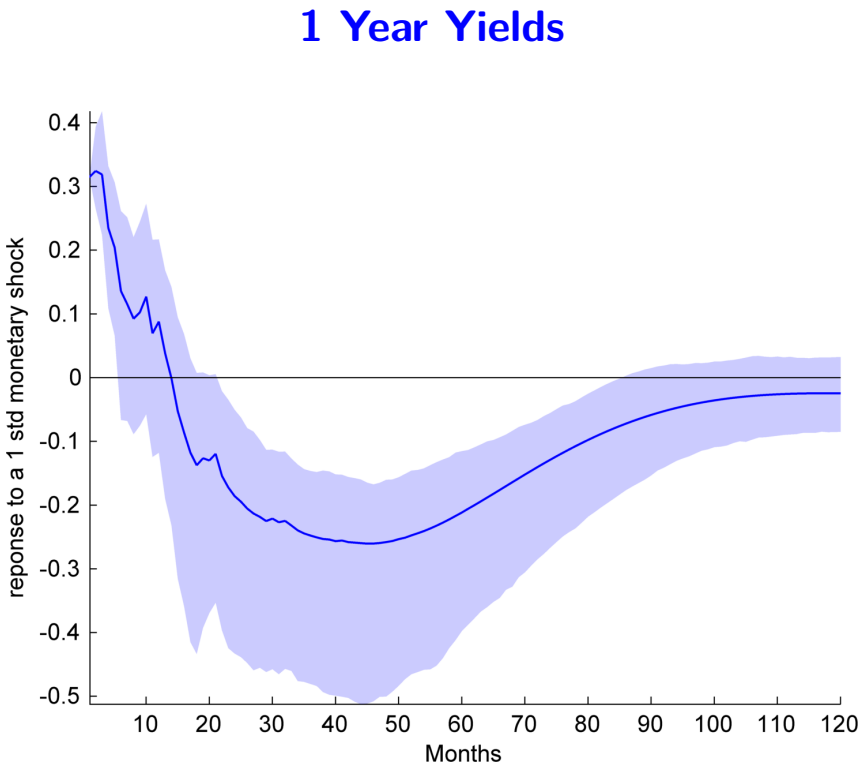
Shock Series

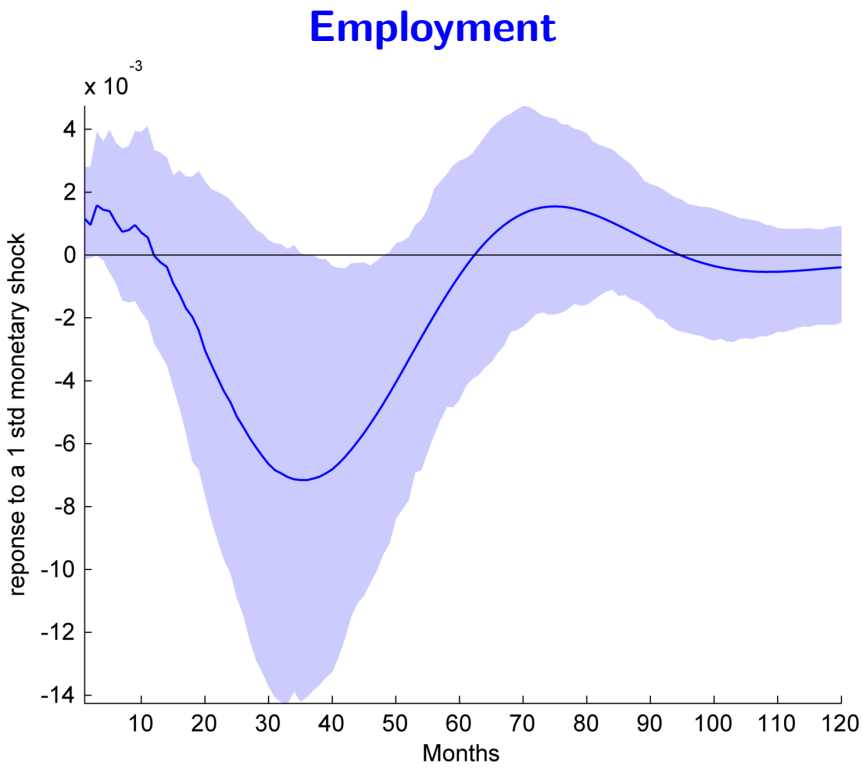


Series put through the VAR

Aggregate Responses

1sd monthly contractionary shock





Notes: Estimates are from a proxy SVAR estimated on UK monthly data over the period 1981-2015. Monetary policy shocks are identified using the Miranda-Agrippino [2016] series. The blue solid lines are the point estimates, and the shaded areas are the 90% confidence intervals constructed from a wild recursive bootstrap.

Output and Prices

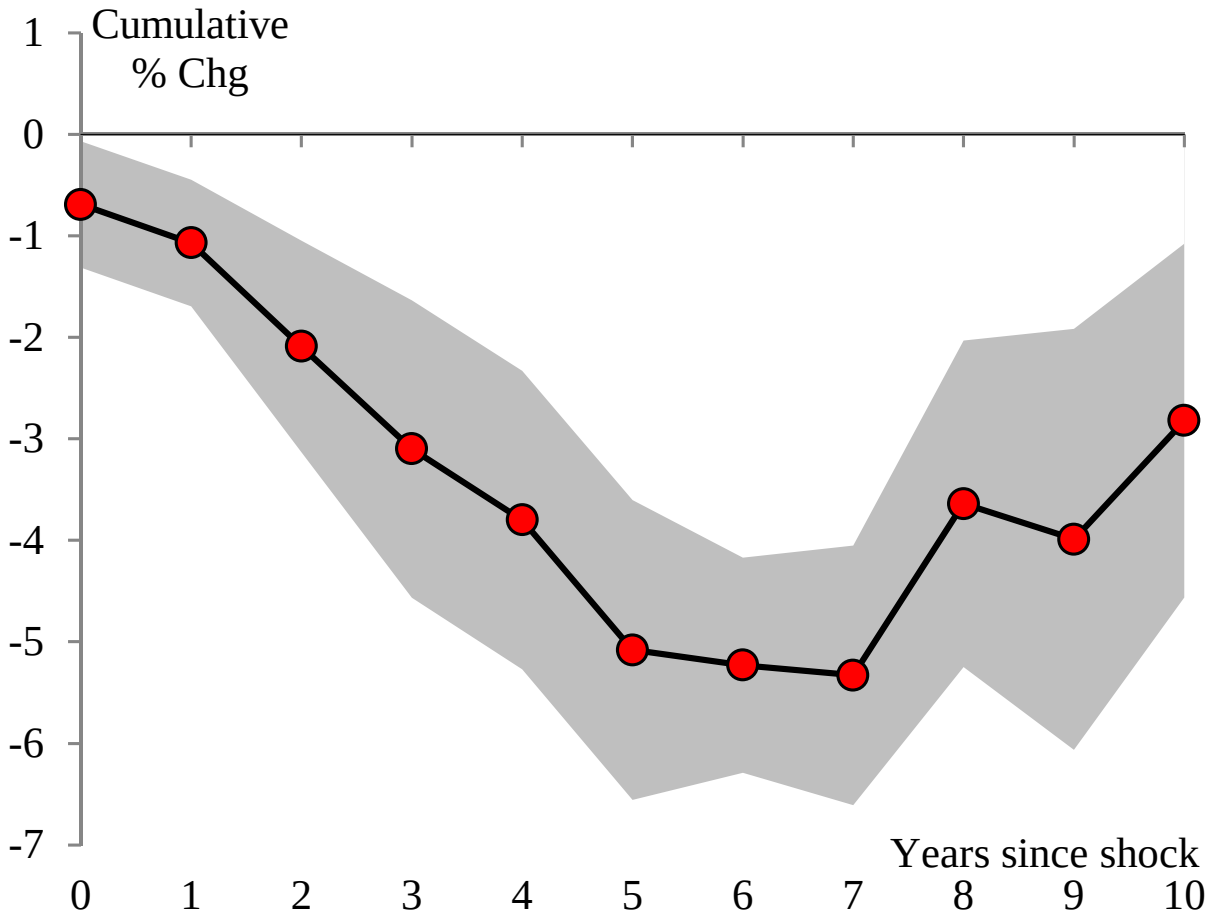
Empirical Methodology

Specification:

$$log(EMP_{t+h,i}) - log(EMP_{t-1,i}) = \alpha_i^h + \beta^h \sum_{m=1}^{12} w_m e_{m,t} + \gamma^h \times controls_{i,t} + \sum_{j=1}^{4} \phi^h \sum_{m=1}^{12} \tilde{u}_{m,j,t} + \varepsilon_{i,t}^h$$

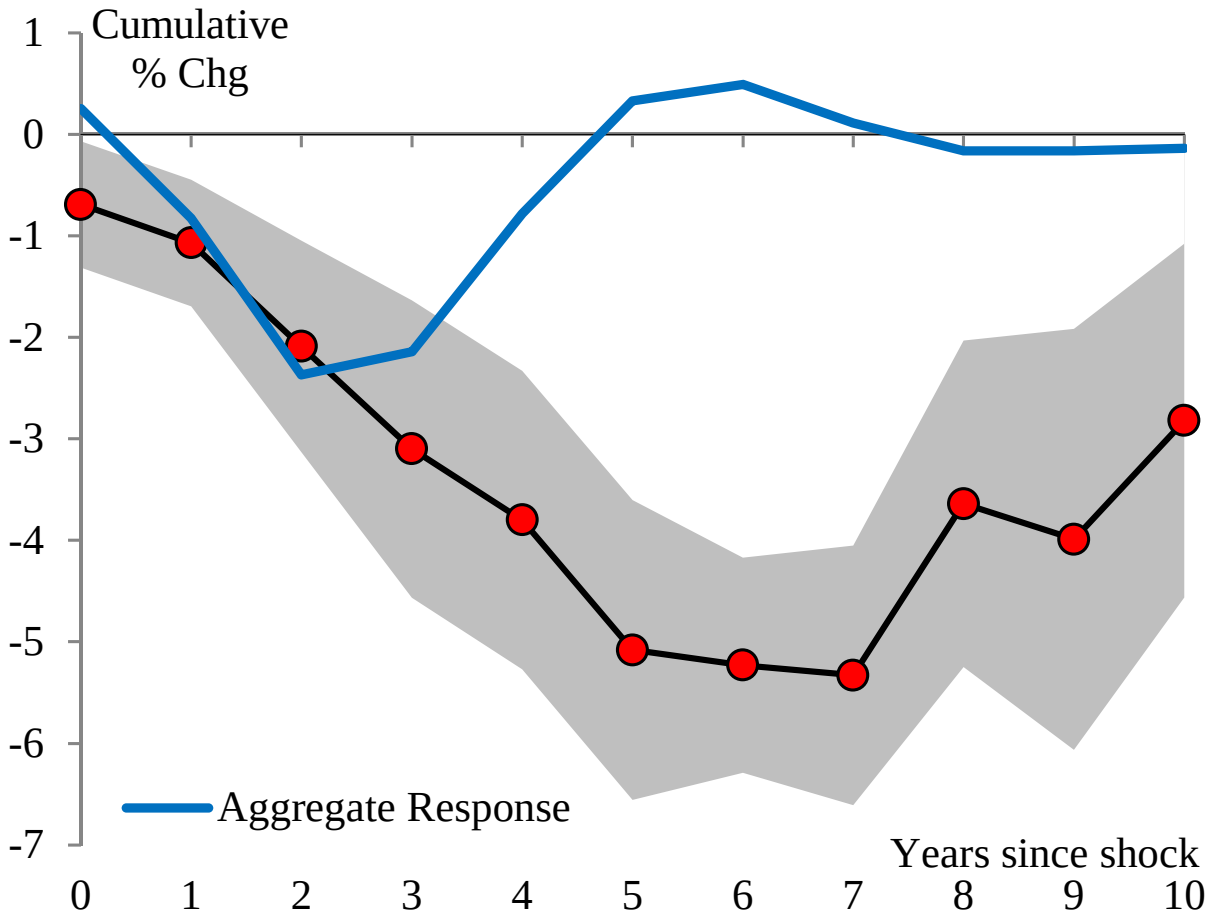
- t is an index of time denoting firm account years (we ignore observations where firms have irregular filing periods).
- m denotes months over a firm's account year $=> \sum_{m=1}^{12} w_m e_{m,t}$ is the weighted sum of monetary shocks over the accounting year.
  - We show $w_m = 1$, results robust to other weights.
- **Inference:**
  - multiway clustering to account for overlapping time windows.
  - plus cluster at the industry level.

Employment Responses: 1sd annual contractionary shock



Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock. Black dotted lines are point estimates. Grey shaded areas are 90% confidence intervals constructed from a t_{G-1} distribution where G is the minimum of clusters in the regression. The dependent variable is the cumulative growth rate in log points of employment from $t-1$ to $t+h$ where t is the date of the monetary policy shock and h is the x-axis. Sample is 105,610 unique UK firms over the period 1990-2015 (at $h=0$ zero this corresponds to 467,816 firm-year observations).

Employment Responses: 1sd annual contractionary shock



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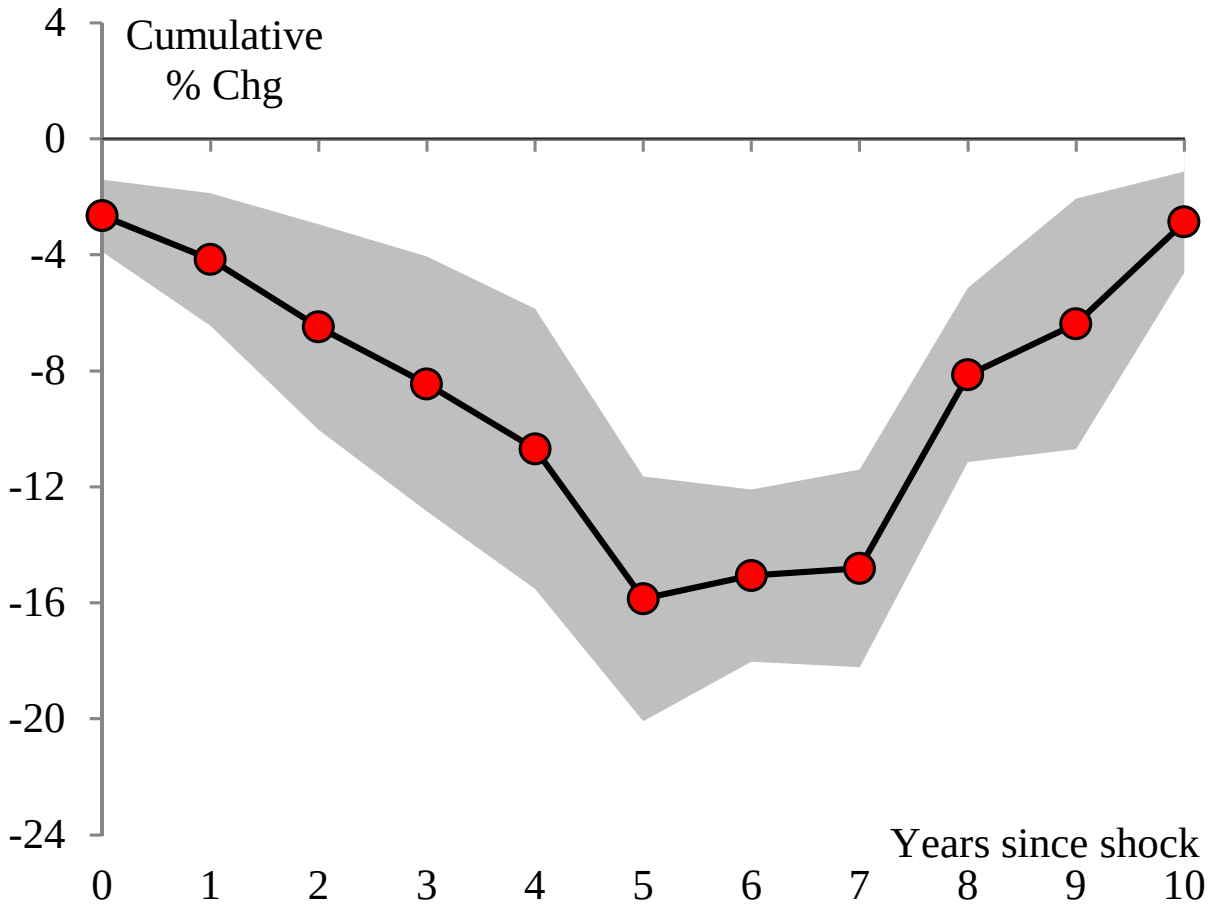
Total Asset Responses: 1sd annual contractionary shock



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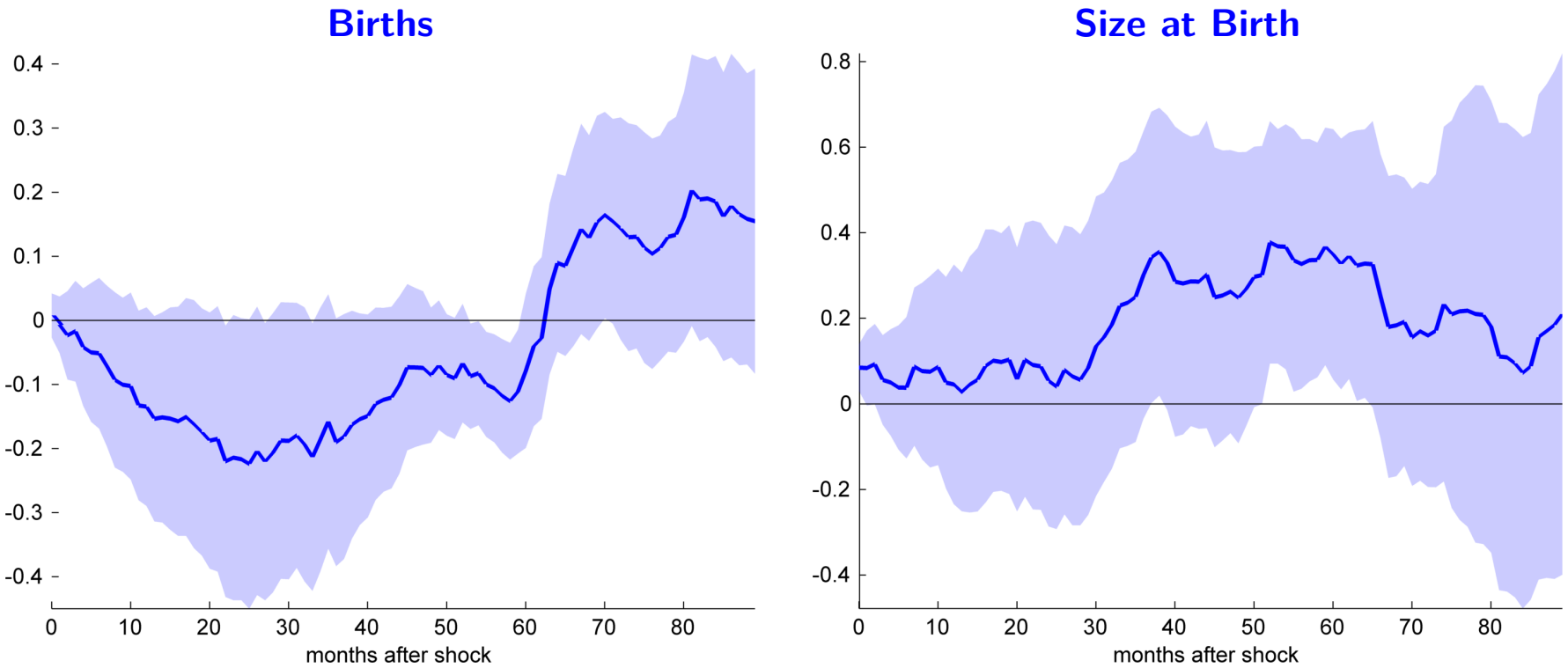
Robustness

- Alternative Estimators
- Alternative Specifications
- Alternative Instruments
- Monte Carlo Study

Reconciling the evidence



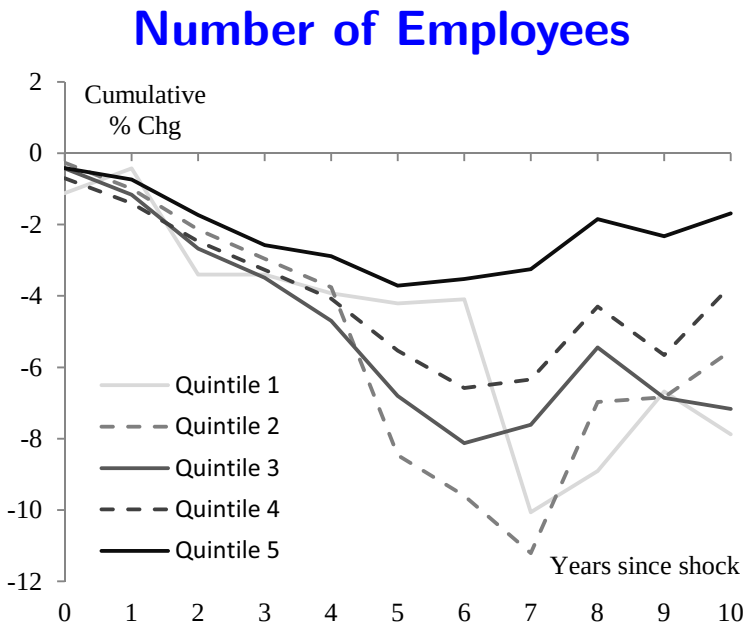
Notes: Aggregate responses to a 1 standard deviation monthly monetary policy shock. Local projections estimated using UK monthly data 1998-2014. Blue solid line is the point estimate, shaded areas are 90% confidence intervals constructed from a HAC adjusted standard errors. *Left panel:* log change in incorporations of new enterprises from $t-1$ to $t+h$ where t is the date of the monetary policy shock. *Right panel:* average birth size measured as real total assets.

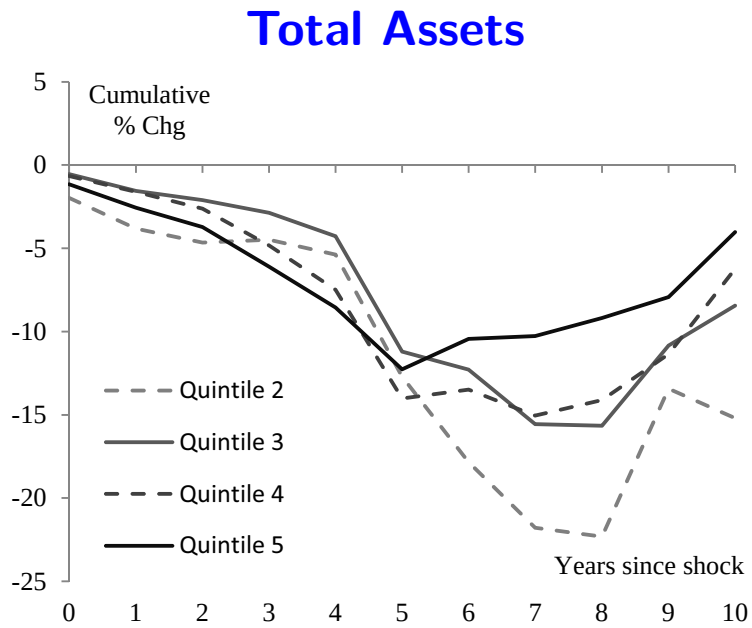
Which incumbents repond?

- If new entrants generate the recovery, useful to ask which incumbents are most sensitive in the first place.
- Subject of debate:
  - Small versus large firms. Gertler and Gilchrist [1994],Moscarini and Postel-Vinay, 2012, Chari et al., 2013, Kudlyak and Sanchez, 2017.
  - Young versus old firms. Fort et al. [2013]
- First condition on quintiles of the age and size distribution.
- Then do the double sort.

Quintile Values

The effect of age

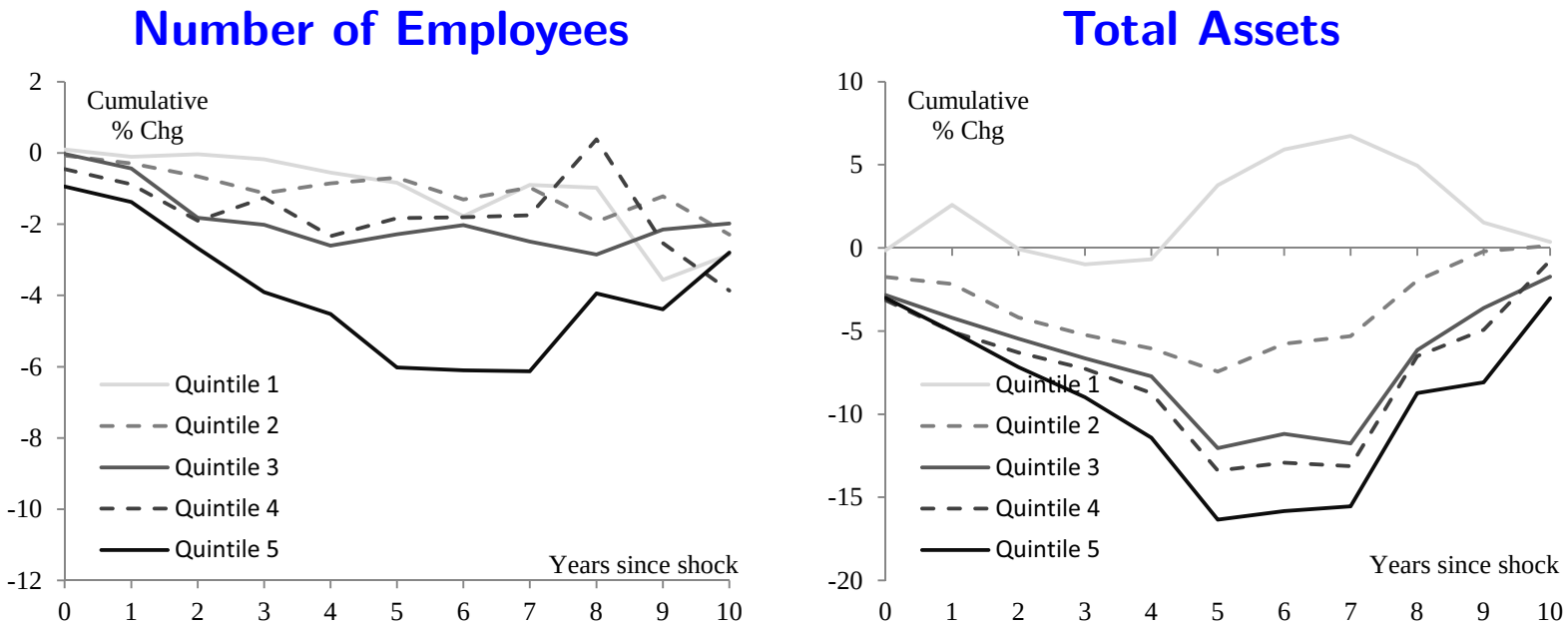




Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock. point estimates for response for firms in the five different portions of the age distribution (when the shock hit).

oldest vs youngest quintiles

The effect of size

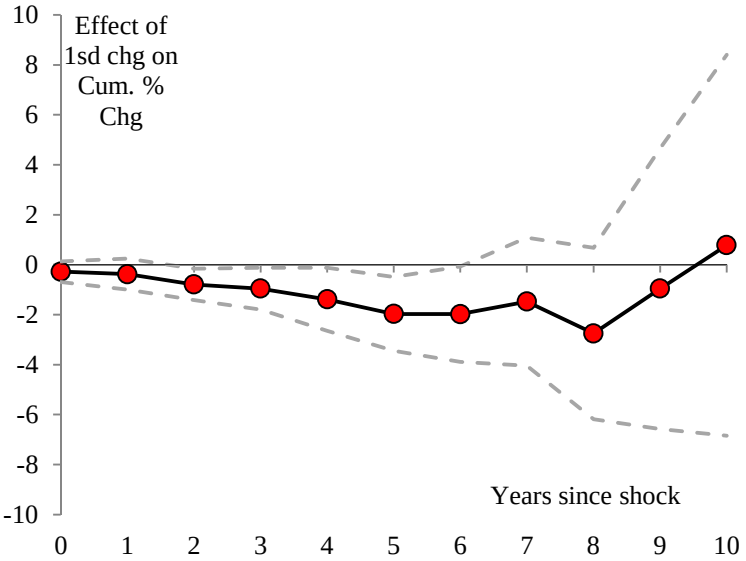


Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock.Point estimates for response for firms in the five different portions of the size distribution (when the shock hit).

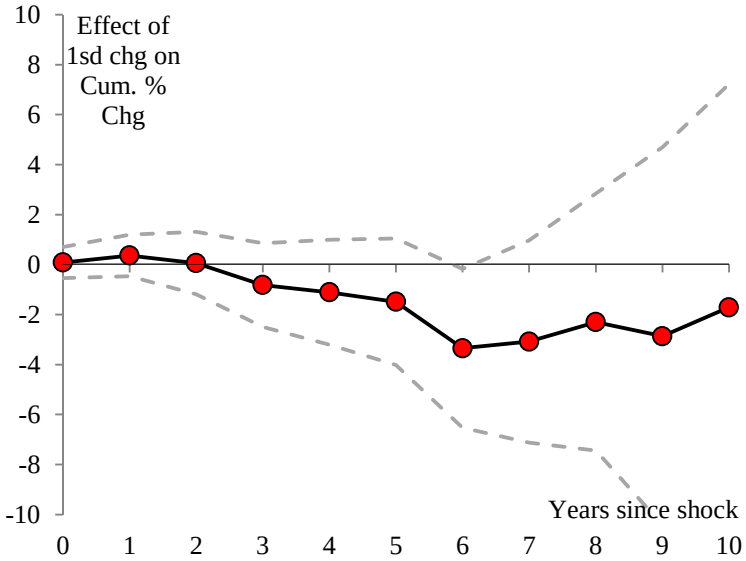
smallest vs largest quintiles

Double Sort: Size and Age I

Small, Young firms



Small, Old firms



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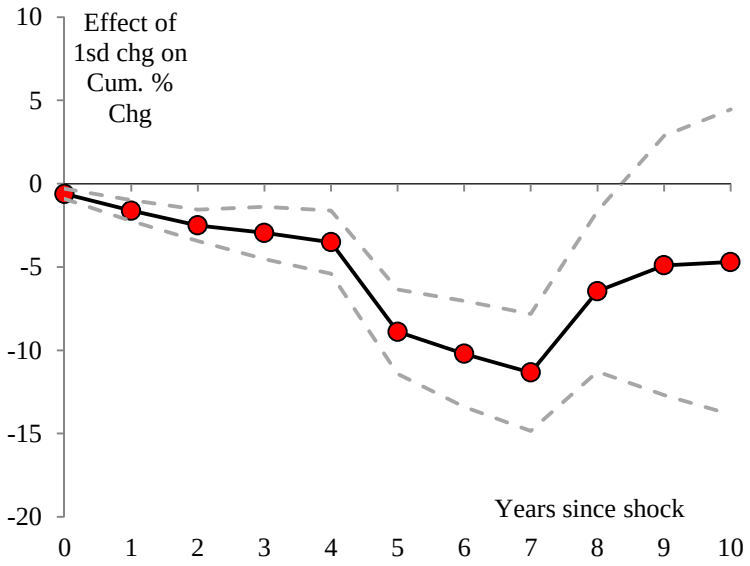
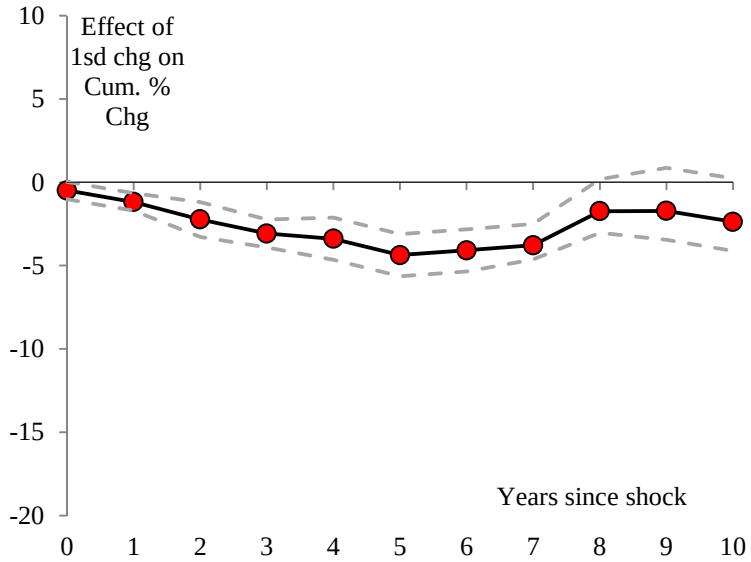
frequency table

Double Sort: Size and Age II

Large, Young Firms



Large, Old Firms



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frequency table

Conclusions

- Provided novel empirical evidence on the impact of monetary policy shocks.
- Monetary policy has far more persistent effects on individual firms than on the aggregate.
- Behaviour of entrants can reconcile this.
- Large, new entrants more vulnerable.

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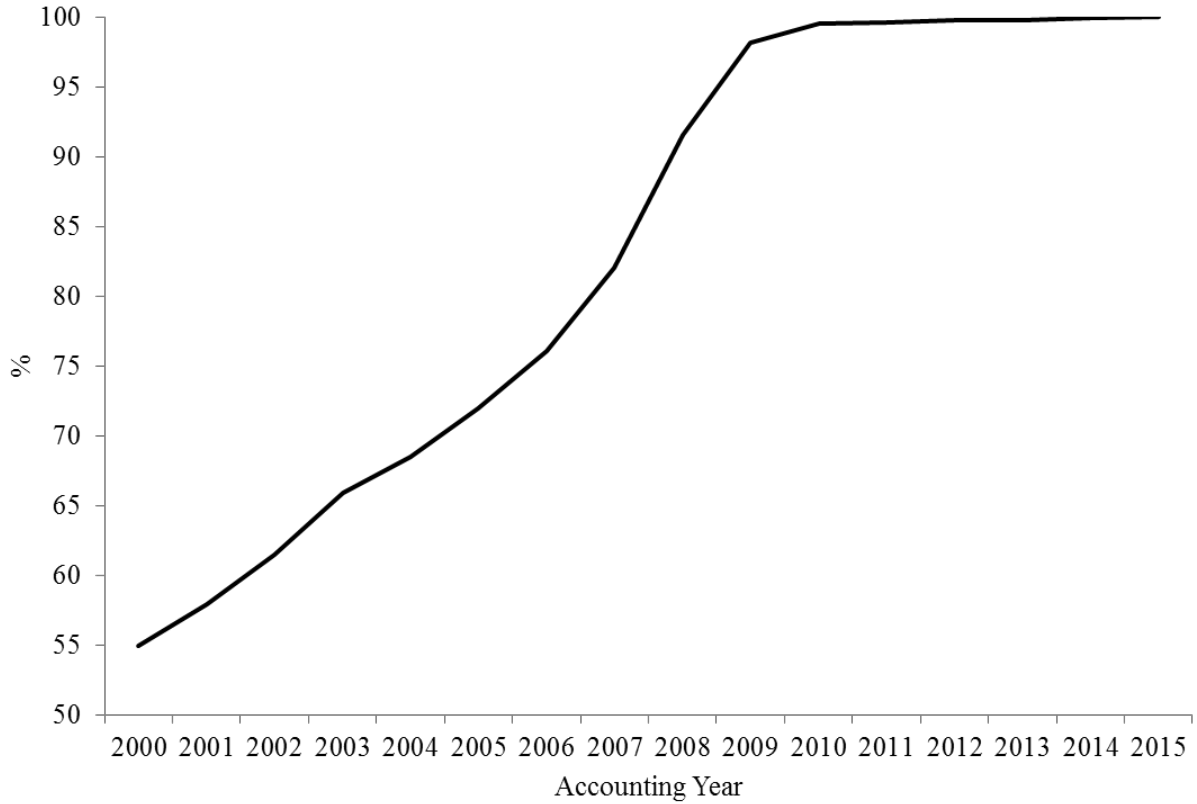
Appendix Material

Illustrating the Selection Effect

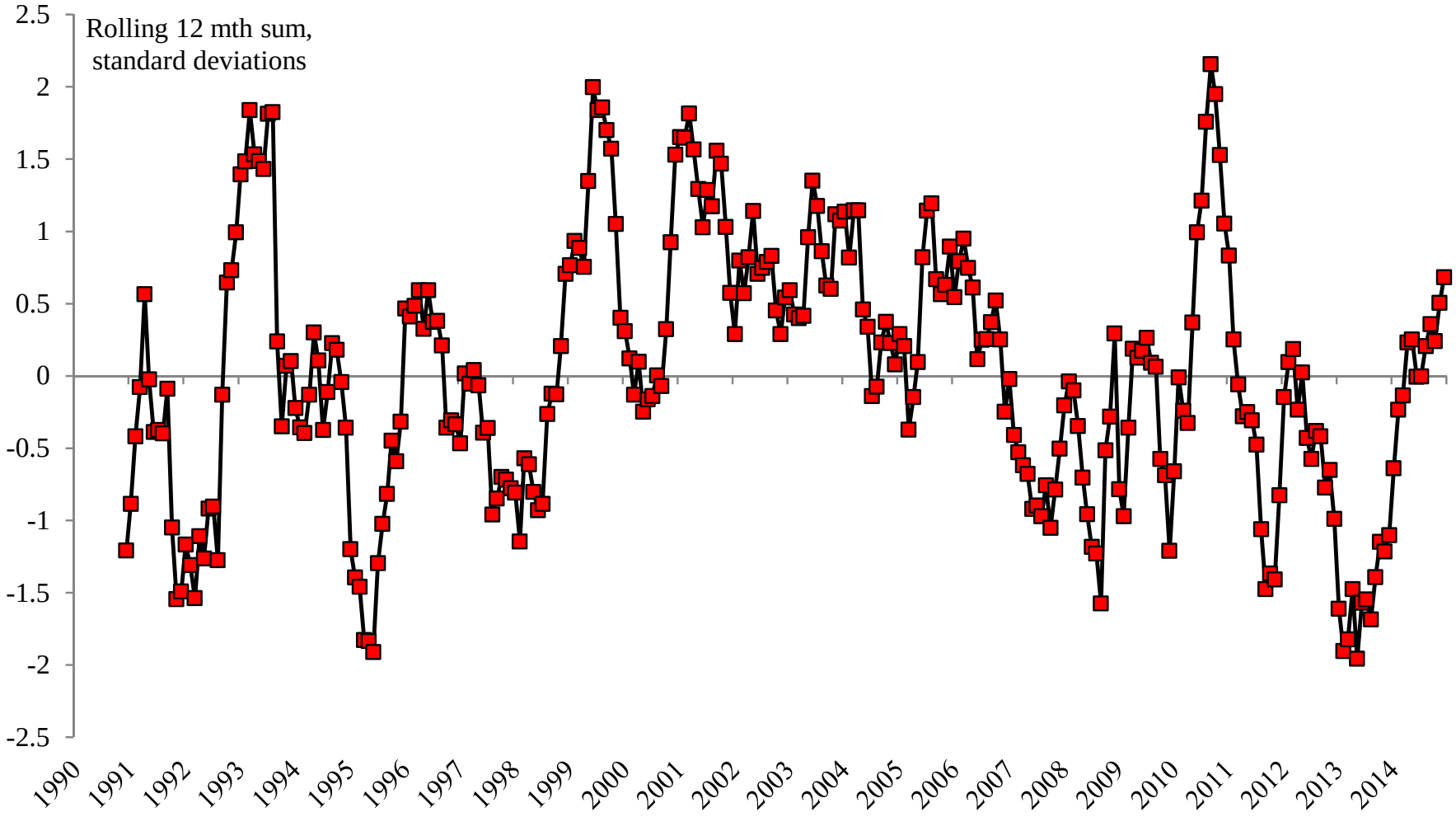
Fraction of Companies Present in August 2015 Vintage



Notes: the figure displays the proportion of companies in each statement year, as derived from the full panel of 21 discs, that are present in the August 2015 disc.

back

Series put through the VAR

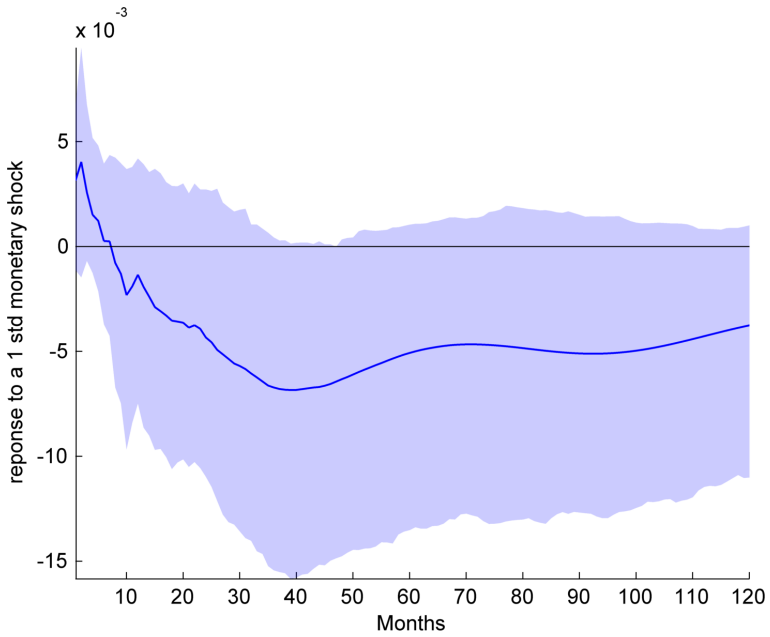


back

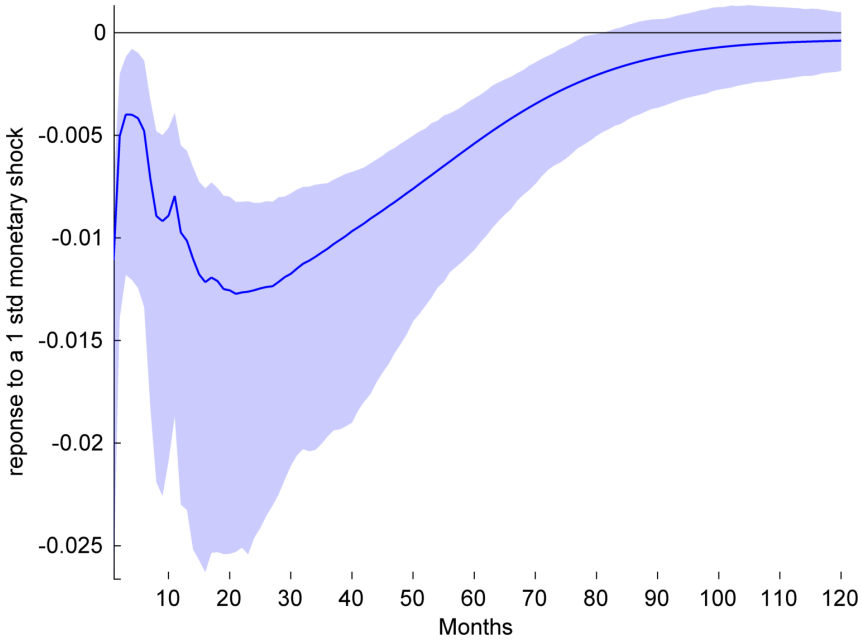
Aggregate Responses

1sd monthly contractionary shock

Retail Prices



Manufacturing Output



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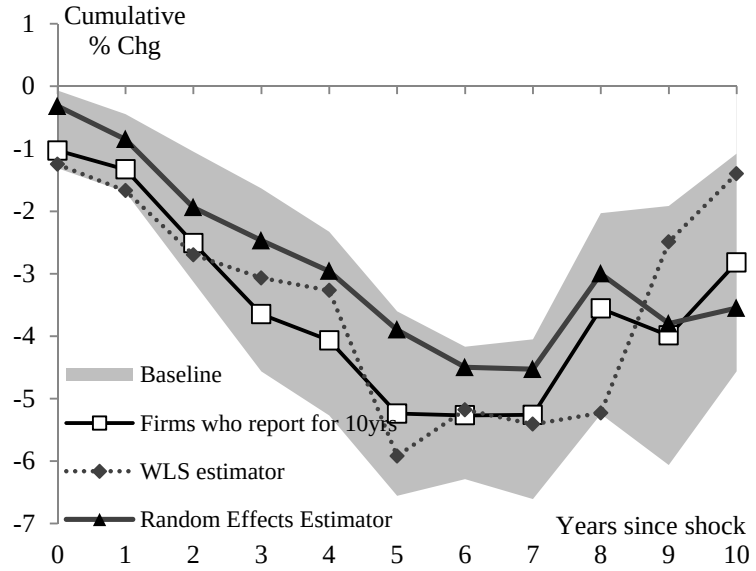
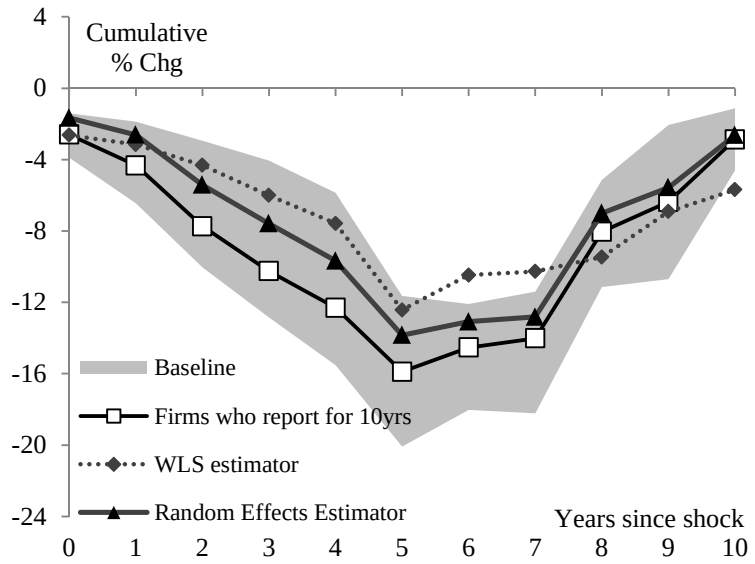
back

Alternative Estimators

Number of Employees



Total Assets

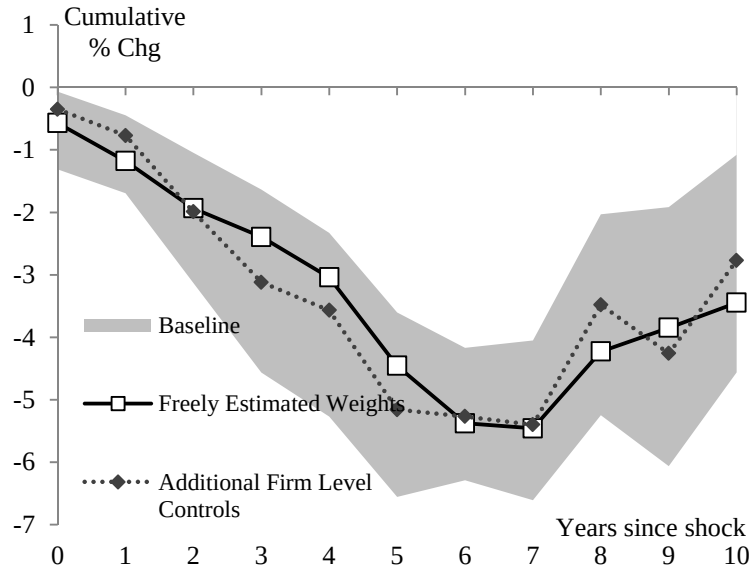


Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock. Grey shaded areas are 90% confidence intervals from our baseline specification constructed from a t_{G-1} distribution where G is the minimum of clusters in the regression. Black solid lines with square markers are point estimates from a sample where we only include firms who report for 10 years, (ii) black dashed lines with diamond markers are point estimates when we weight our baseline regression model by initial *number of employees* left panel or initial *total assets* right panel, and (iii) black solid lines with triangular markers are point estimates from where we estimate our baseline regressions using a random effects estimator. *Left panel:* The dependent variable is the cumulative growth rate in log points of employment from $t-1$ to $t+h$ where t is the date of the monetary policy shock and h is the x-axis. *Right panel:* The dependent variable is the cumulative growth rate in log points of in real total assets from $t-1$ to $t+h$ where t is the date of the monetary policy shock and h is the x-axis.

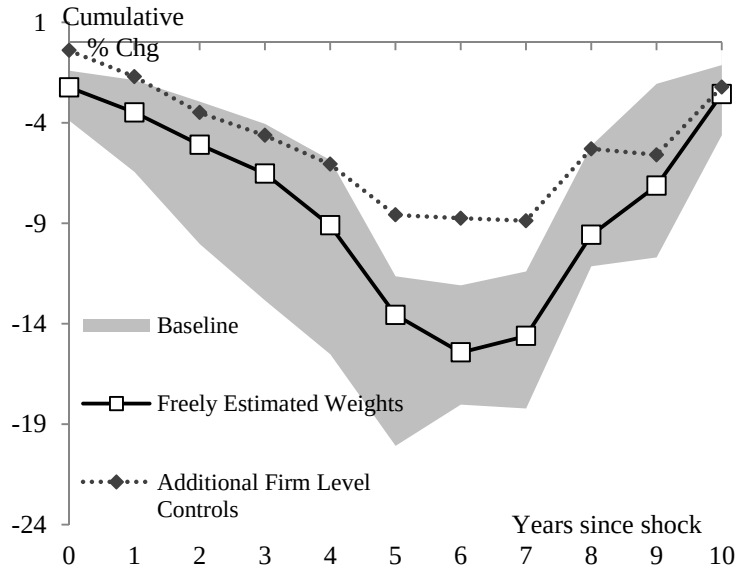
back

Alternative Specifications

Number of Employees



Total Assets



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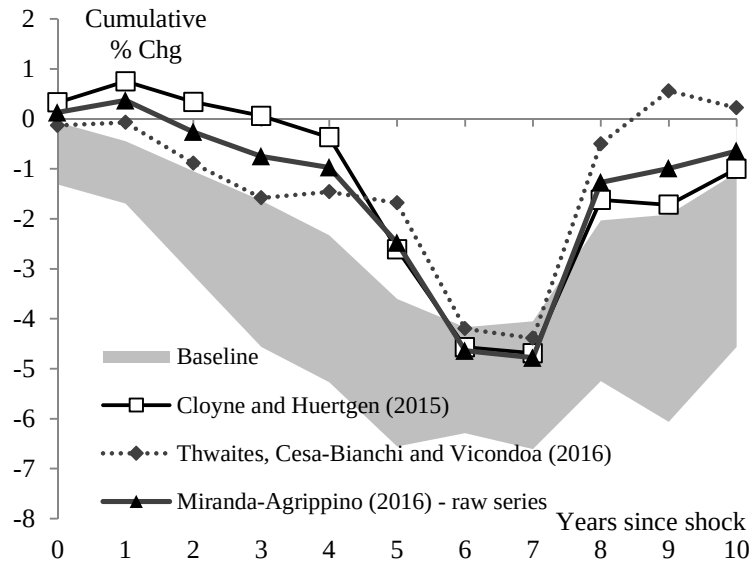
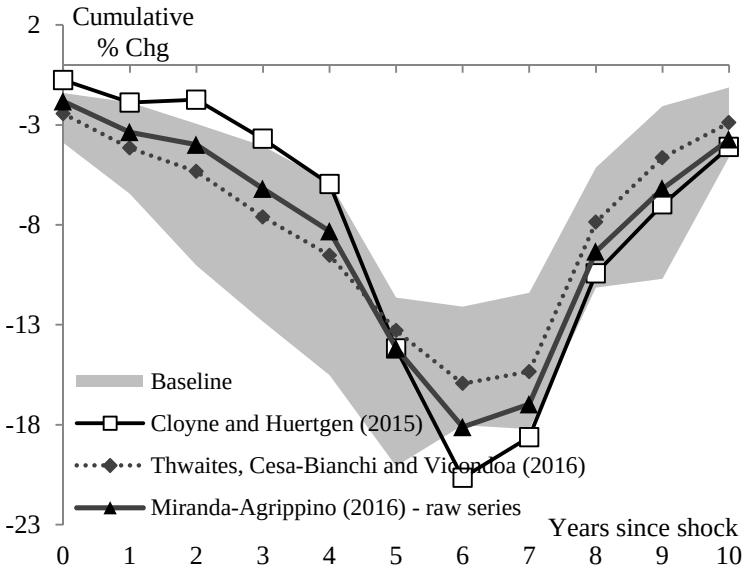
back

Alternative Instruments

Number of Employees



Total Assets



Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock. Grey shaded areas are 90% confidence intervals from our baseline specification constructed from a t_{G-1} distribution where G is the minimum of clusters in the regression. Black solid lines with square markers are point estimates from a model where we identify monetary policy using the Cloyne and Hurtgen [2016] monetary policy series. Black dashed lines with diamond markers monetary policy identified using Cesa-Bianchi et al. [2016]. Black dashed lines with diamond markers monetary policy identified using Cesa-Bianchi et al. [2016]. Black solid lines with triangular markers are point estimates from where we estimate our baseline regressions using a random effects estimator.

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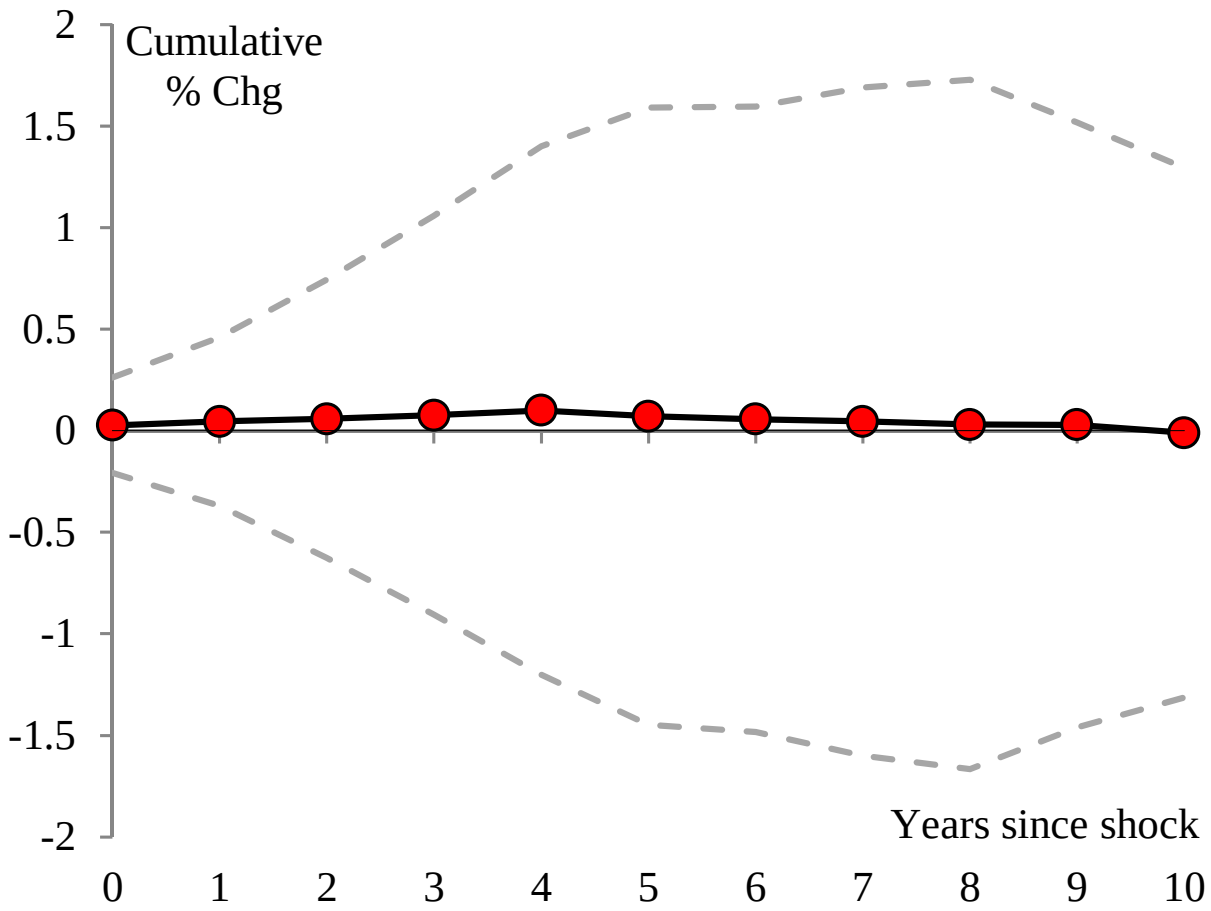
Monte Carlo



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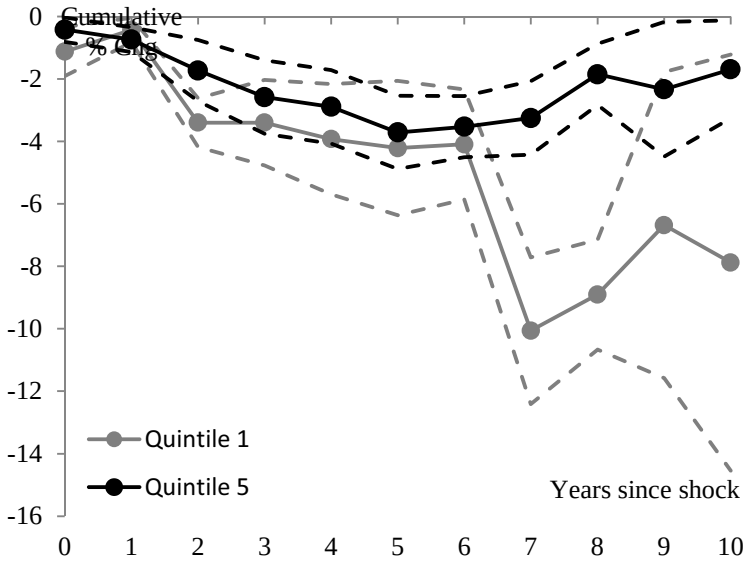
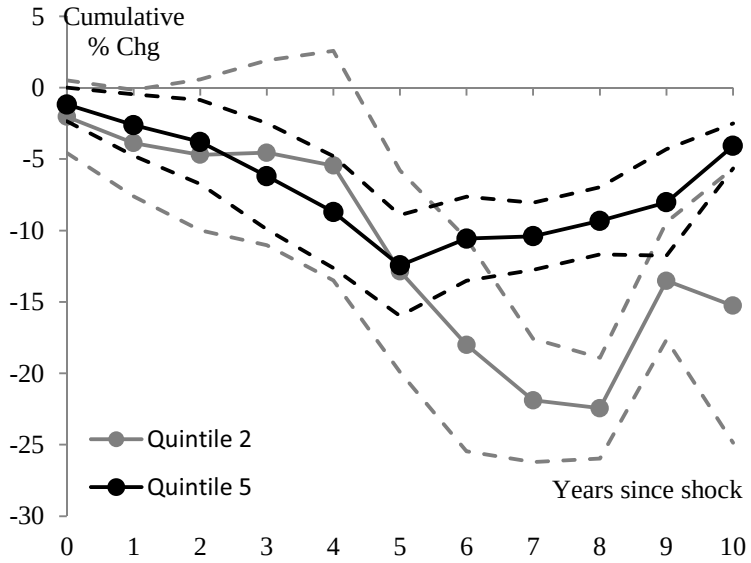
The effect of age: Oldest vs Youngest Firms

Number of Employees



Total Assets



Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock.Comparing oldest and youngest quintile. Dash lines enclose 90% confidence intervals constructed from a t_{G-1} distribution where G is the minimum of clusters in the regression.

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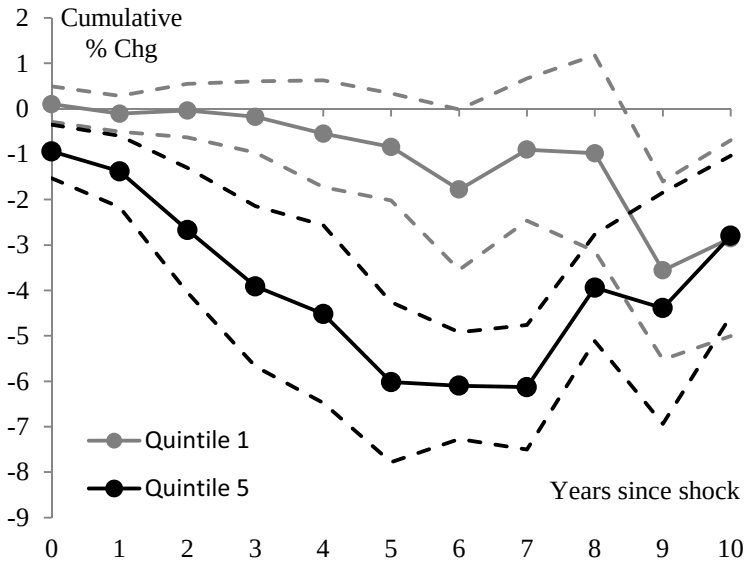
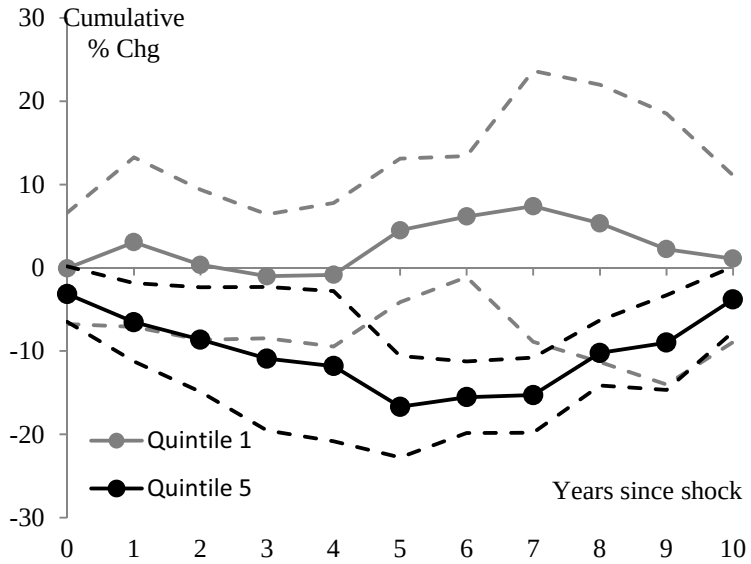
The effect of size: Smallest vs Largest Firms

Number of Employees



Total Assets



Notes: Firm level responses to a 1 standard deviation contractionary monetary policy shock. Comparing largest and smallest quintile.

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Quintiles

	Sample I: Employment		Sample II: Total Assets	
	Size (assets £'000s)	Age (months)	Size (assets £'000s)	Age (months)
Q1	77	42	11	36
Q2	1109	75	33	63
Q3	3677	117	92	107
Q4	8986	201	320	188

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Double Sort: Frequency Table

	young	old
small	20.1%	3.5%
large	5.1%	6.5%

total observations=1,451,978

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Measuring Productivity

Measure I: Labour productivity $A_{i,t}$ defined as:

$$A_{i,t} = \frac{Y_{i,t}}{L_{i,t}}, \tag{2.1}$$

where $Y_{i,t}$ is real value-added of firm i at time t, and $L_{i,t}$ is the number of workers employed by firm i. We deflate with 2-digit SIC code level value-added price deflators. **Measure II:** Total factor productivity $TFP_{i,t}$: We follow Wooldridge [2009], Gopinath et al. [2015]) in estimating the following Cobb-Douglas production function:

$$y_{i,t} = c_j + \alpha_j k_{i,t} + \beta_j l_{i,t} + \varepsilon_{i,t}, \tag{2.2}$$

- c_j is an industry FE, $y_{i,t}$ is log real value-added, $k_{i,t}$ is log of real fixed assets , $l_{i,t}$ is labour input is log wage bill.
- We estimate 2.2 with the IV method of Wooldridge [2009] to mitigate the endogeneity of input choices by using intermediate inputs as proxy variables for productivity. The log TFP measure for each firm-year observation is given by the residual $\varepsilon_{i,t}$ from 2.2.

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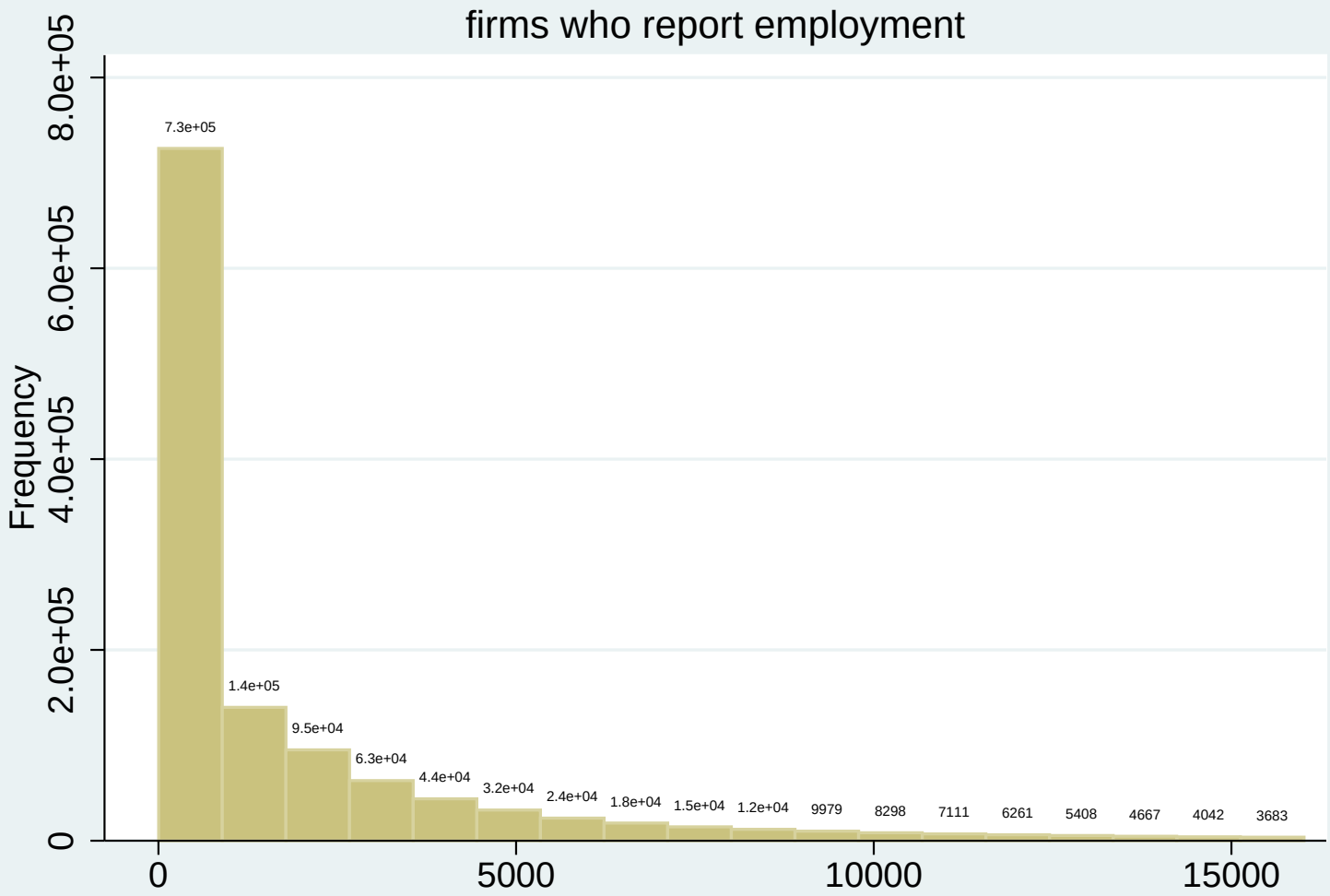
Histogram: Total Assets



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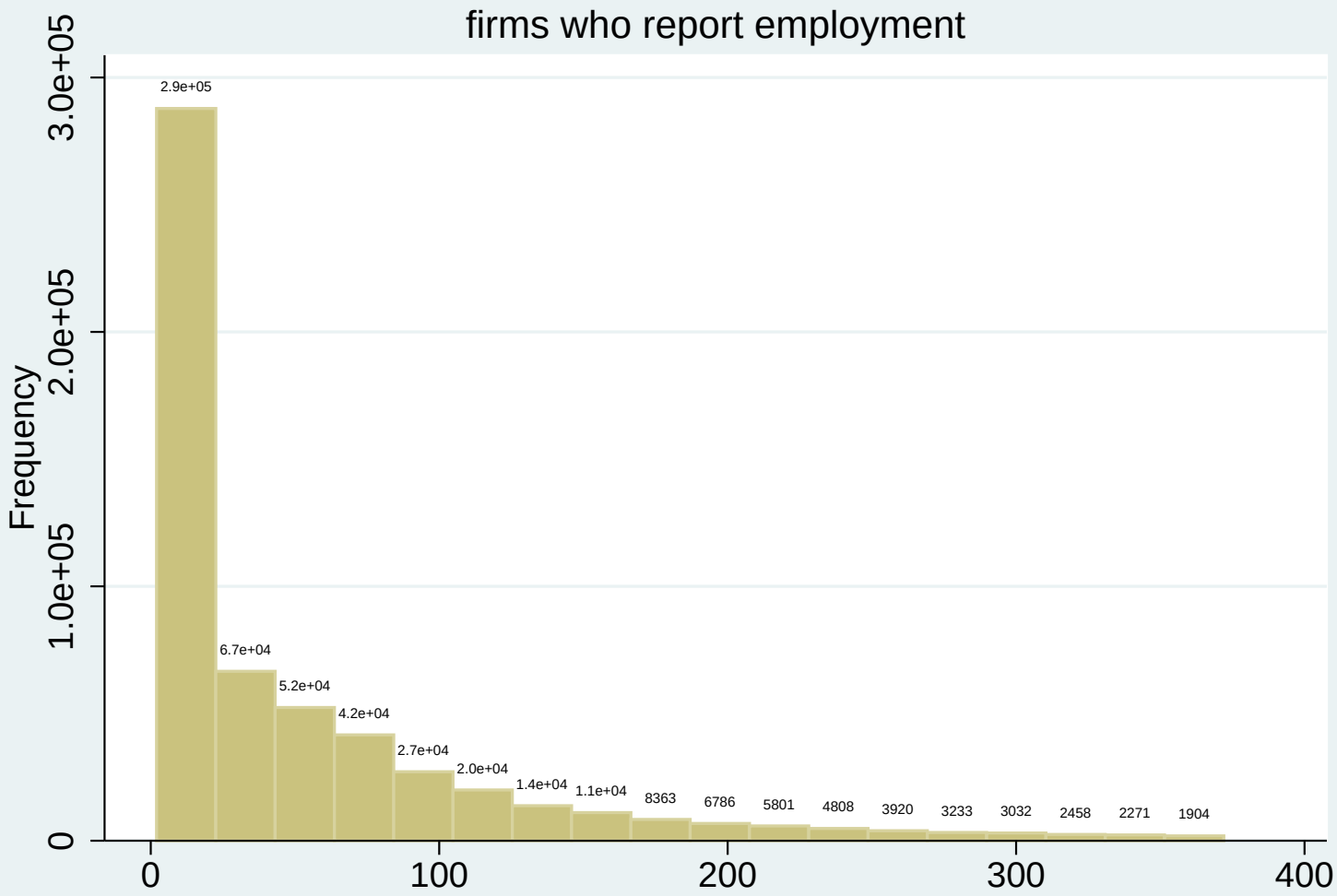
Histogram: Number of Employees



Notes: The data in this graph are truncated at 5% and 95% levels.

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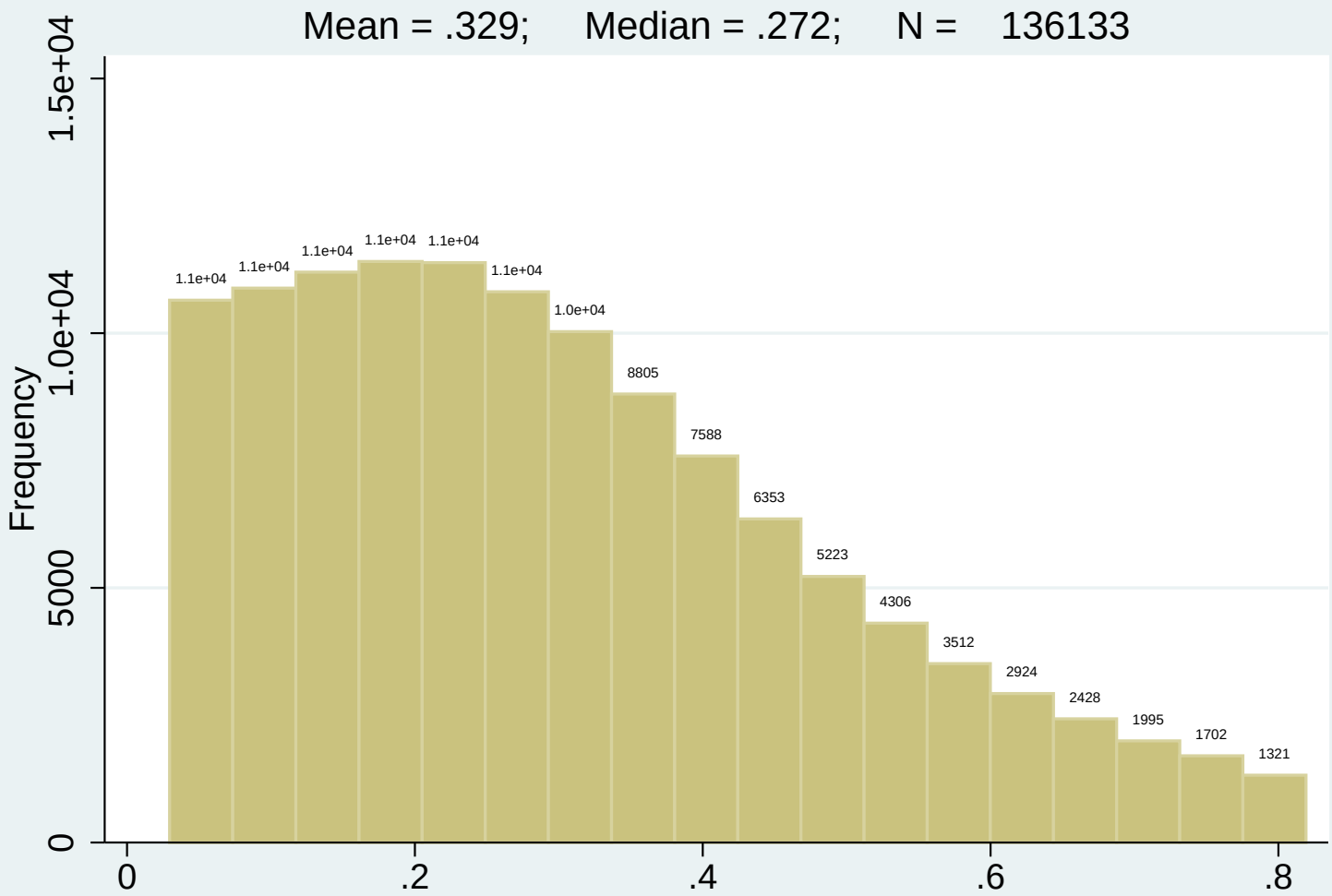
Histogram: Debt to Assets



Notes: The data in this graph are truncated at 5% and 95% levels.

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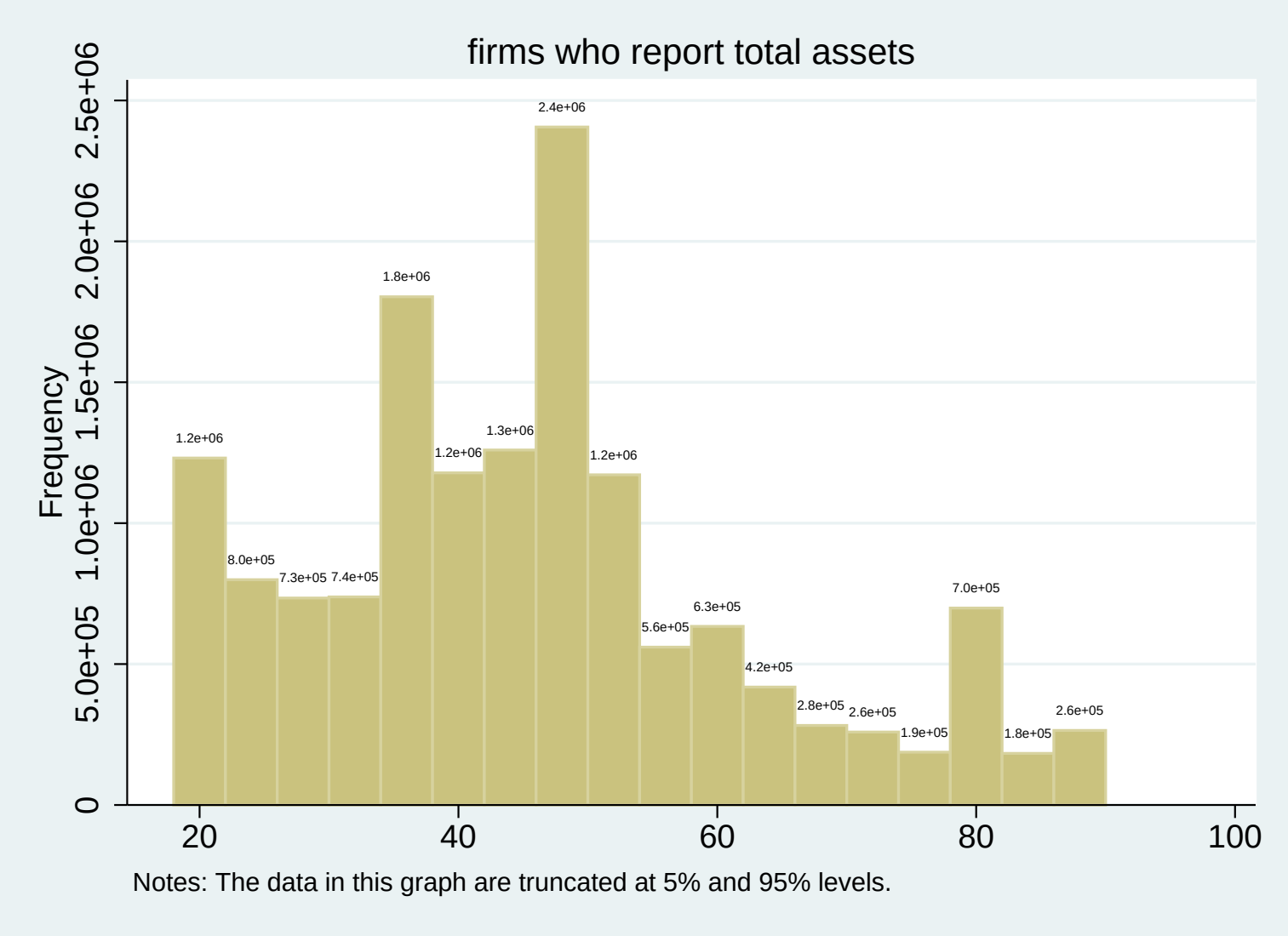
Histogram: Credit Score



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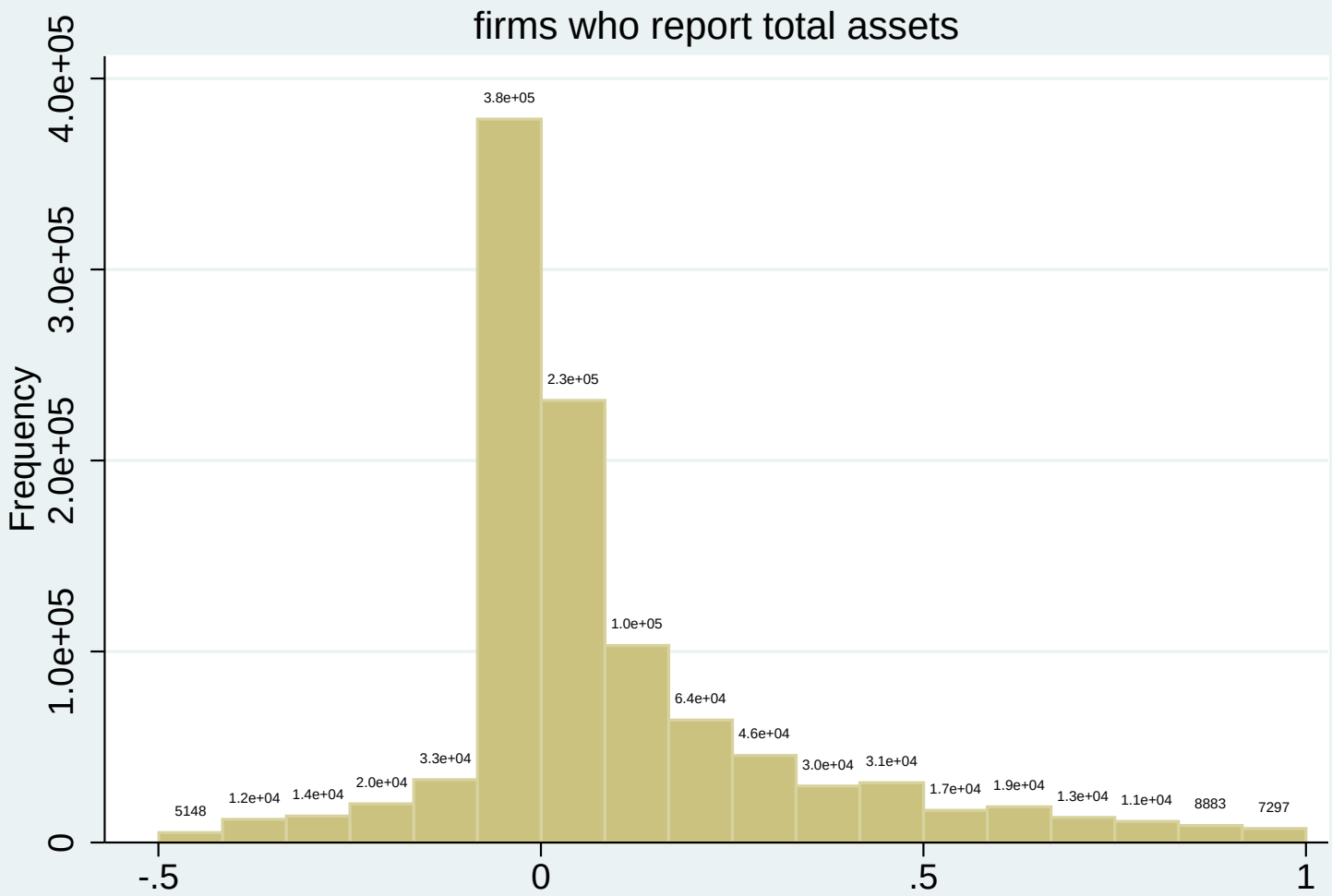
Histogram: Interest Coverage Ratio



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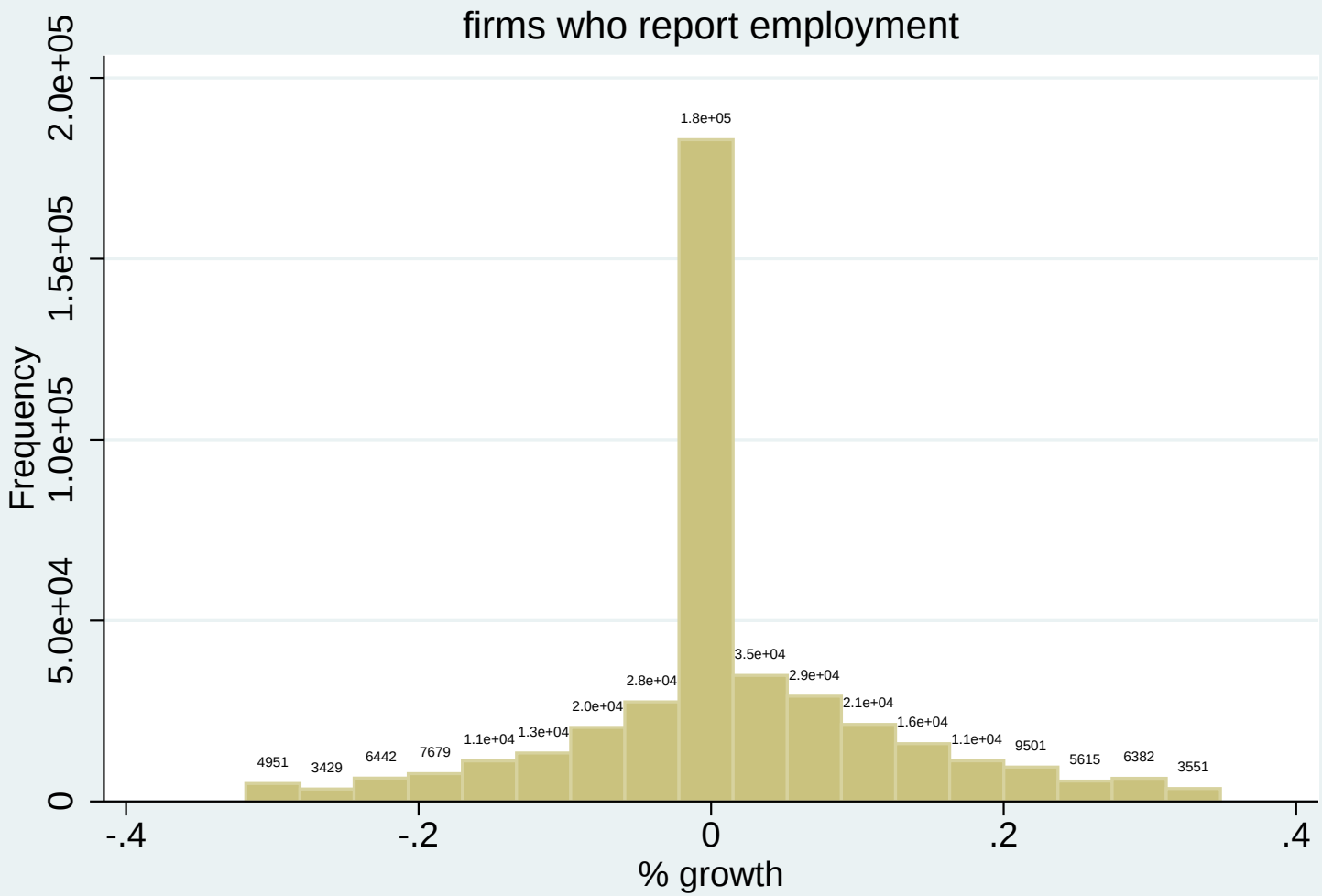
Histogram: Employment Growth 1-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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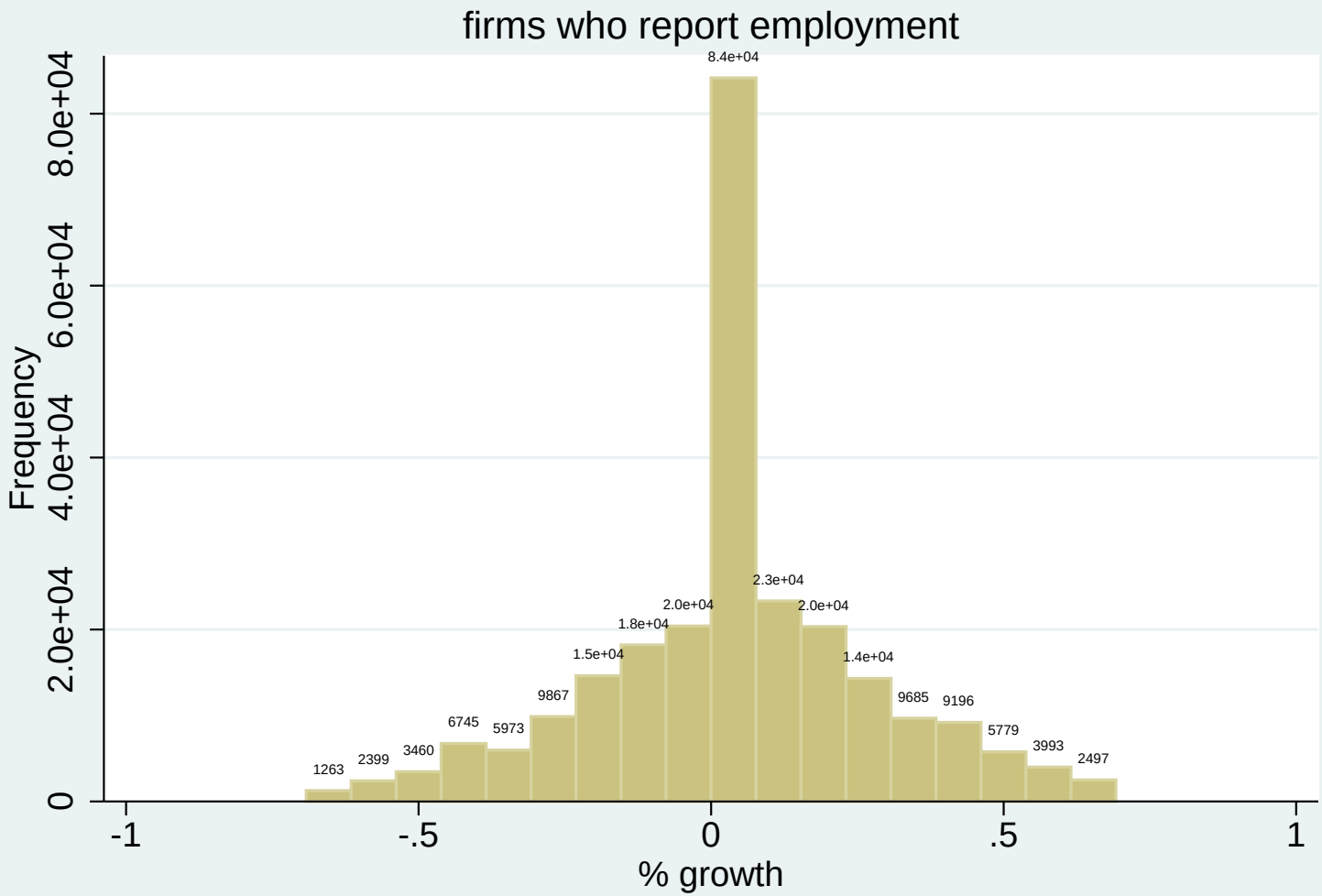
Histogram: Employment Growth 3-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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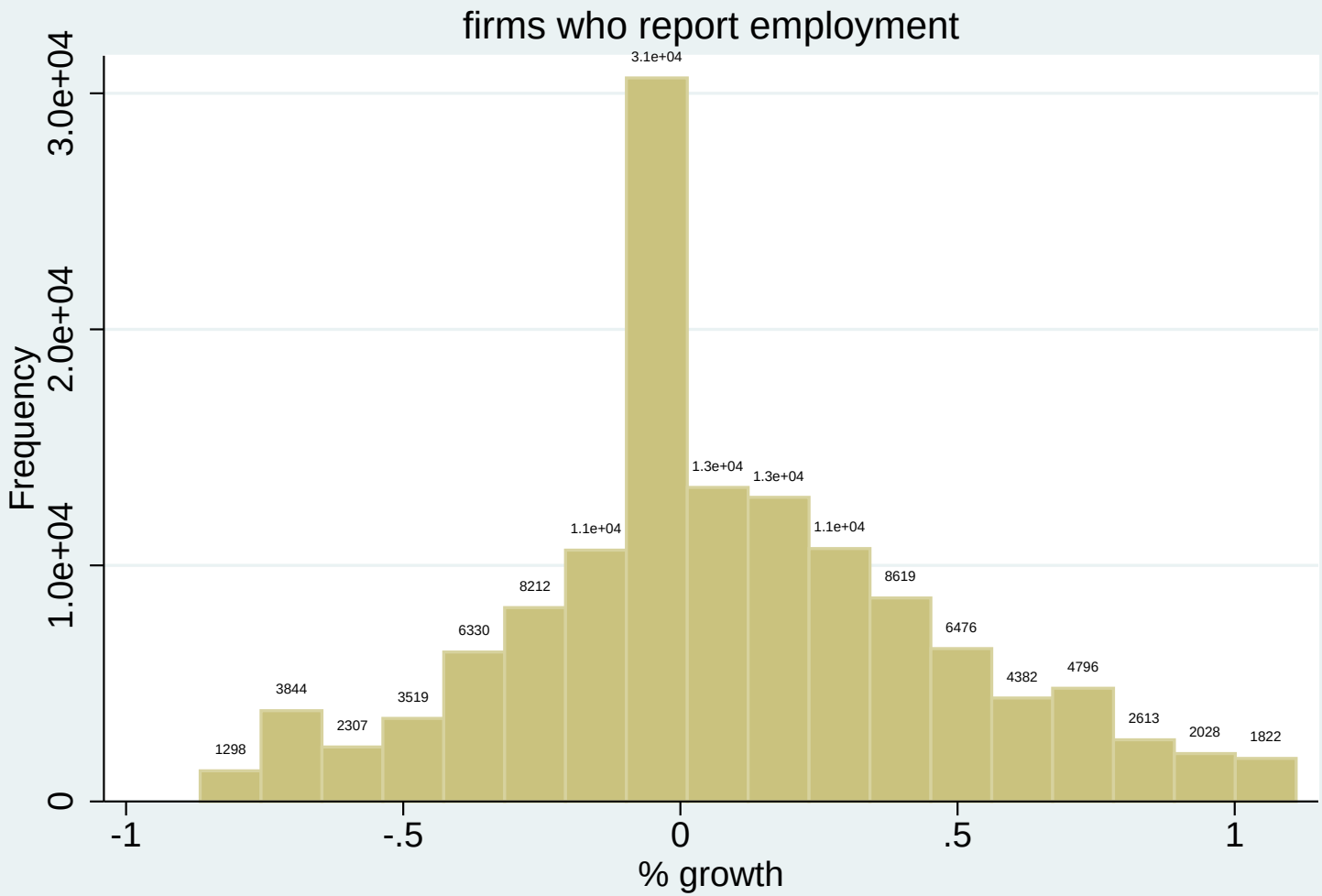
Histogram: Employment Growth 5-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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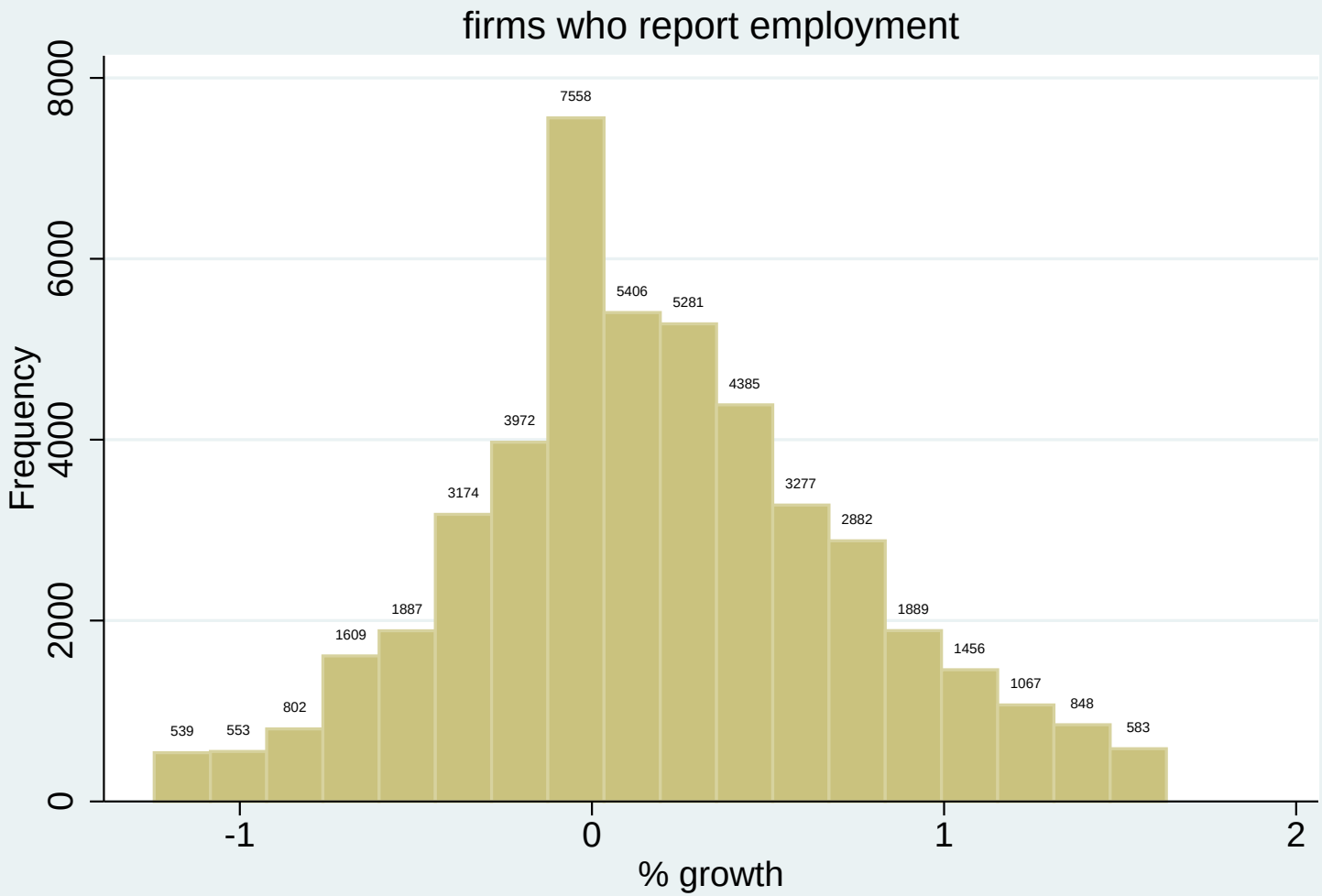
Histogram: Employment Growth 10-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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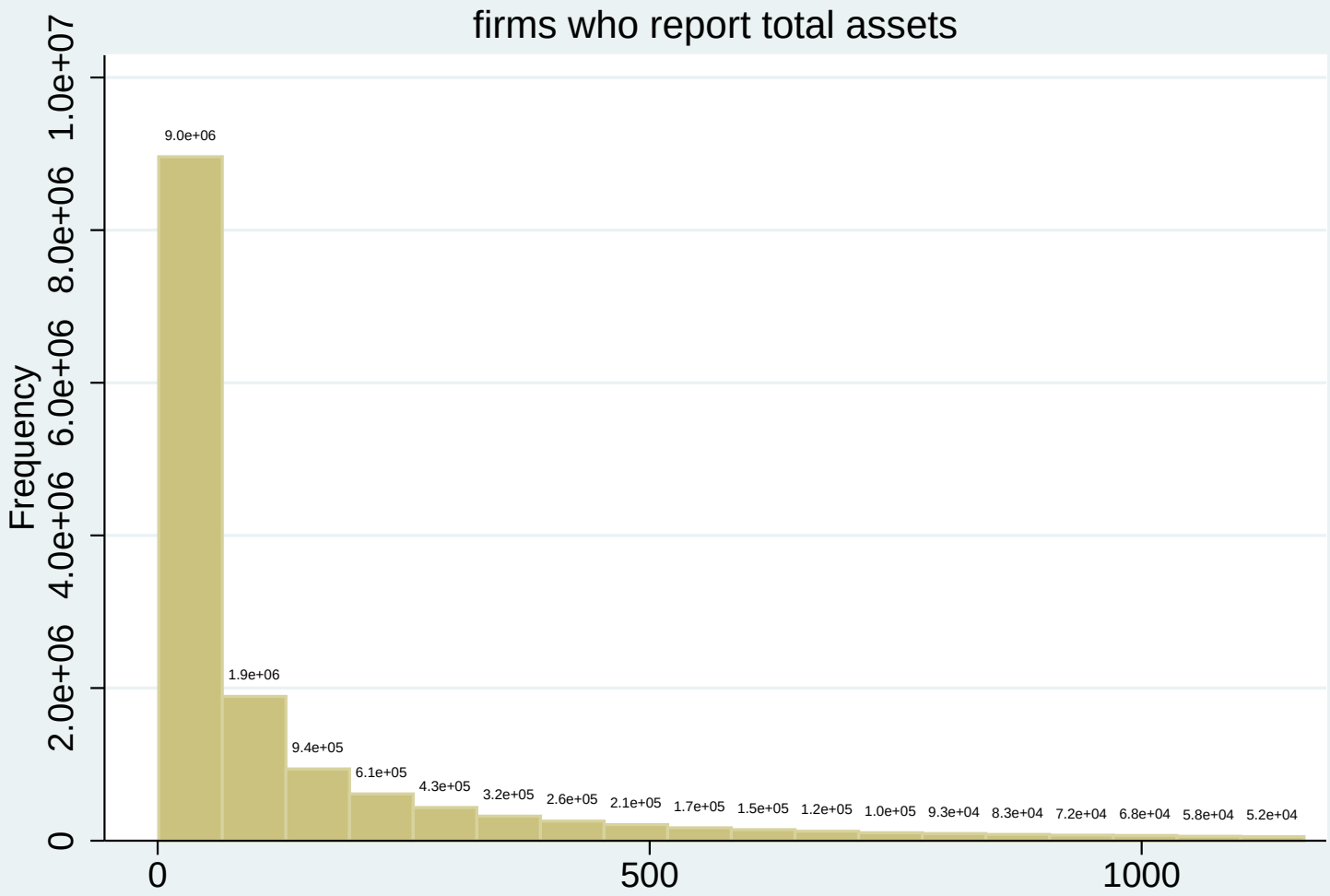
Histogram: Total Assets



Notes: The data in this graph are truncated at 5% and 95% levels.

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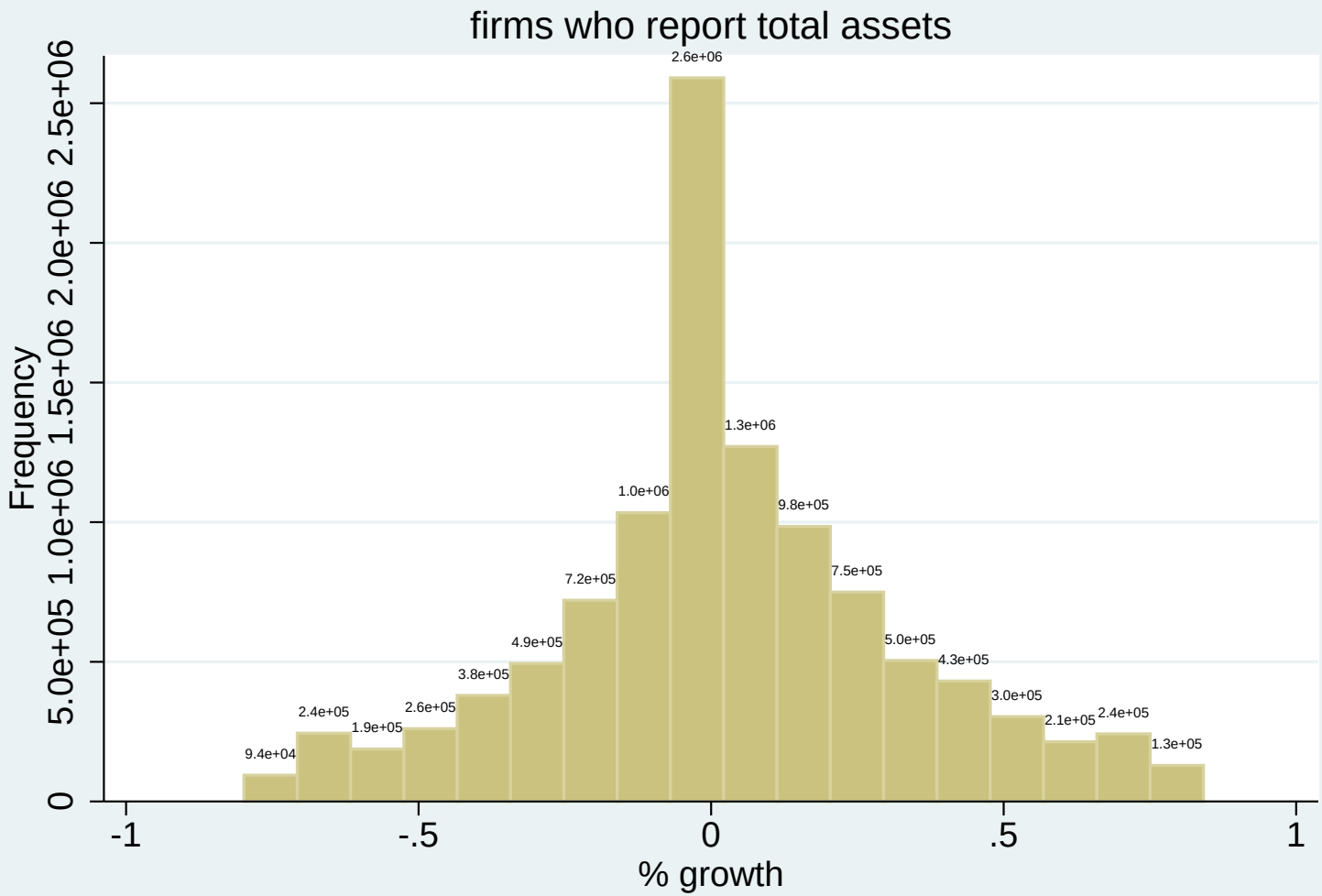
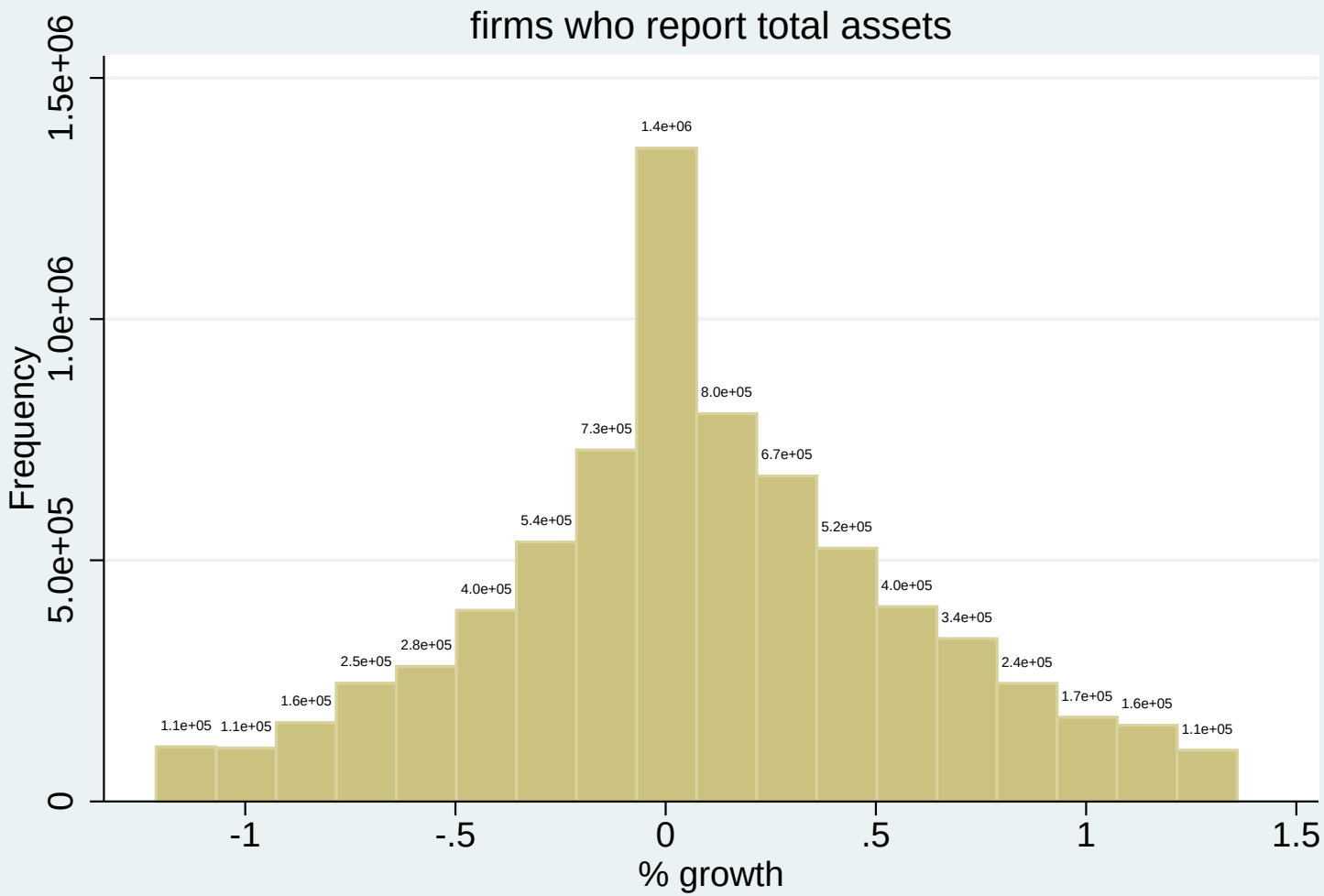
Histogram: Asset Growth 1-year



Notes: The data in this graph are truncated at 5% and 95% levels.

back

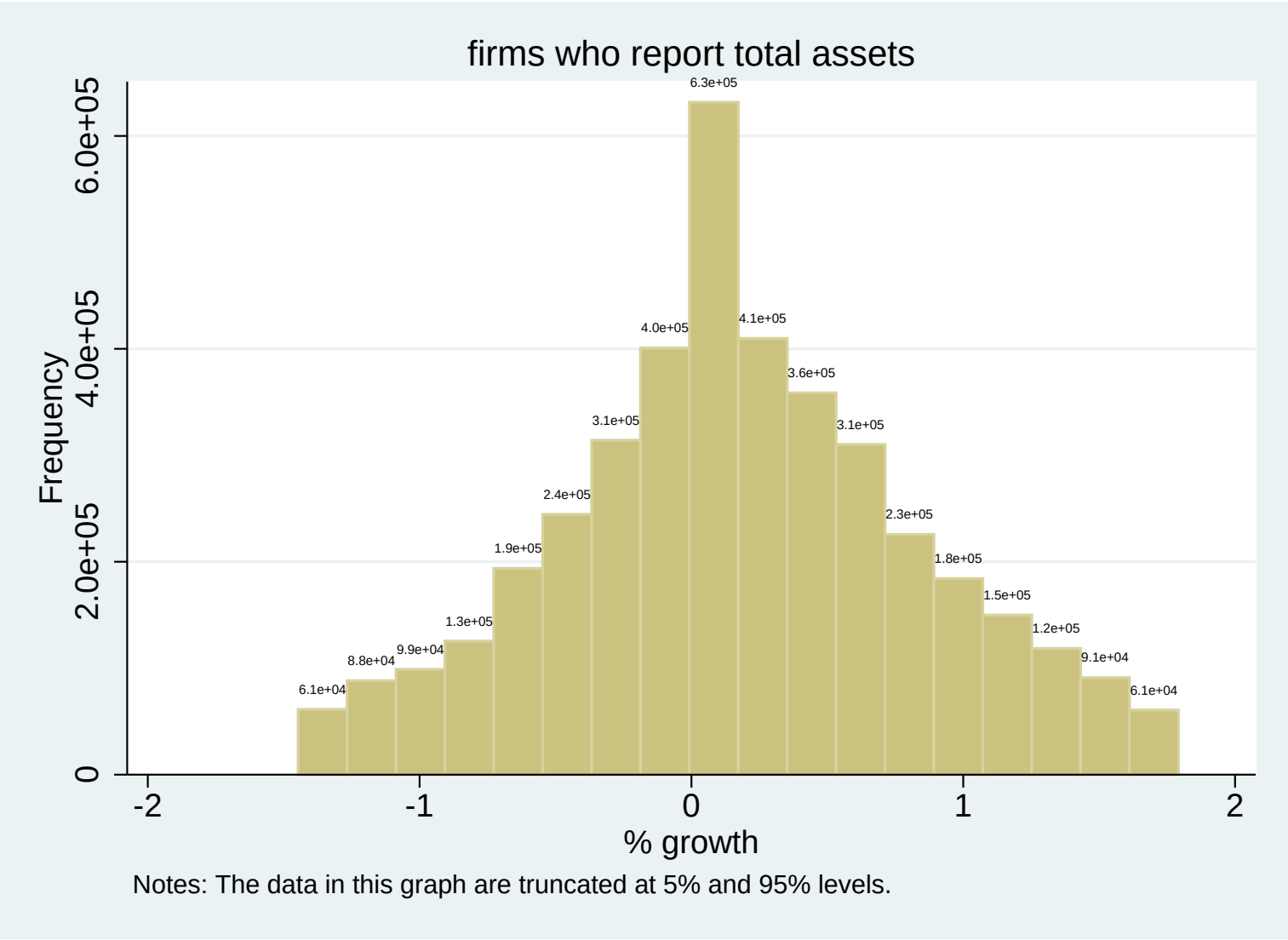
Histogram: Asset Growth 3-year



Notes: The data in this graph are truncated at 5% and 95% levels.

back

Histogram: Asset Growth 5-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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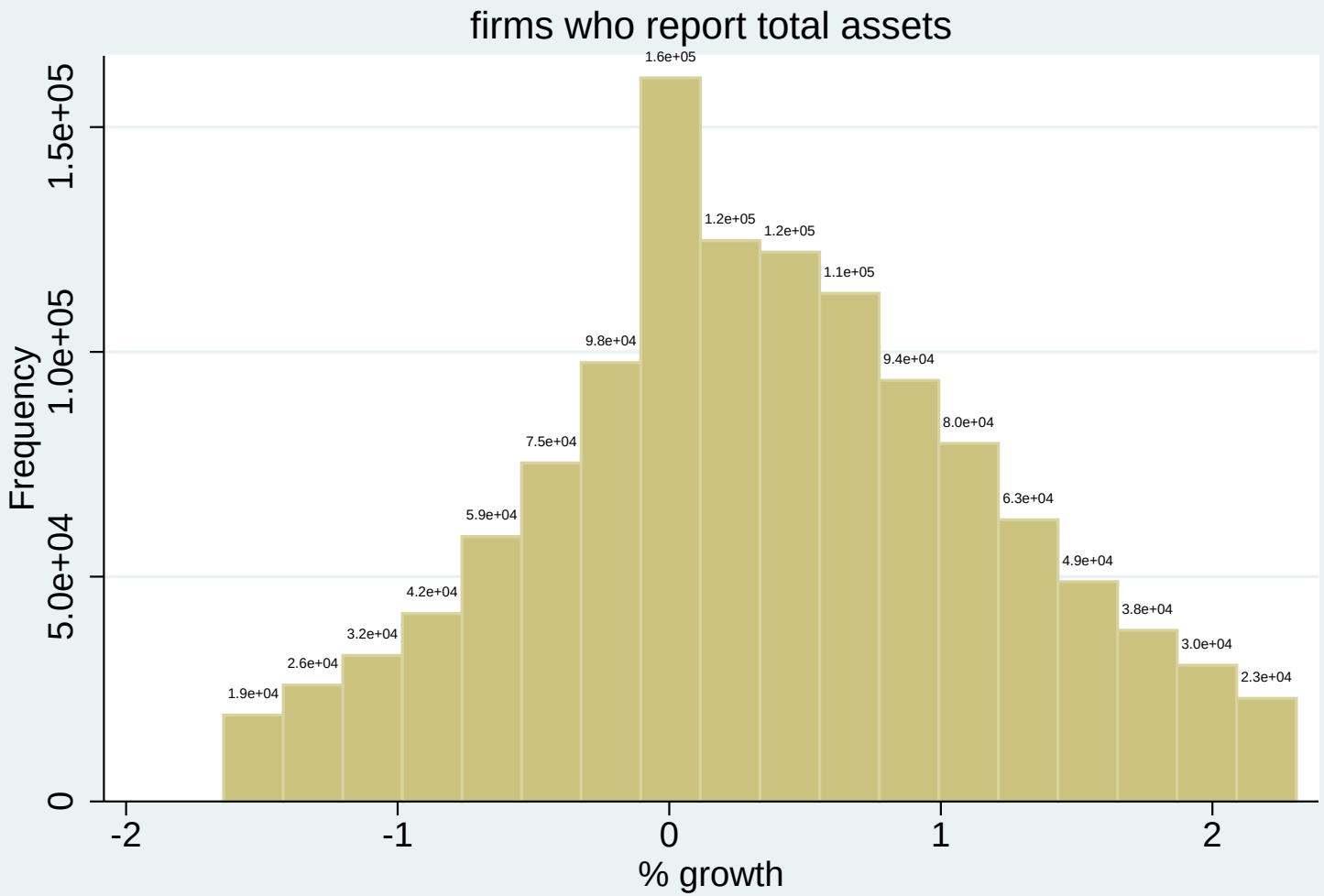
Histogram: Asset Growth 10-year



Notes: The data in this graph are truncated at 5% and 95% levels.

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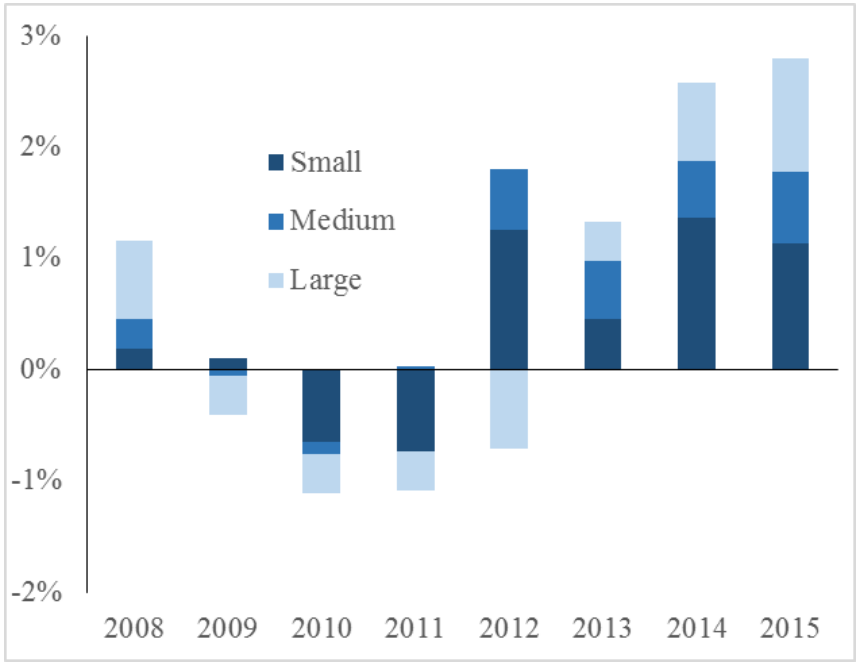
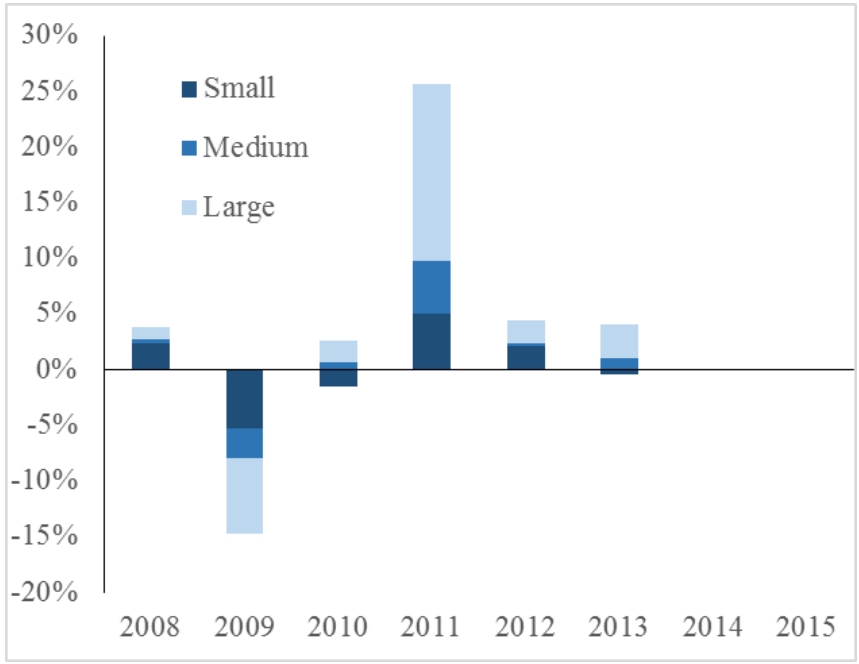
Are Small Firms Important?

Contributions to Macro Dynamics by Firm Size

Employment



Investment Growth



Source: ONS, BSD and ABS, Note: microdata do not perfectly correspond to national accounts, small: <50 employees, medium: >50 & <250; large: >250.