The Employment Effects of Monetary Policy: Macro Evidence from Firm-Level Data[1]

Saleem Bahaj Angus Foulis **Gabor Pinter** Paolo Surico

Bank of England; London Business School
NBER SI

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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 PRC.

Research Questions

1. Which **types of firms** are most sensitive to monetary policy shocks (driving the aggregate response)?

2. Are the patterns of heterogeneity consistent with balance sheet constraints and **collateral channels**?

Main Result I: Heterogeneous Effects of Monetary Policy

- **Younger firms** show largest employment response after an interest rate change
- Younger firms tend to have **worse balance sheet condition** (low credit score, small size, low net worth)
- Results are **robust** to controlling for size and leverage
- Younger firms drive **about two thirds of aggregate** employment growth Decomposing Aggregate Employment Growth by Firm Age

Main Result II: Exploring Balance Sheet Channels

- In regions where house prices are **more sensitive** to monetary policy $\longrightarrow$ larger reaction of young firms
- In regions where house prices are **less sensitive** to monetary policy $\longrightarrow$ *no difference* between firm responses
- Consistent with monetary policy propagating via **asset prices**
- Real estate - key source of collateral (securing 75% of SME loans)

Three Sources of Variation and Empirical Challenges

1. Time-series variation in high-frequency monetary policy shocks

   → To identify the **average** effect of monetary policy

2. Firm-level variation; by age, leverage, credit score etc.

   → To identify the **heterogeneous** effect of monetary policy

3. Regional variation in house price sensitivity of monetary policy shocks

   → Assess whether the **mechanism** is via asset price fluctuations
   → Compare (young) firms in high vs low house price sensitive regions
   → Compare (young) firms whose directors live in high vs low house price sensitive regions

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Related Literature

- **Which types of firms are more sensitive to aggregate shocks?**
  - firm size: Gertler and Gilchrist [1994], Moscarini and Postel-Vinay [2012], Chari et al. [2013], Kudlyak and Sanchez [2017], Crouzet and Mehrotra [2017], Dinlersoz et al. [2018]
- **Firm age and firm dynamics**: Schoar [2010], Hurst and Pugsley [2011], Decker et al. [2016a,b], Sedlacek and Sterk [2017]
- **Macro literature on household heterogeneity and monetary policy:** Auclert [2015], Cloyne et al. [2016], Kaplan et al. [2016]
- **Recent work on firm investment using Compustat:** Ippolito et al. [2017], Jeenas [2017], Cloyne et al. [2018], Ottonello and Winberry [2018]
- **Financial accelerator and collateral channel:** Kiyotaki and Moore [1997], Bernanke et al. [1999], Christiano et al. [2014]

Outline

1. Data and Approach
2. Heterogeneity
3. Exploring Balance Sheet Channels

Firm Data

Overview

UK Accounting Data: Bureau van Dijk (BVD) & Companies House

- Covers ~1.5 million UK firms, 1997-2016
- Covers **private** & listed; manufacturing & non-manufacturing firms
- Information on employment, age, credit score, leverage as well as on **corporate property** and **director residential addresses**
- BVD is a live database – selection issue, dead firms leave the database after ~ 5years, can't keep track of ownership structure etc.
- →Use **archived** data (Gopinath et al. 2017, Bahaj et al. 2017)

Illustrating the Selection Effect Descriptive Statistics

General Methodology

Identifying Monetary Policy Effects

- High frequency surprises on short rate futures in a 30 minutes window around policy announcements, 2001-2014 Gerko-Rey (2017)

- Monthly macro proxy-SVAR over 1982-2016 using the high frequency surprises as proxies to extract the shock for the full sample (Stock and Watson 2012, Mertens and Ravn 2013, Ramey 2016)

Firm Level Responses

Local Projection (Jorda, 2005)

Linear Effects:

$$ln(EMP_{t+h,i}) - ln(EMP_{t-1,i}) = \beta^h \times \Delta r_t + \varepsilon^h_{i,t}$$

- Horizon $h = 0, 1, 2, 3, 4$ years after the shock
- Δr_t: change in interest rate (instrumented by policy shock)
- standard errors following Driscoll-Kraay (1998)

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Heterogeneous Effects:

$$ln(EMP_{t+h,i}) - ln(EMP_{t-1,i}) = \delta^h_{j,t} + \sum_{g=1}^{G} \alpha^h_g \times Dg^h_{i,t-1} + \sum_{g=1}^{G} \beta^h_g \times Dg^h_{i,t-1} \times \Delta r_t + \varepsilon^h_{i,t}$$

- Two specifications considered:
  - Separate estimates for groups, $Dg^h_{i,t-1}$, of age, leverage, etc
  - Estimates **relative** to Gth group, including industry-time FE $\delta^h_{j,t}$

Firm Level Employment Response

25bp Contractionary Shock

Notes: Shaded area corresponds to 90% confidence intervals, associated with the firm-level response.

Aggregate Responses

Outline

1. Data and Approach
2. Heterogeneity
3. Exploring Balance Sheet Channels

Descriptive Statistics

Median values by Age, <15, 15-30, >30 Years

	Young	Middle	Old
2-year Asset Growth	0.12	0.10	0.08
Number of Employees	22	48	78
Total Assets (in £000s)	2047	3328	5484
Leverage	0.71	0.63	0.50
Credit Score	65	71	83

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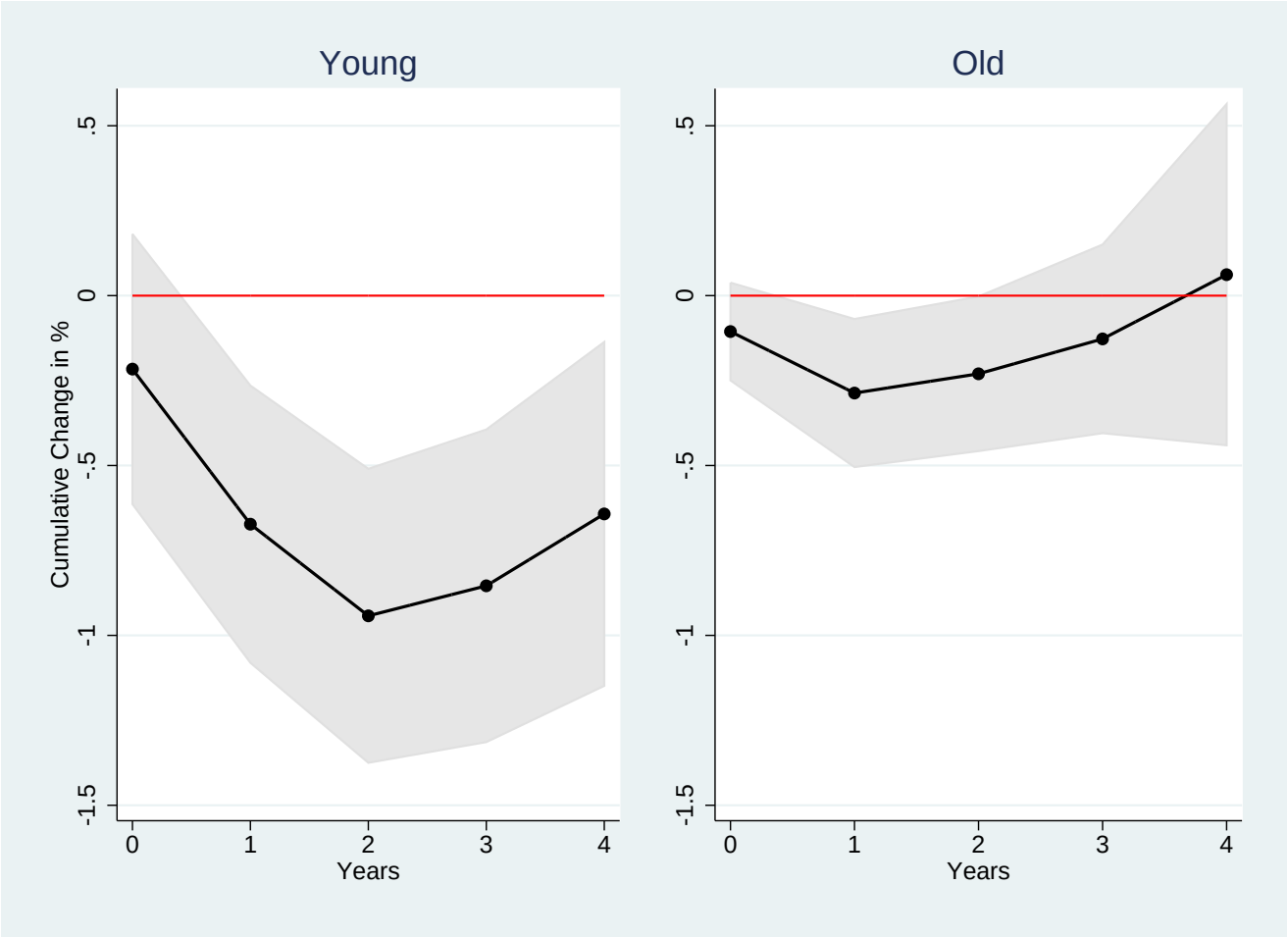
Credit Score and Leverage by Firm Age

Grouping by Firm Age

Below 15 Years, Above 30 Years

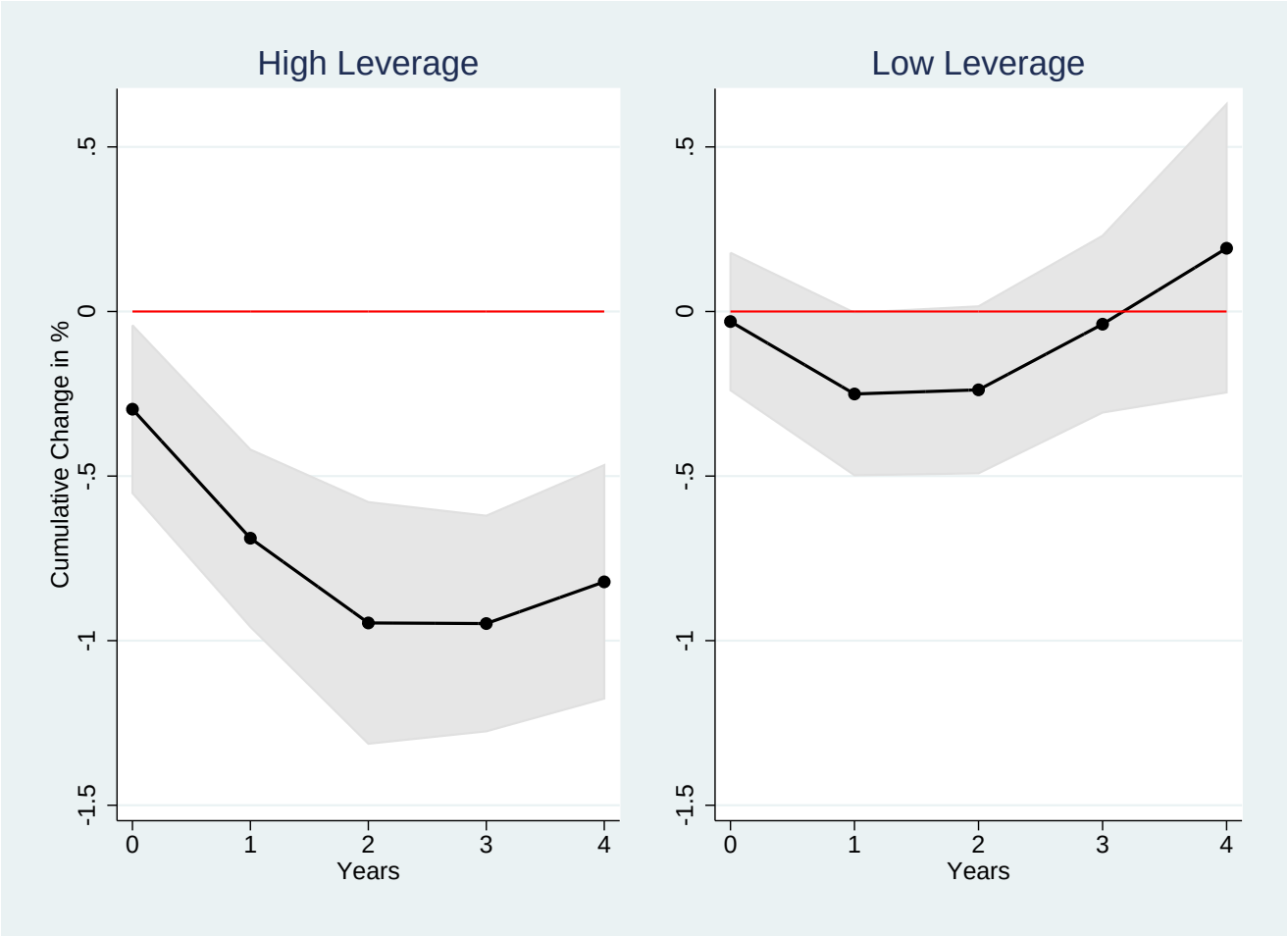


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Relative Effect

Grouping by Firm Leverage

Upper and Lower Tertile

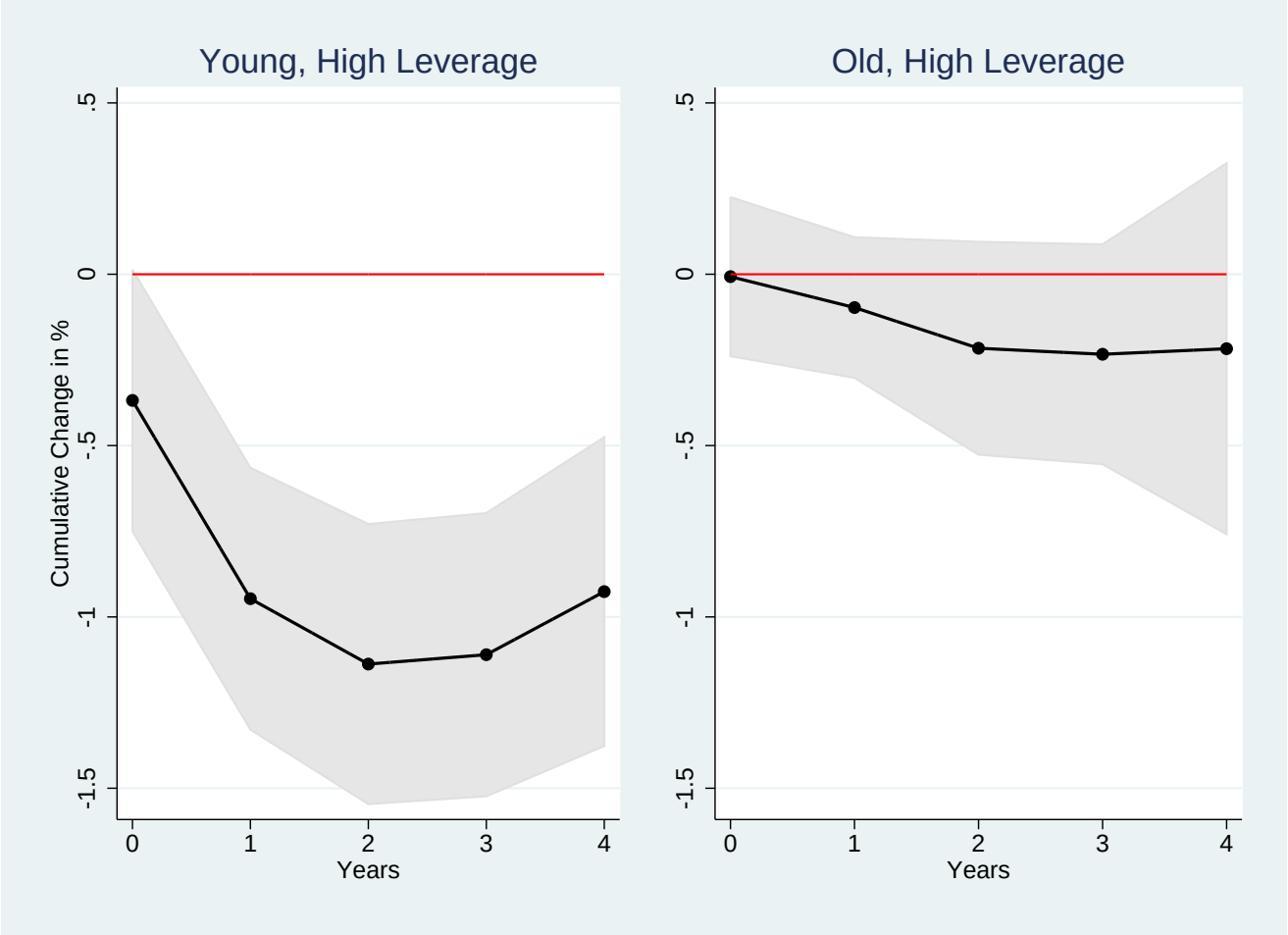


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Relative Effect

High Leverage Firms: Young vs Old Firms

The Role of Firm Age



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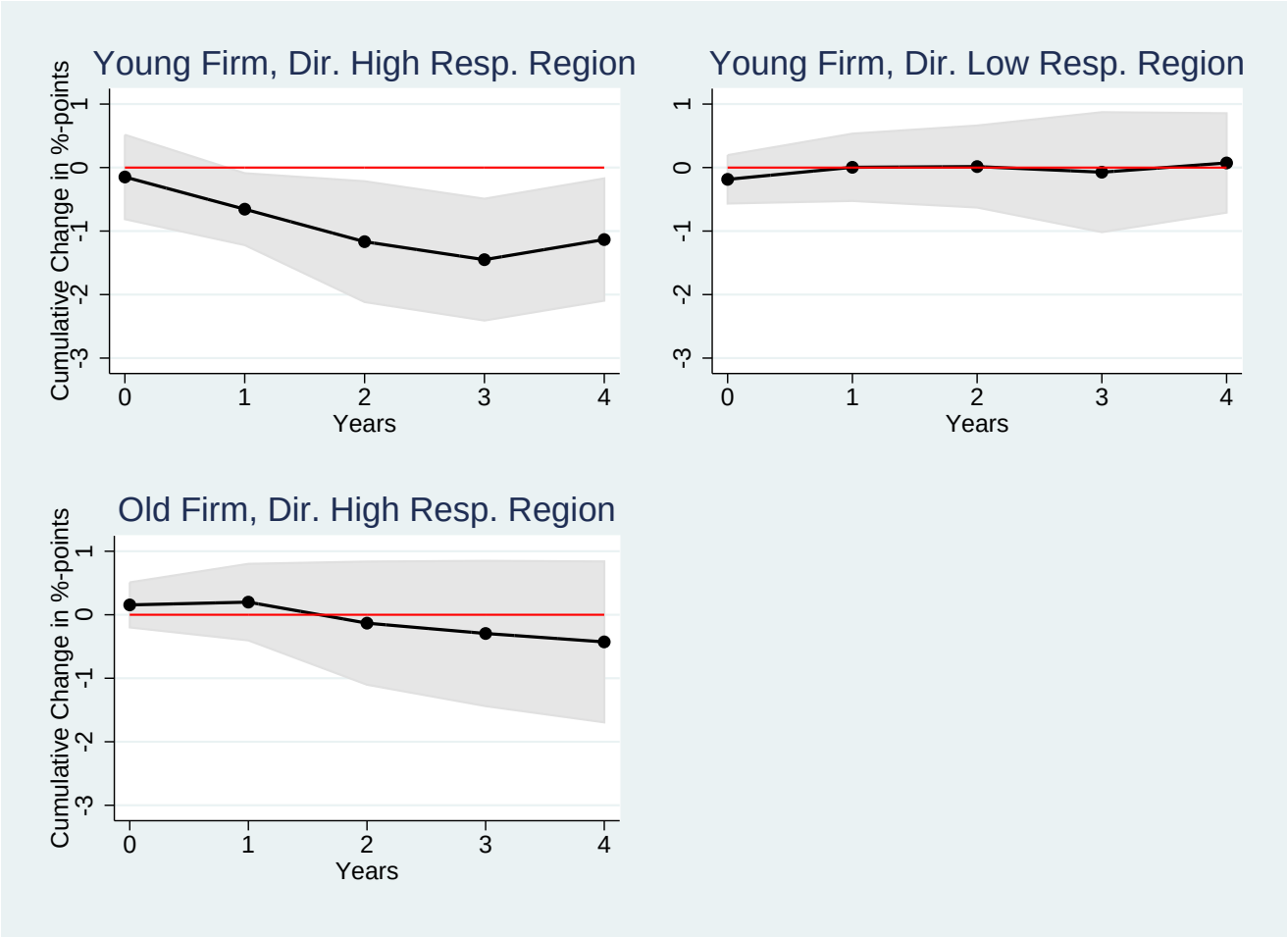
Real Estate as Collateral

- Main **source of collateral**: 75% of SME loans secured on property
- Real estate prices are affected by **monetary policy** International Evidence
- Estimate **house price betas** for 173 UK regions → Put firms in **high** and **low** responsive regions Regional Heterogeneity in Monetary Transmission
- Homes of firm directors as collateral: worth ≈ 80% of GDP
  Real Estate and Firm Borrowing Real Estate by Firm Size
  - Every £1.1m increase in director home values generates 1 job [Bahaj-Foulis-Pinter (2018): "Home Values and Firm Behaviour"]
- Identification: ∼ 50% of directors live in a **different region** to their firm

Employment Response – by Director Region

Effect Relative to Old Firm With Unresponsive Region



Level Effects | Firm-Region Responsiveness

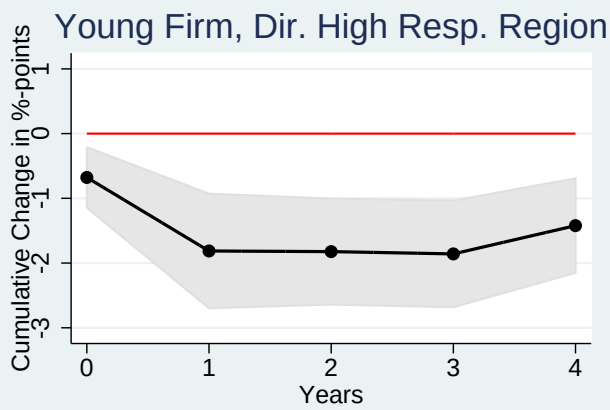
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals

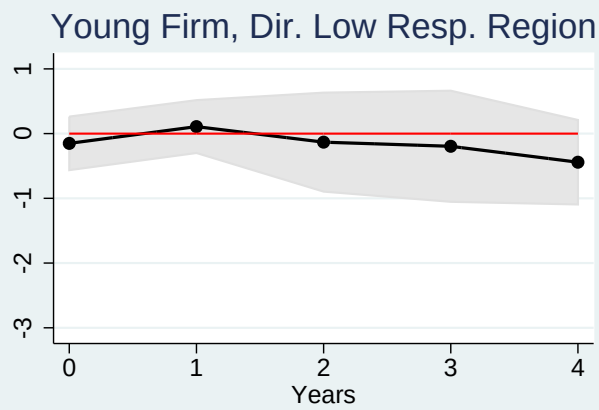
How does Net Worth Respond?

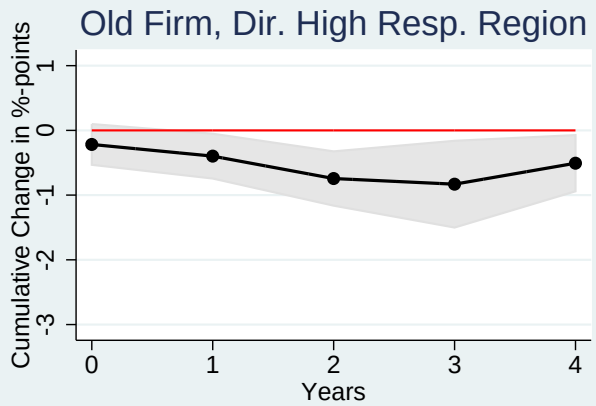
- **Net worth** (Shareholder's Funds):
  - Key state variable in financial frictions models

Net Worth (Shareholder's Funds) Response

Effect Relative to Old Firm With Unresponsive Region







Level Effects

Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Robustness and Extensions

- Insights from Theoretical Models Theory
- Firm Age vs Director Age Director Age
- Low vs High Credit Score Credit Score
- Including Bank-Time Fixed Effects Bank-Time FE
- Including Region-Time Fixed Effects Region-Time FE
- Excluding the Period of Zero Lower Bound Pre-ZLB

- High-Leverage Firms in High vs Low Responsive Regions High Leverage
- Only Firms in the Tradeables Sector Local Demand?
- Directors Located More than 30 Miles from Firm >30 miles
- Response of Working Capital Working Capital

Response of other Balance Sheet Variables

- Response of cash is insignificant
- Response of interest payments is homogeneous across groups
- Sales fall but by a relatively small amount
- Short-term loans fall significantly

Conclusions

- **Younger firms** adjust their employment the most and **drive the aggregate** response
- Younger firms tend to be smaller, have lower credit score, higher leverage, and most of their **borrowing is asset-based**.
- Only for younger firms in most house price sensitive regions **net worth falls** significantly after a contractionary monetary policy shock

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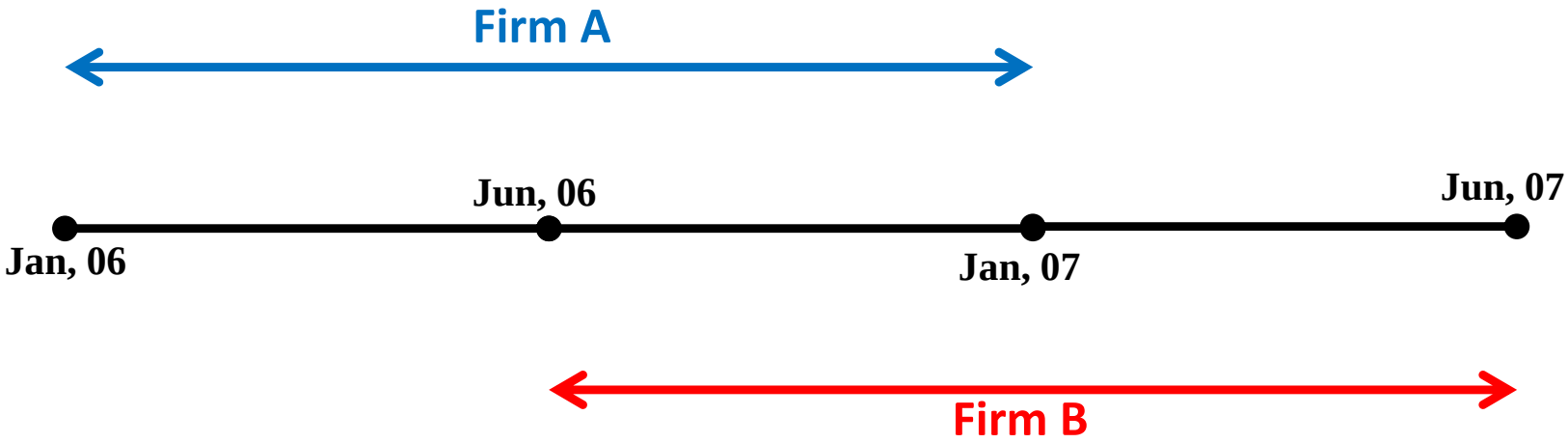
Appendix Material

Filings of Firm Accounts

Illustrating the Variation

- Annual data but firms have different accounting periods.



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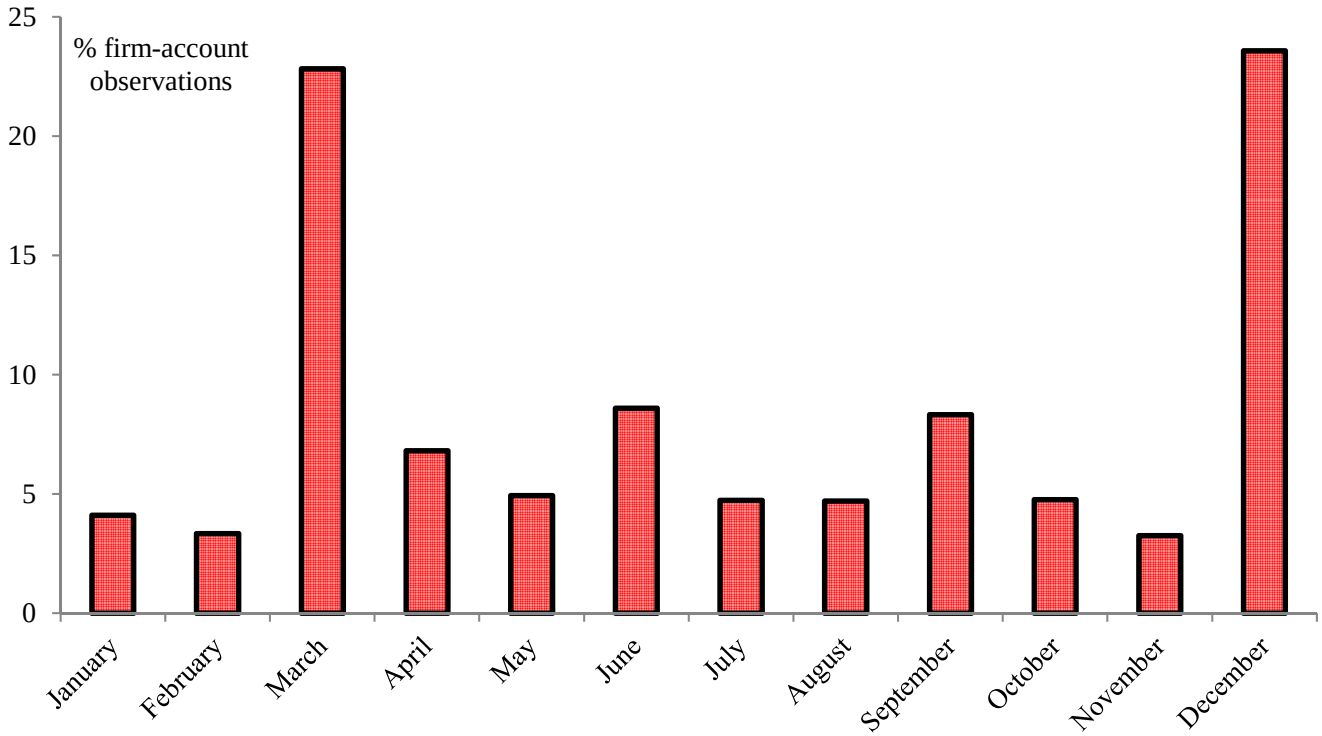
Distribution of Filing Dates by Month



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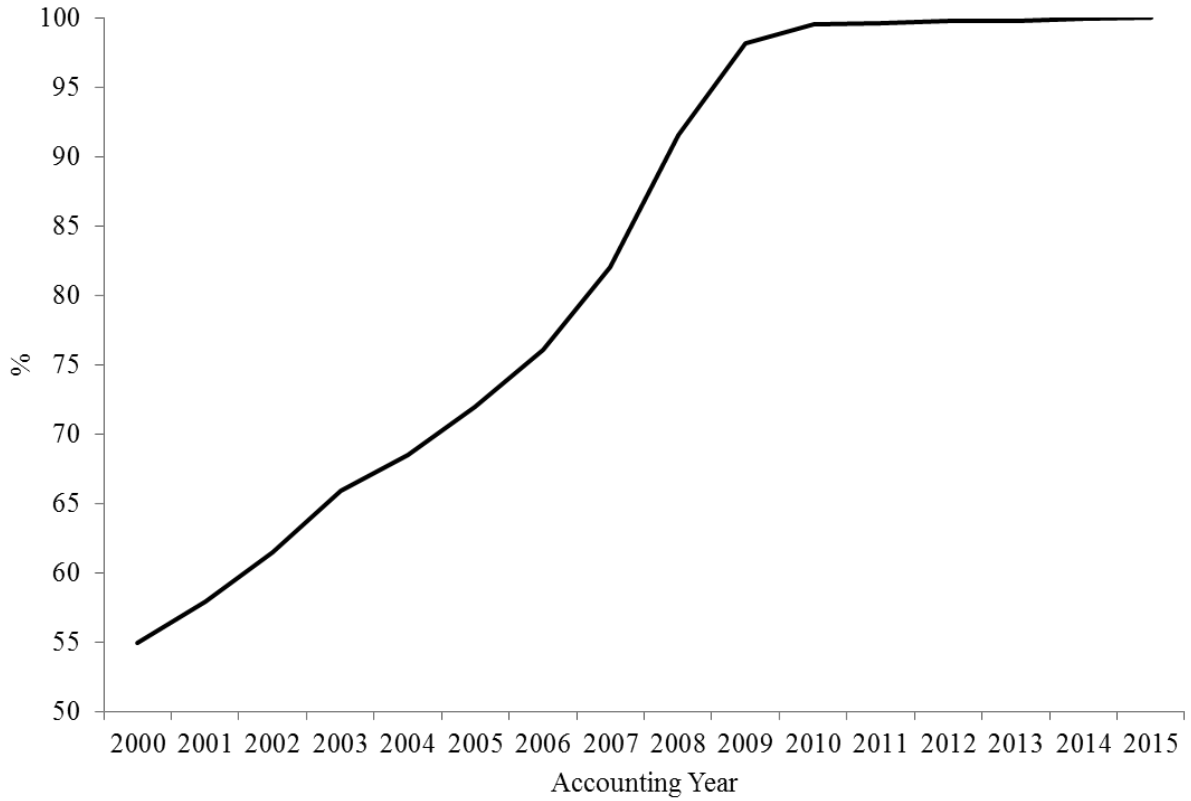
Illustrating the Selection Effect

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

Monetary Policy VAR

Gerko and Rey (2017)

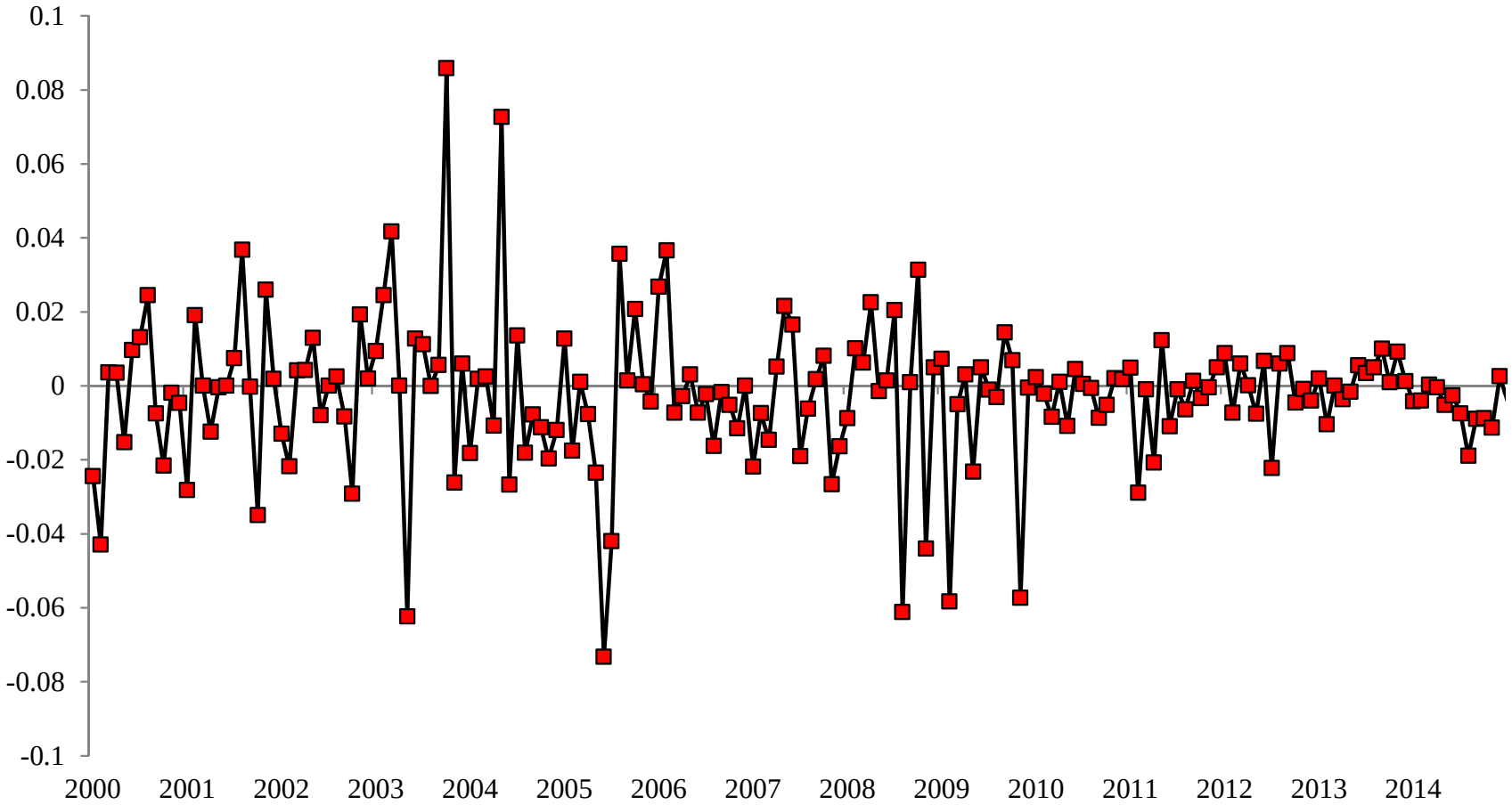
Off-the-shelf approach

- Shock instrument from Gerko and Rey [2017], covering 2000m1-2015m1
- High frequency market reaction to monetary policy announcements
  - Using Bank of England's MPC Minutes, Inflation Report
  - Interpretation is a monetary policy news shock

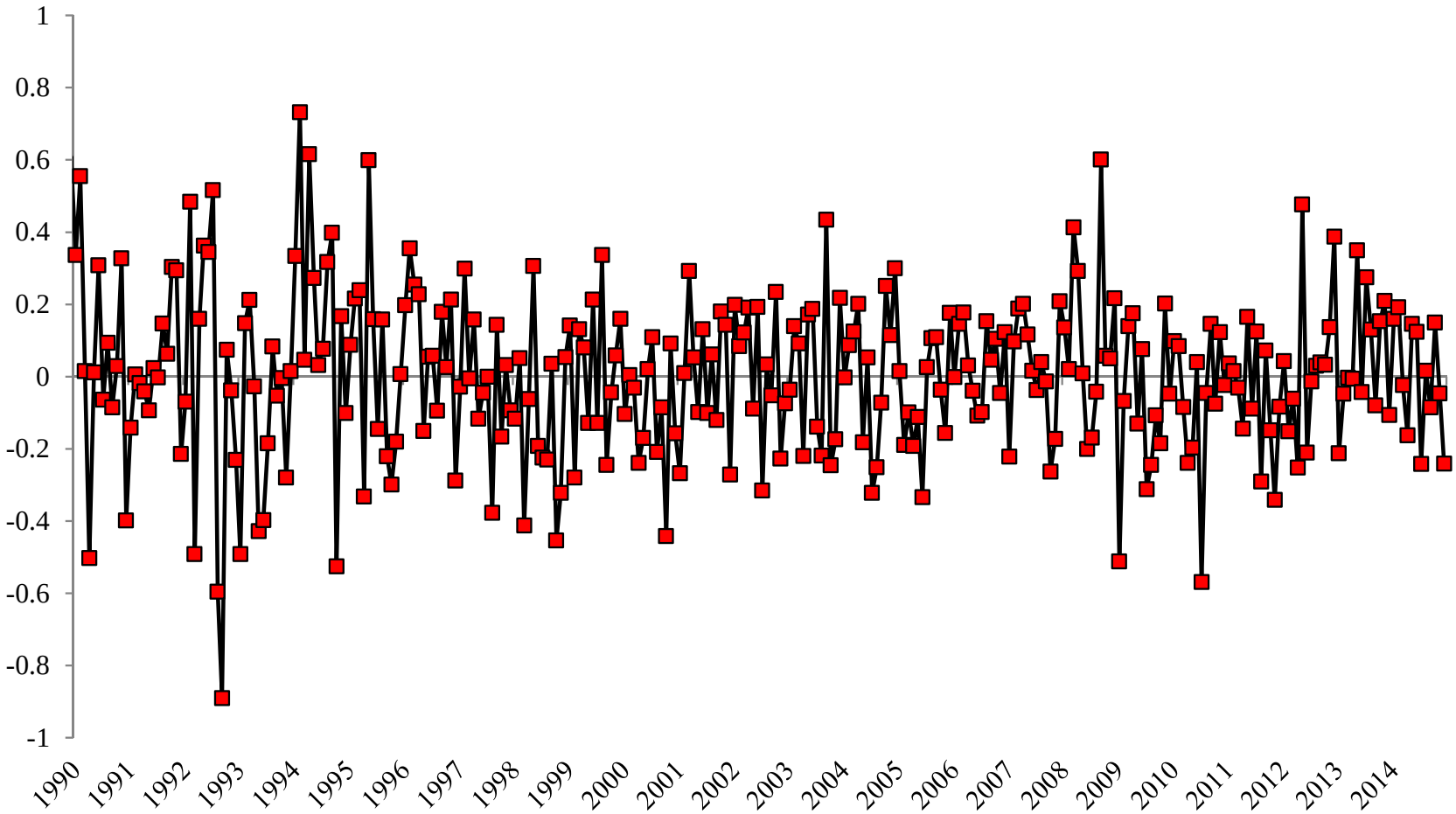
- Specification as in Gerko and Rey [2017] (augmented to include labour variables). Proxy SVAR, estimated over 1982-2016.
  - VAR series: 5-year gilts, IP, Prices, £/$, corporate bond spread, unemployment rate, employment of firms in our industries
  - F-stat for relevance of instrument is above 10
  - The estimated shock goes into our firm level regression

Monetary Policy VAR

Gerko Rey (2017) Policy Surprises

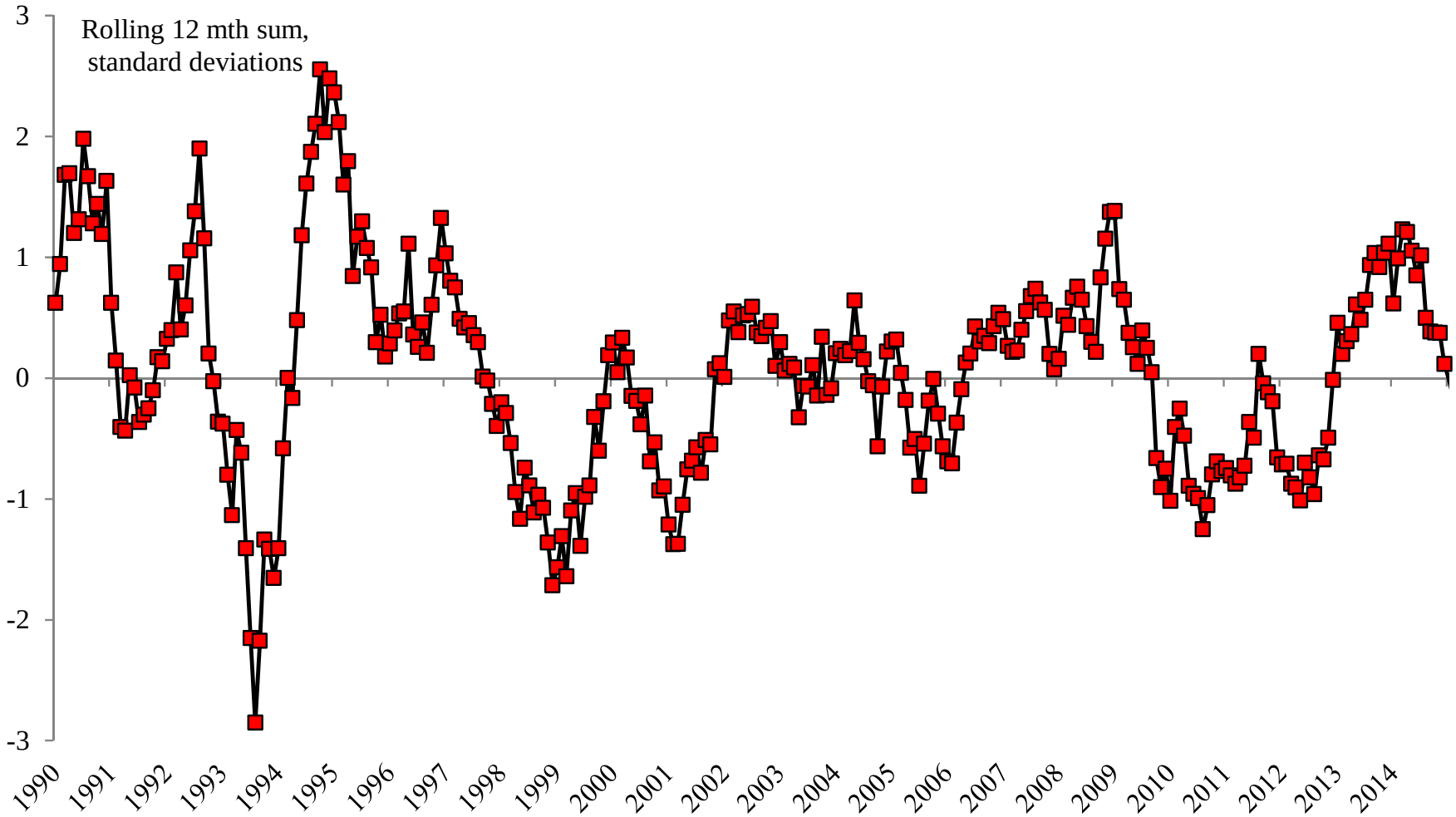


Monetary Policy Shock Series Extracted From the VAR



1 standard deviation = 25bps

Shock Series Extracted from the VAR



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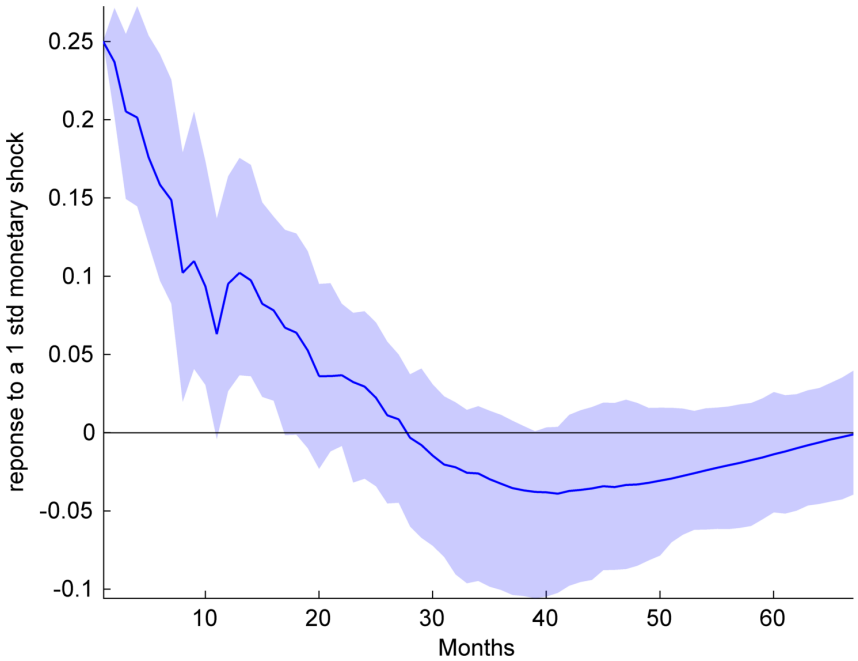
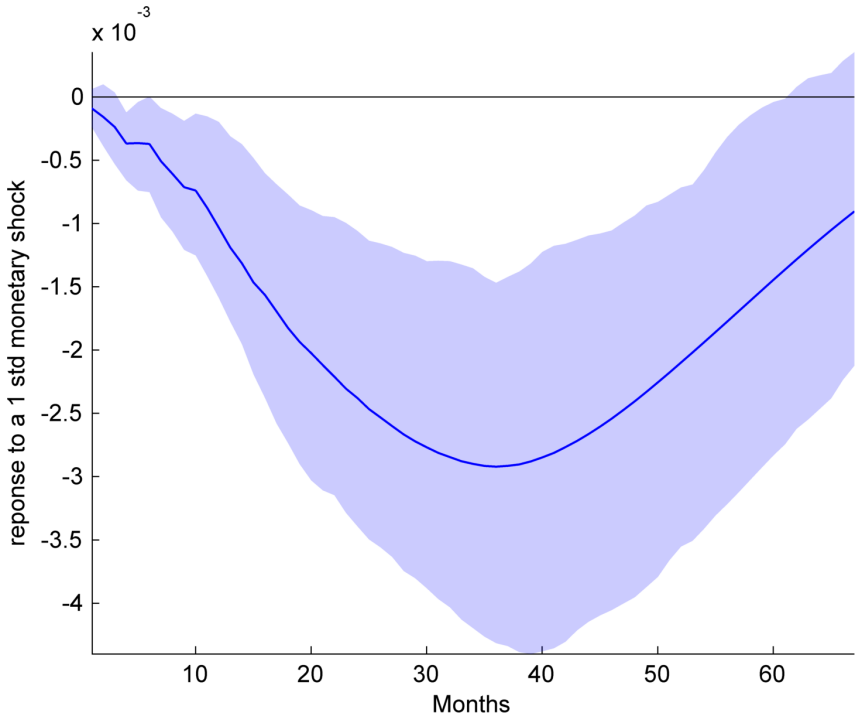
Aggregate Responses to Monetary Policy Shock

1sd monthly contractionary shock: 25bps

Interest Rate



Employment

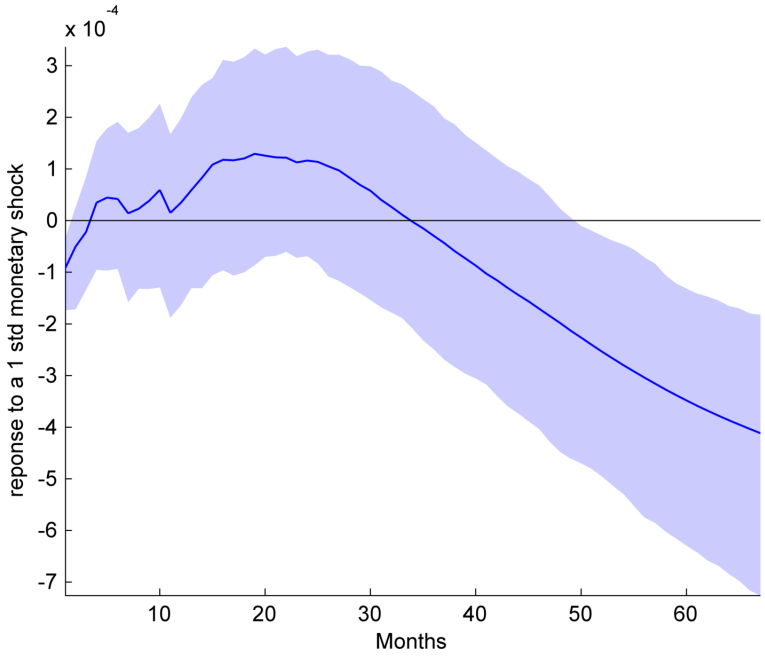


Notes: Estimates are from a proxy SVAR estimated on UK monthly data over the period 1982-2016. Monetary policy shocks are identified using the Gerko and Rey [2017] series. The blue solid lines are the point estimates, and the shaded areas are the 90% confidence intervals constructed from a wild recursive bootstrap.

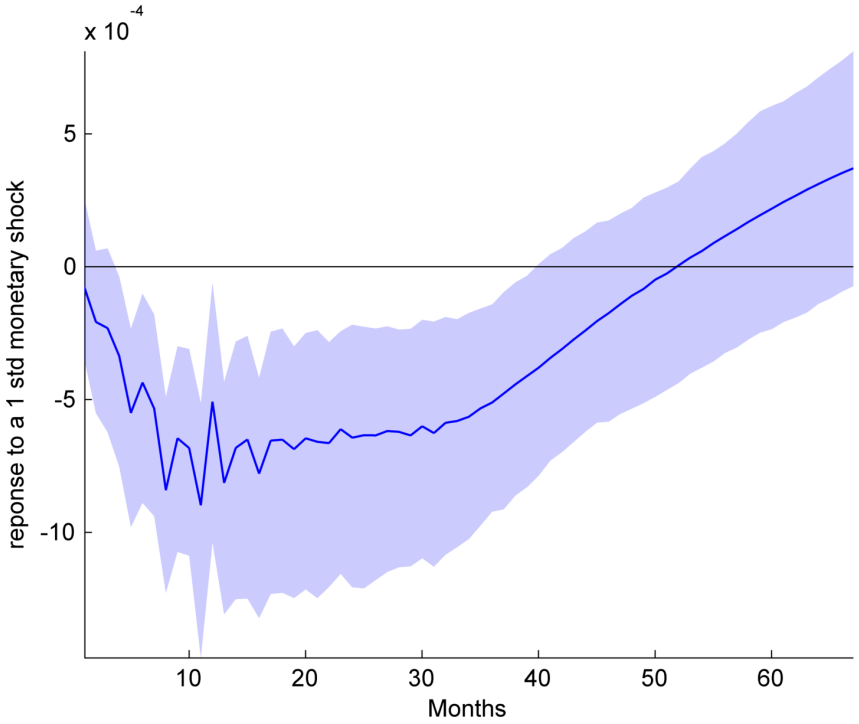
Aggregate Responses to Monetary Policy Shock

1sd monthly contractionary shock: 25bps

Retail Prices (ex Mortgages)



Industrial Production



Notes: Estimates are from a proxy SVAR estimated on UK monthly data over the period 1982-2016. Monetary policy shocks are identified using the Gerko and Rey [2017] series. The blue solid lines are the point estimates, and the shaded areas are the 90% confidence intervals constructed from a wild recursive bootstrap.

back

Firm Level Employment Response With Firm FE

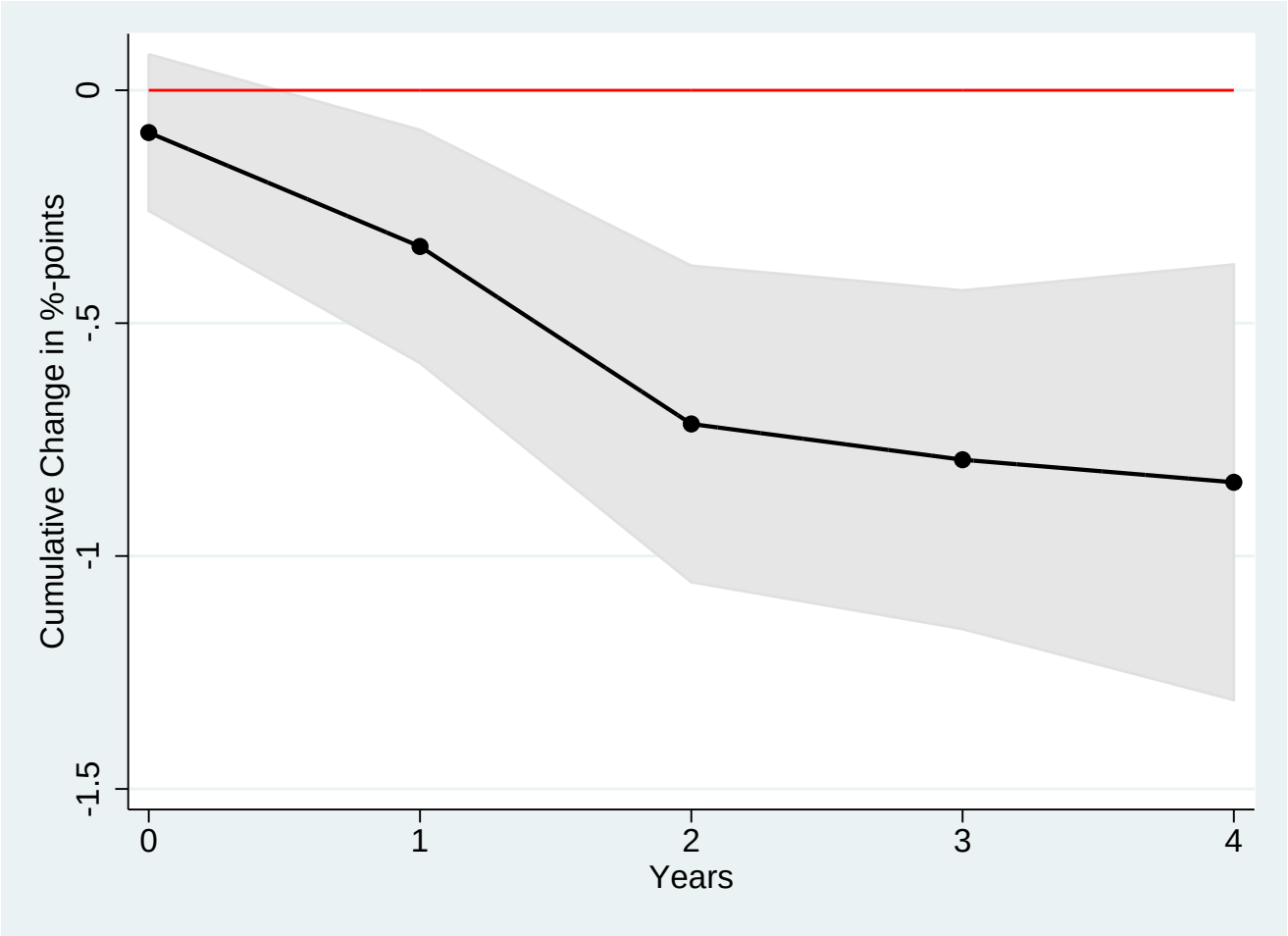
25 bp contractionary shock

Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

back

Grouping by Firm Age

Relative Effect of Being a Young Firm

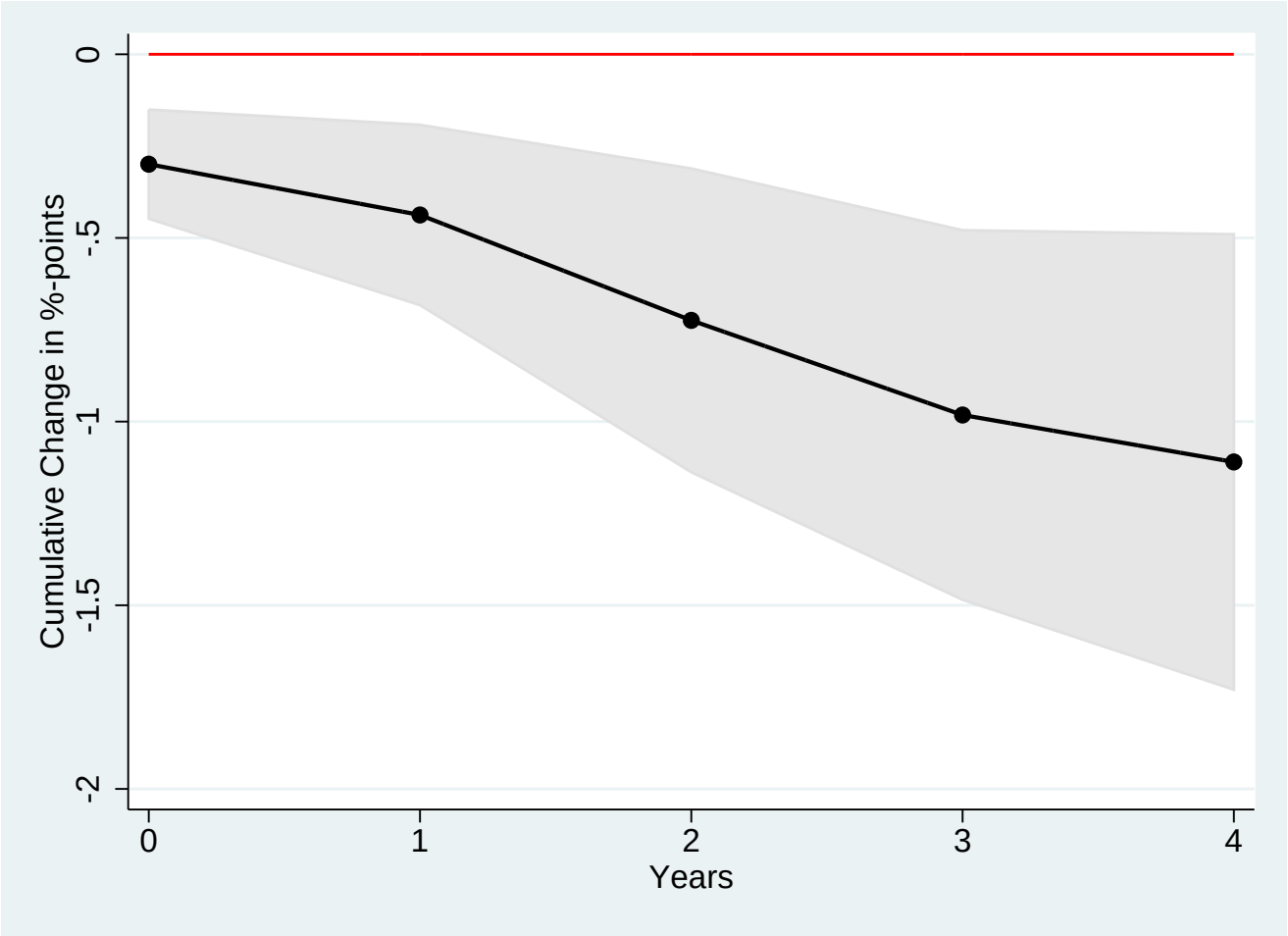


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back

Grouping by Firm Leverage

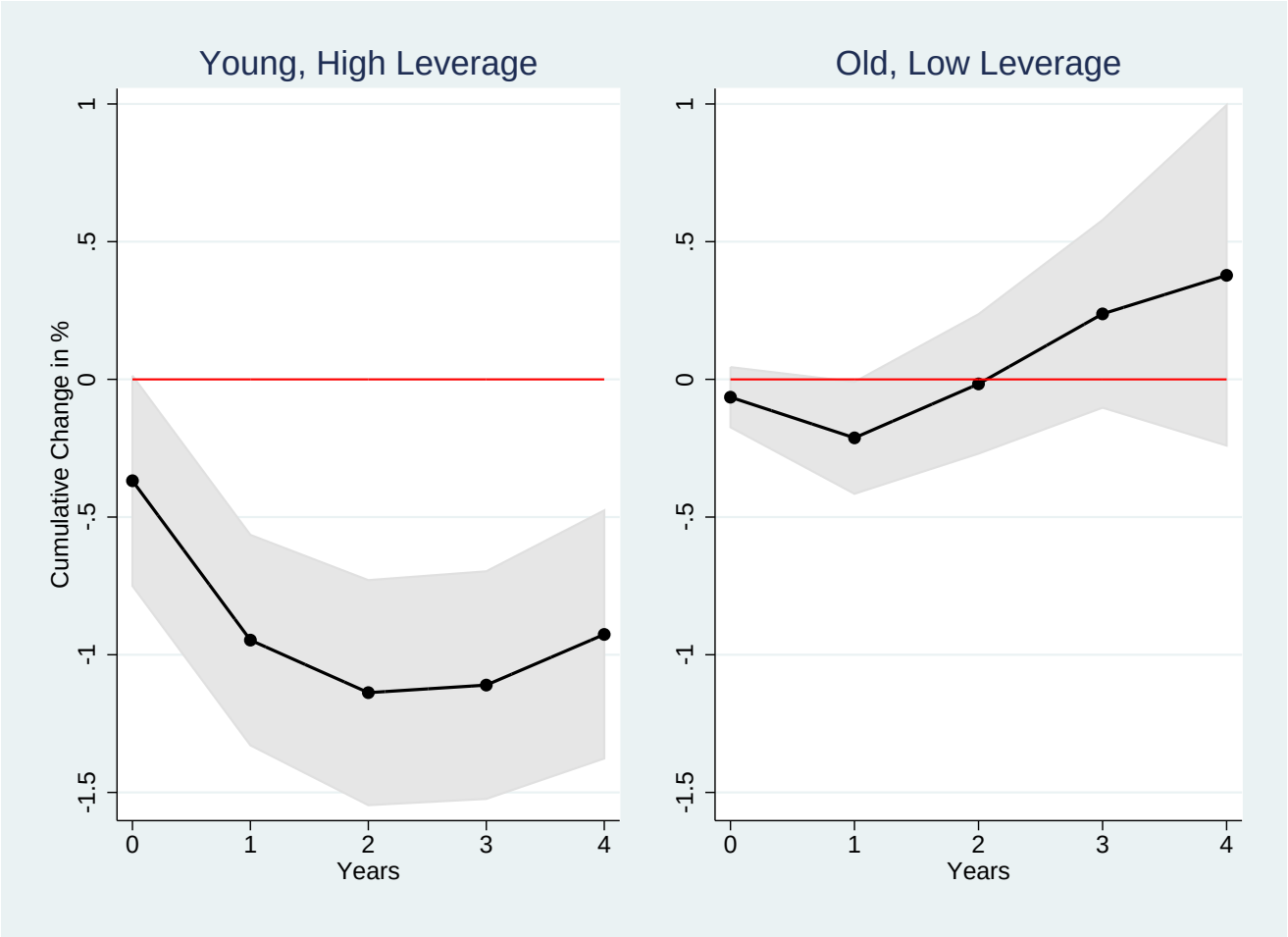
Relative Effect of Being a High Leverage Firm



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back

Young, High Leverage vs. Old, Low Leverage Firms

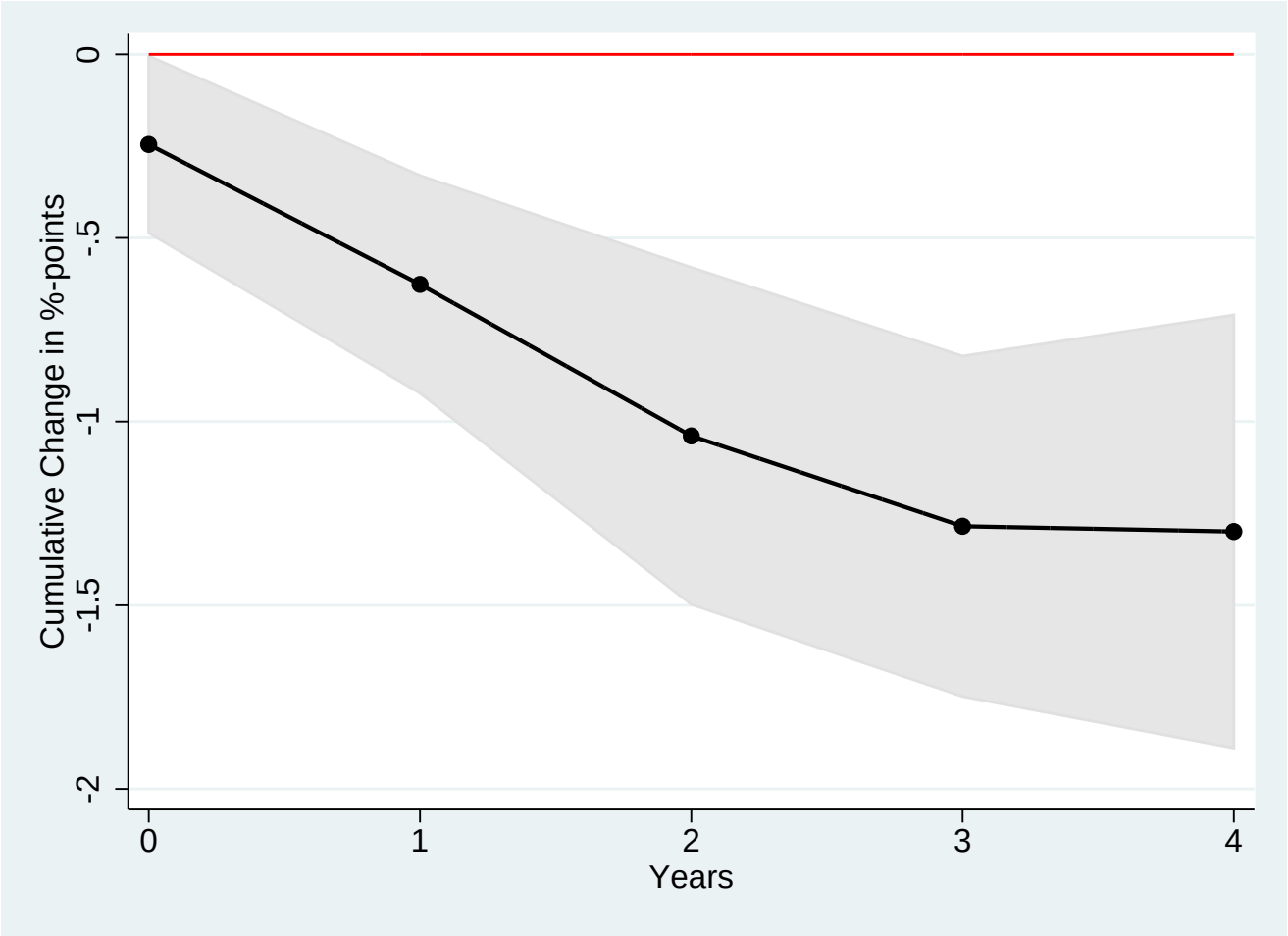


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back Relative Effect

High Leverage Firms: Young vs Old Firms

Relative Effect

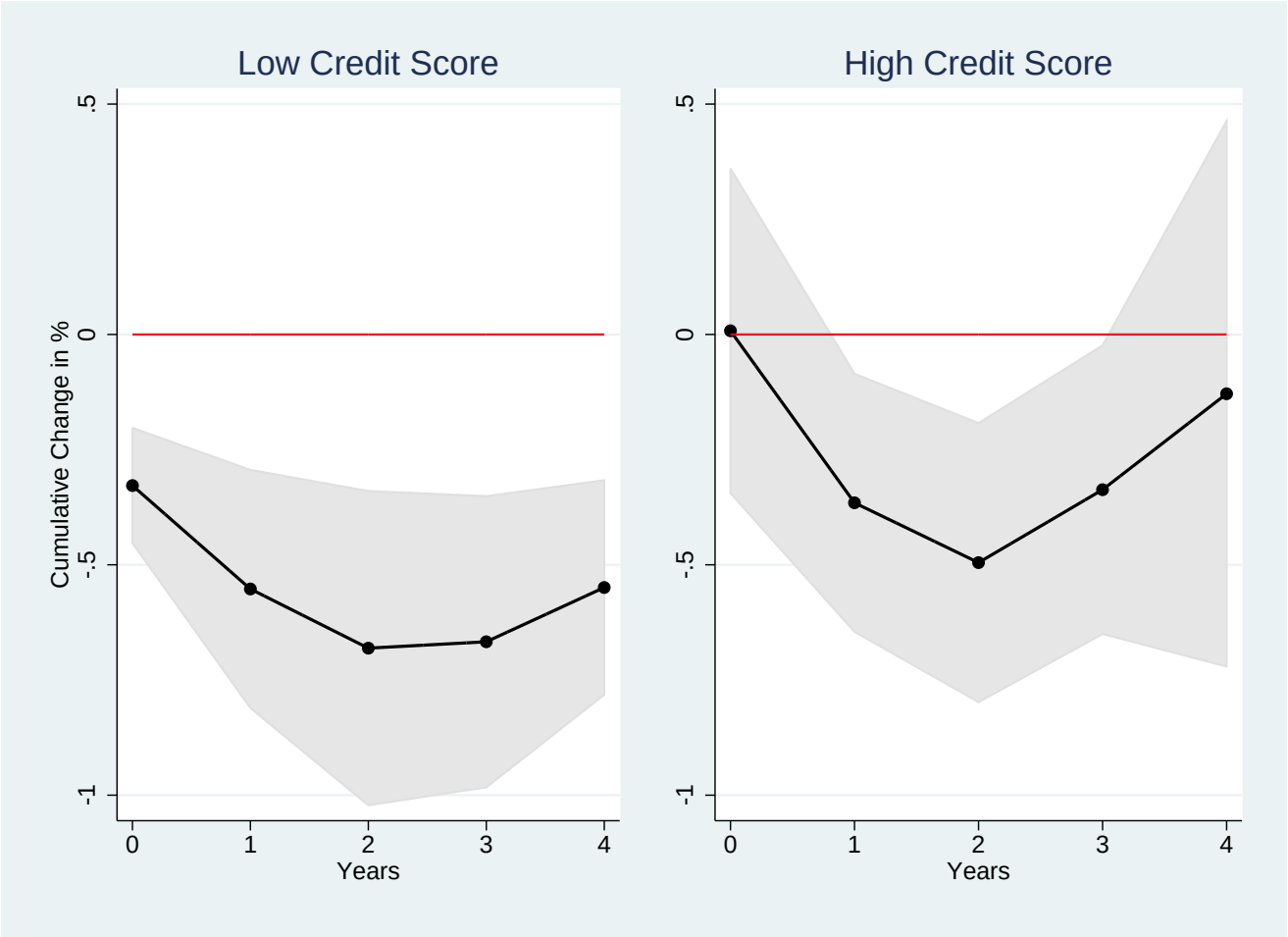


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back

Grouping by Firm Credit Score

Below, Above Credit Score of 60

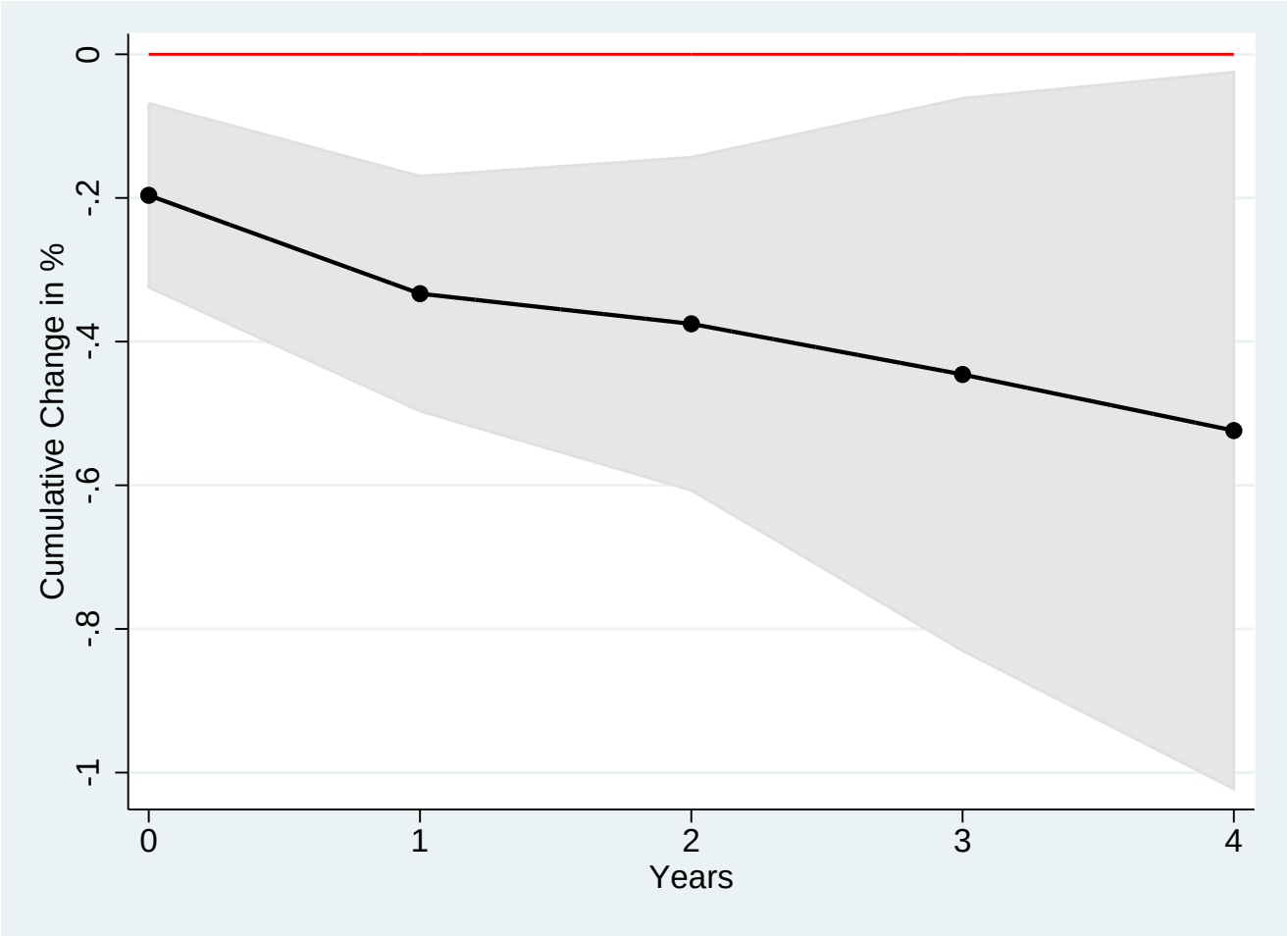


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Relative Effect

Grouping by Firm Credit Score

Relative Effect of Being a Low Credit Score Firm



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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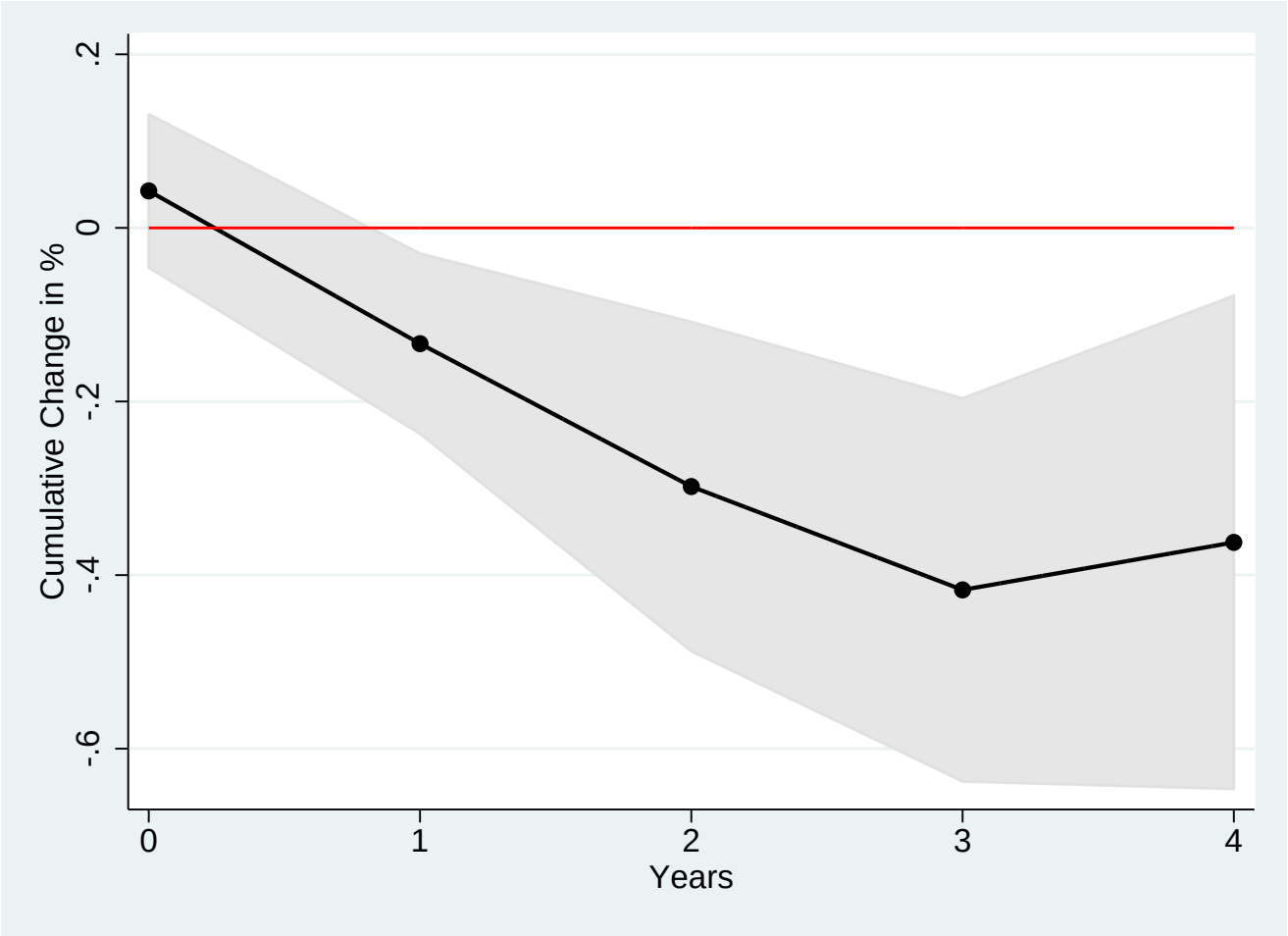
Grouping by Firm Director Age

Relative Effect of Having Young Directors



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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Real Estate and Firm Borrowing

Survey of Borrowers

	Secured on Any Property	Secured By Guarantee or Res. Property
	(1)	(2)
0-9 Year Old Firm	69%	49%
10-15 Year Old Firm	75%	51%
15+ Year Old Firm	88%	35%
All Firms	79%	42%

Survey of Lenders

	Secured on Any Property	Secured By Guarantee
	(1)	(2)
0-9 Year Old Firm	76%	37%
10-15 Year Old Firm	73%	31%
15+ Year Old Firm	70%	24%
All Firms	73%	29%

Notes for Panel A: the UK Survey of SME Finances (2004 and 2008 waves).
Notes for Panel B: The Bank of England's 2015 survey of UK SME and Mid-Corporate Lending. Firms borrowing at least £250k with annual turnover below £500mn.

Cross-country Comparison of Personal Guarantees

Country	Paper	Use of PGs	Notes
Australia	Connolly et al. [2015]	>UK/US	as a % of new SME loans
Ireland	Carroll et al. [2015]	33%	as a % of new SME loans
Japan	Ono and Uesugi [2009]	67%	as a % of new SME loans
Italy	Calcagnini et al. [2014]	40%	as % of number of new loans
Finland	Peltoniemi and Vieru [2013]	30%	as % of number of new loans
France	Davydenko and Franks [2008]	35%	value at default as % of total collatera
Spain	CEET [2010]	30-45%	as a % of new SME loans
UK	BoE	29%	as a % of new SME loans
	Franks et al. [2015]	50-60%	as % of loans to distressed companies
USA	Bathala et al. [2006]	53%	as a % of new SME loans
	Meisenzahl [2014]	54%	as a % of new SME loans

Notes: The Table provides a summary of the results from the recent empirical literature. The %-values typically capture the share of the number of loans at origination that are secured by a personal guarantee of a company director. The exception is Davydenko and Franks [2008] that focuses on firms with loan exposure at default.

Back

Real Estate and Firm Borrowing

Survey of Borrowers

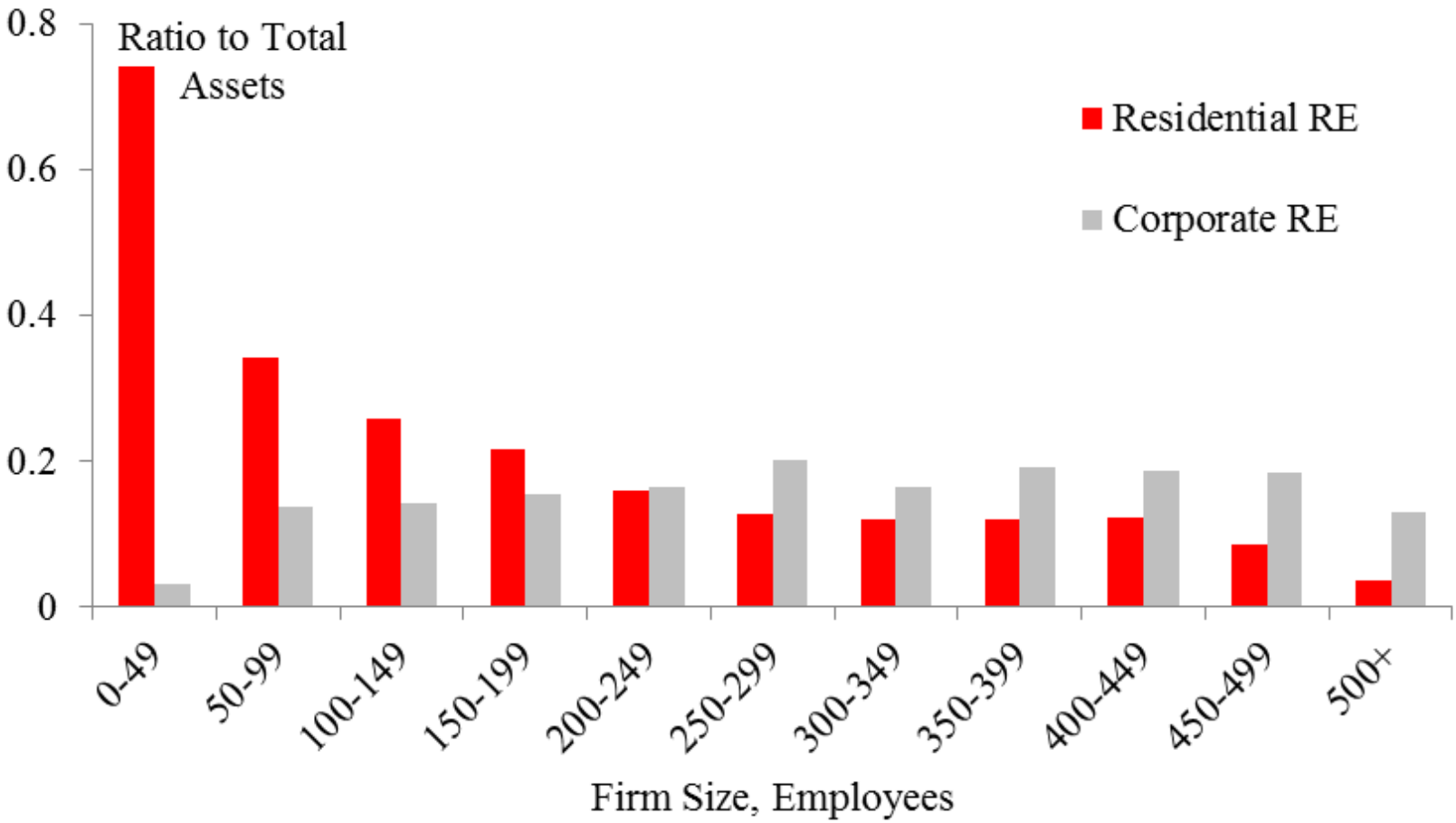
	Secured on Any Property	Secured By Guarantee or Res. Property
	(1)	(2)
0-1 Employees	80%	46%
2-49 Employees	81%	40%
50-249 Employees	67%	27%
250+ Employees	–	–
All Firms	79%	42%

Survey of Lenders

	Secured on Any Property	Secured By Guarantee
	(1)	(2)
2-49 Employees	80%	33%
50-249 Employees	54%	31%
250+ Employees	50%	25%
All Firms	73%	29%

Notes for Panel A: the UK Survey of SME Finances (2004 and 2008 waves).
Notes for Panel B: The Bank of England's 2015 survey of UK SME and Mid-Corporate Lending. Firms borrowing at least £250k

Residential and Corporate Real Estate by Firm Size



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Estimating Regional Housing Betas

- Estimate **house price betas** for 173 UK regions response to monetary policy shocks
- Use monthly regional house price indices
- For each region j estimate:

$$\log(P_{t+h}) - \log(P_{t-1}) = a + \beta^h \times MP_t + controls + \varepsilon_t^h$$

- Estimate for $h = 0, ..., 24$ months
- Sum the first 24 months of βs to get a coefficient B_j for region j:

$$B_j = \sum_{i=1}^{24} \beta^i$$

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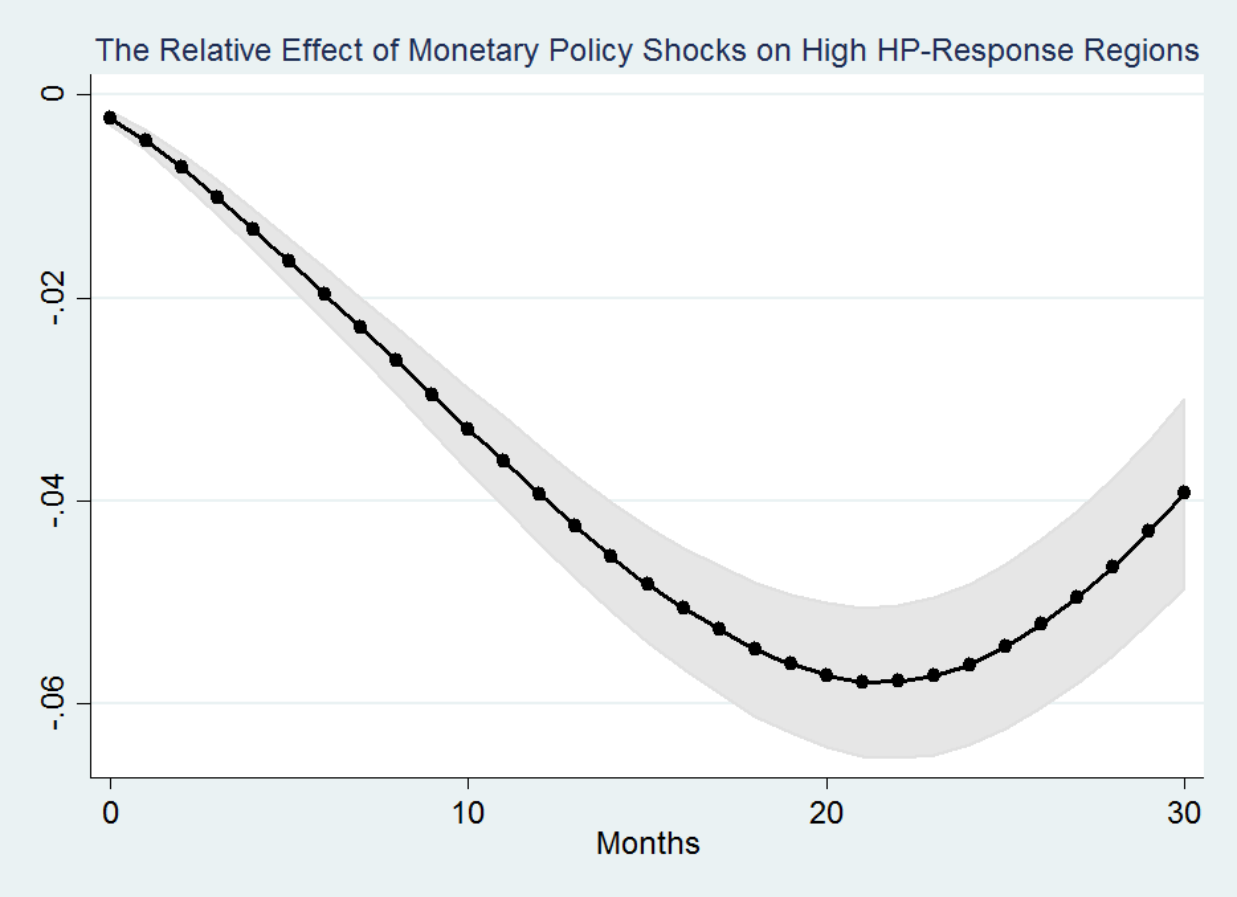
Monetary Policy and House Prices

Relative Response Across Regions

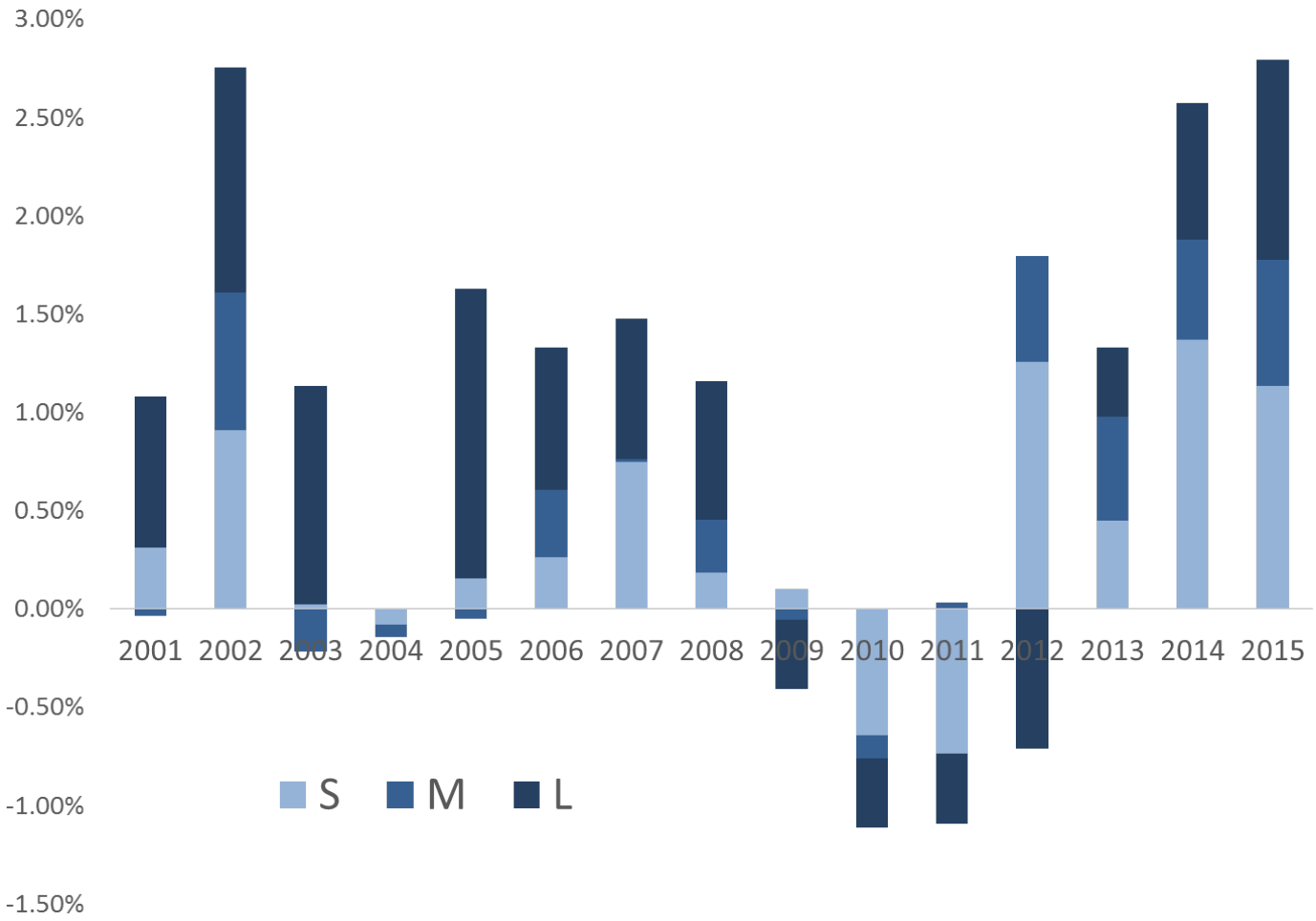


Notes: Responses to a 25bp contractionary monetary policy shock. Black solid line is point estimate at the regional level. Shaded area corresponds to 90% confidence intervals.

Back

Are Small Firms Important for the Economy?

Contributions to Changes in Aggregate Employment by Size



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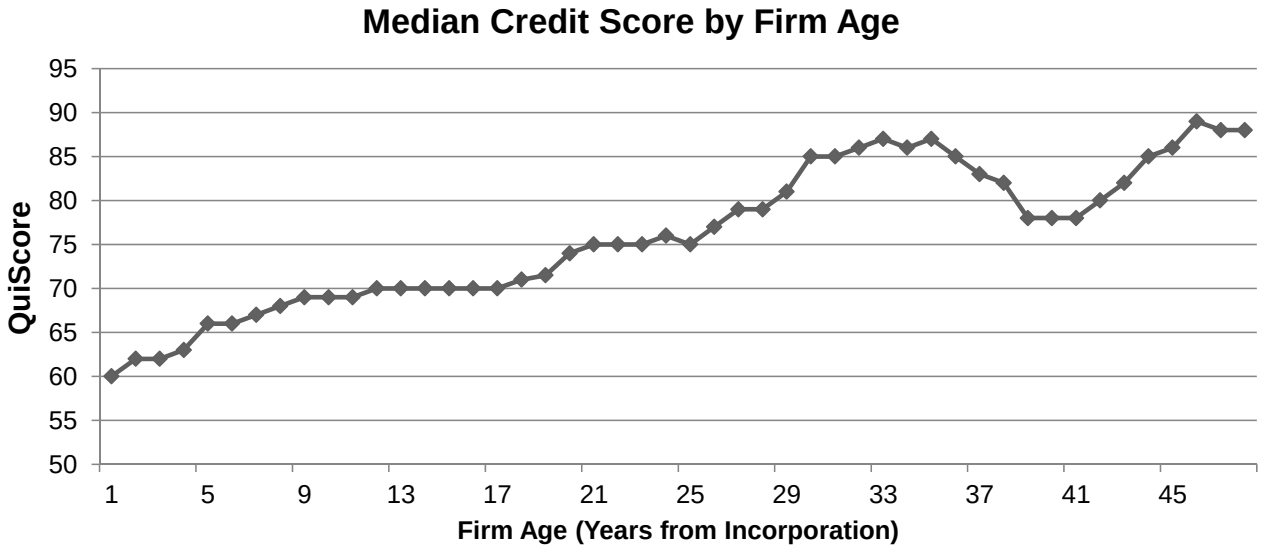
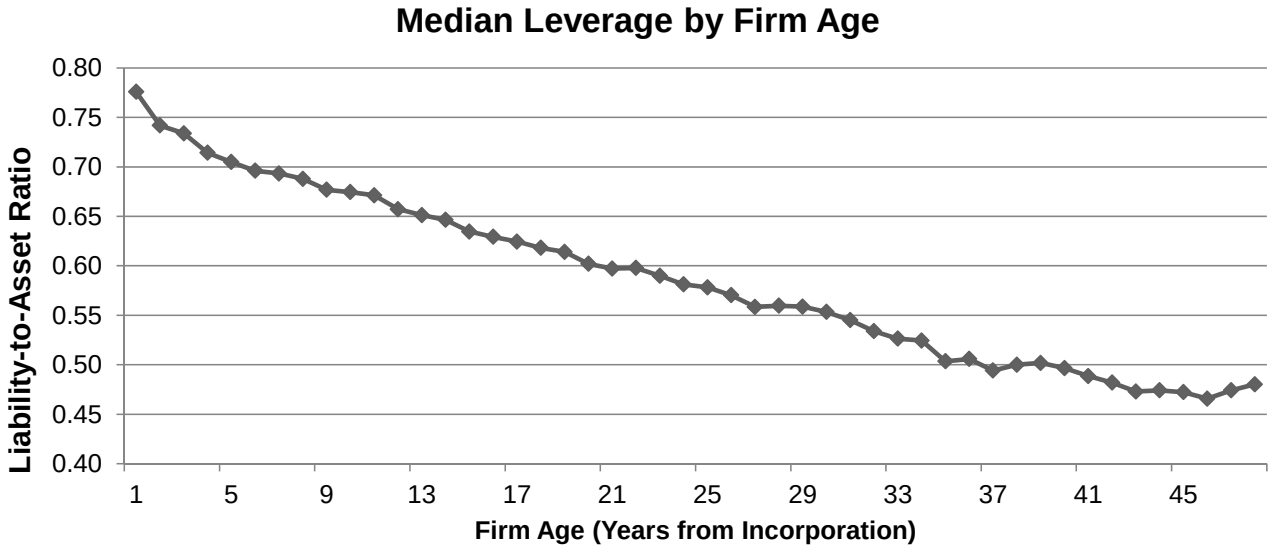
Firm Leverage and Credit Score over the Life-Cycle





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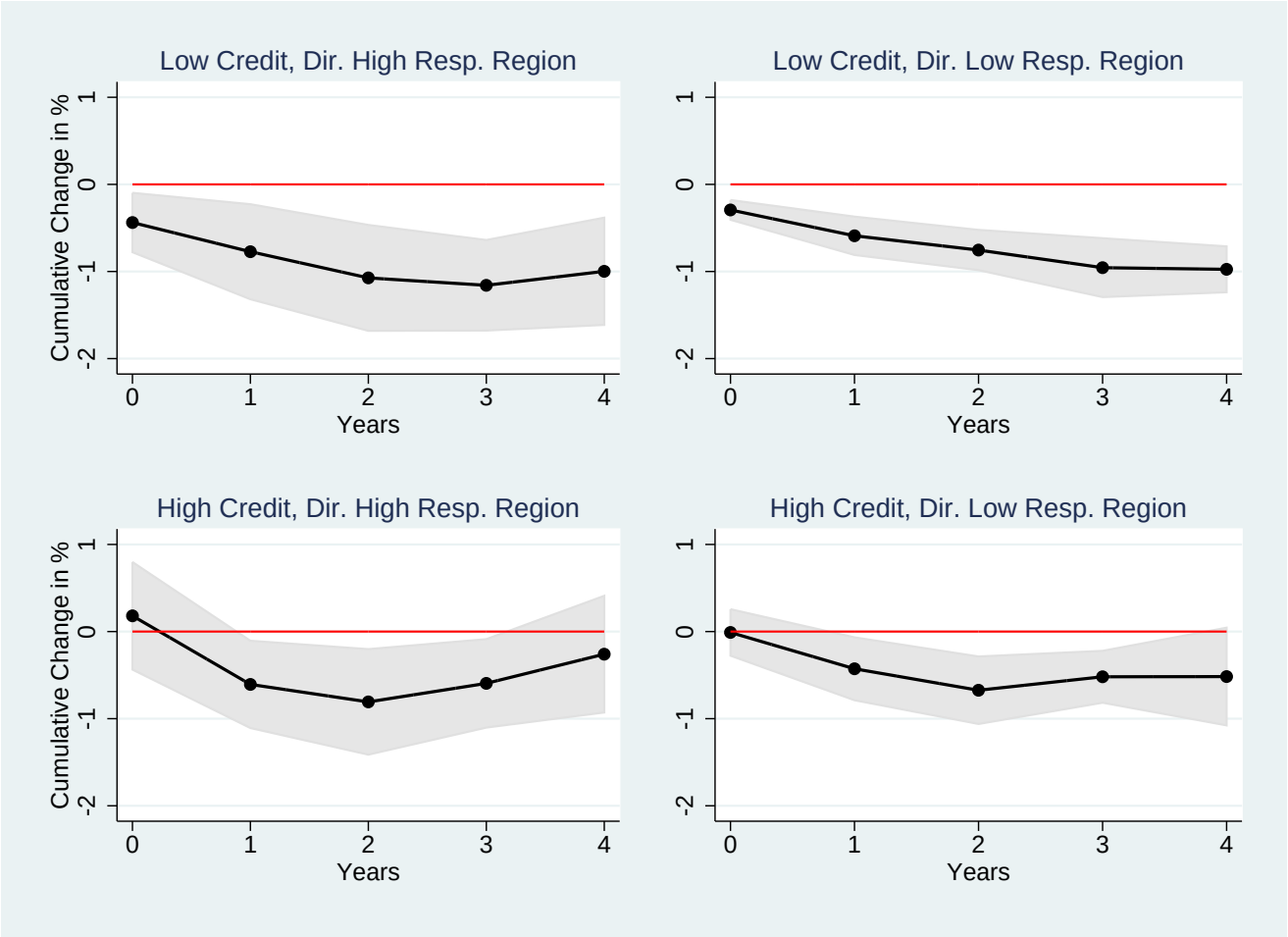
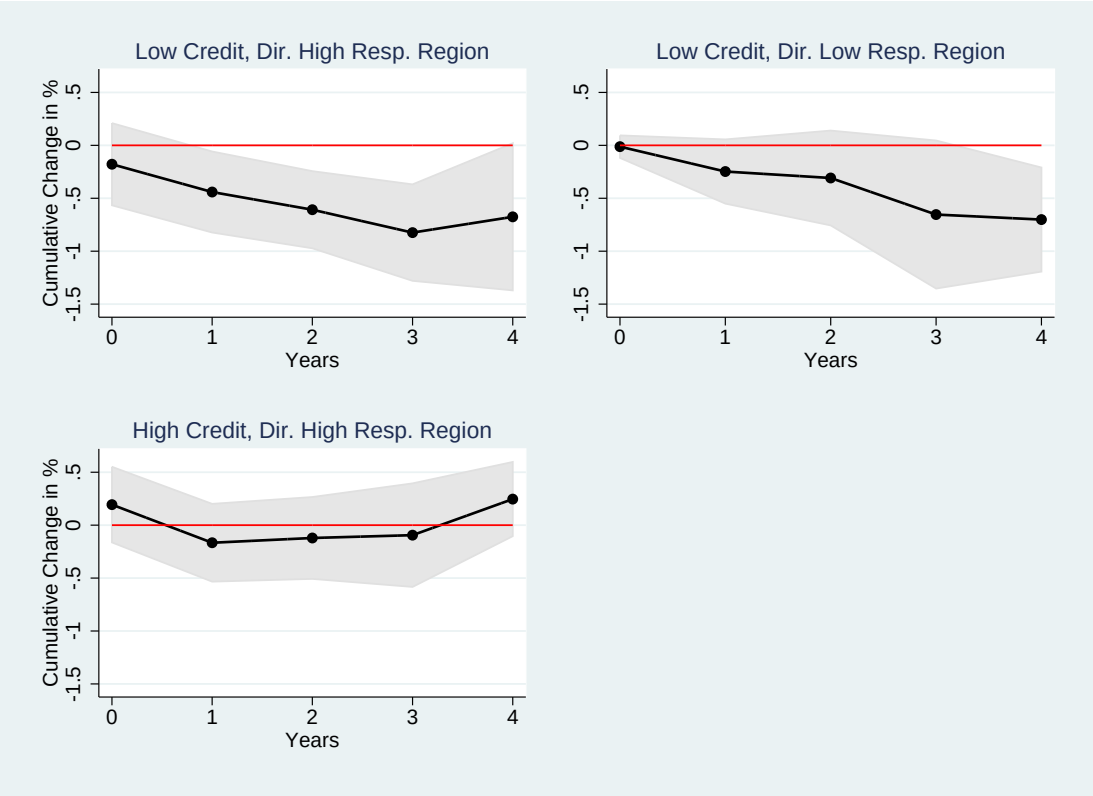
Grouping by Firm Credit Score and House Price Responsiveness of Director Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Grouping by Firm Credit Score and House Price Responsiveness of Director Region

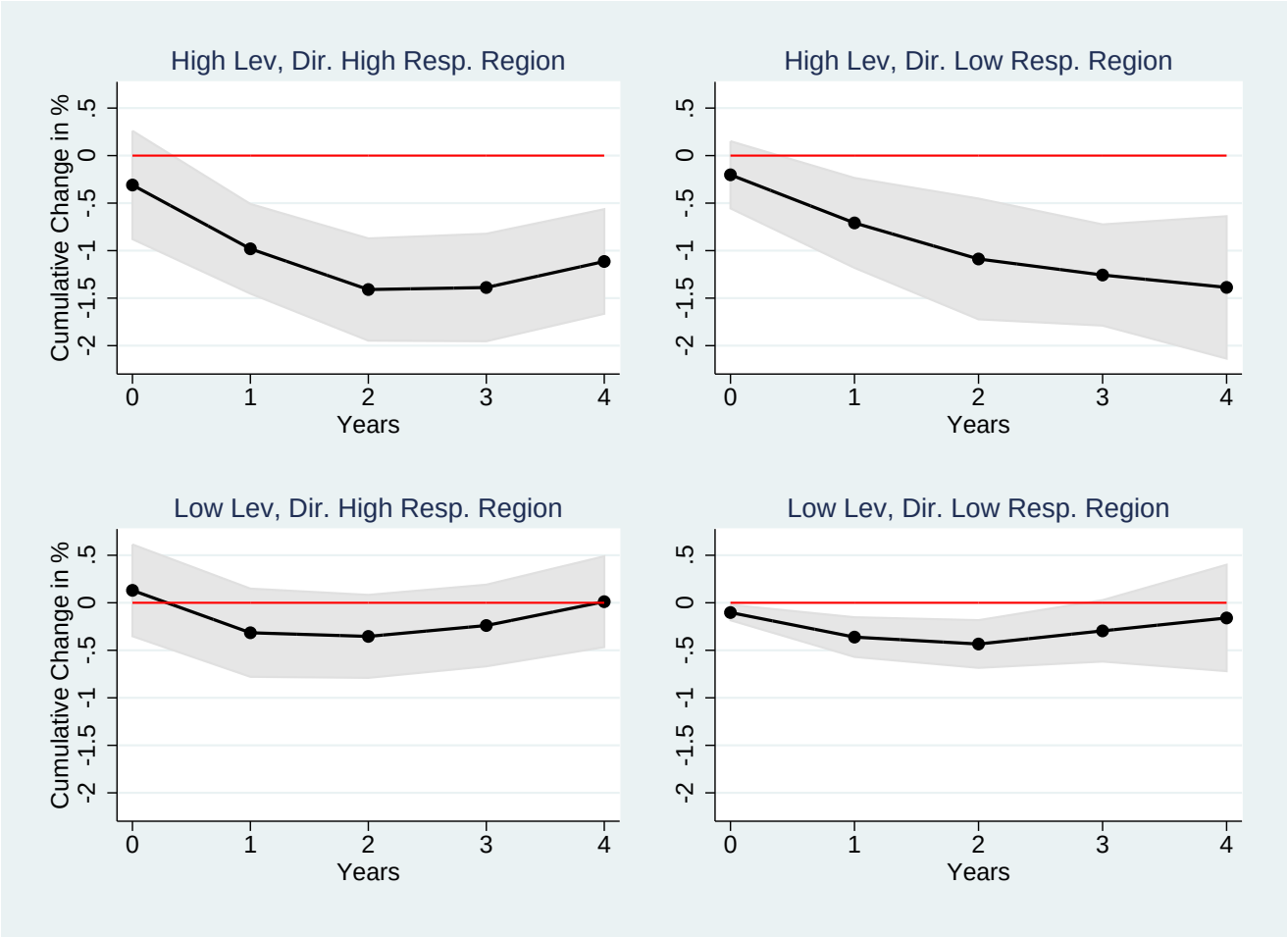
Effect Relative to High Credit Score Firm With Unresponsive Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back

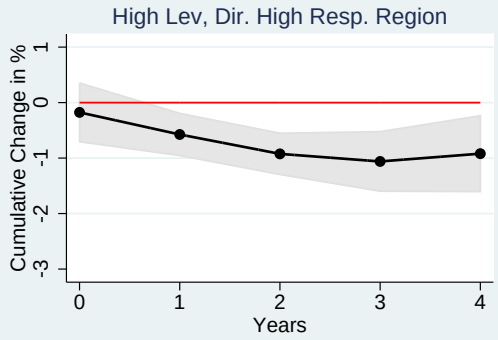
Grouping by Firm Leverage and House Price Responsiveness of Director Region

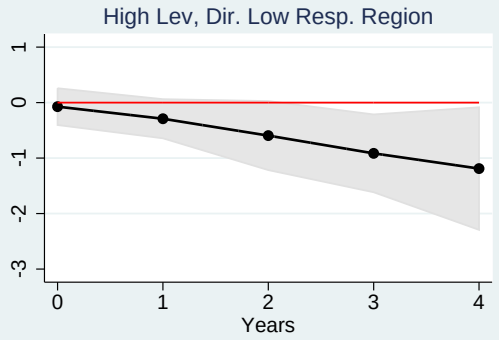


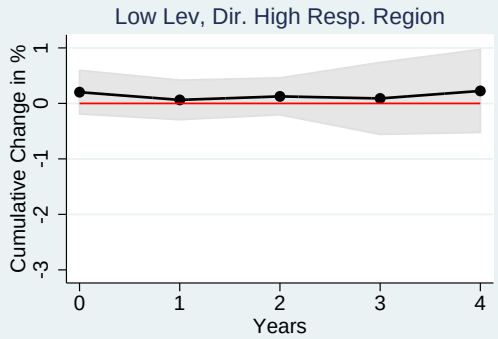
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Grouping by Firm Leverage and House Price Responsiveness of Director Region

Effect Relative to Low Leverage Firm With Unresponsive Region







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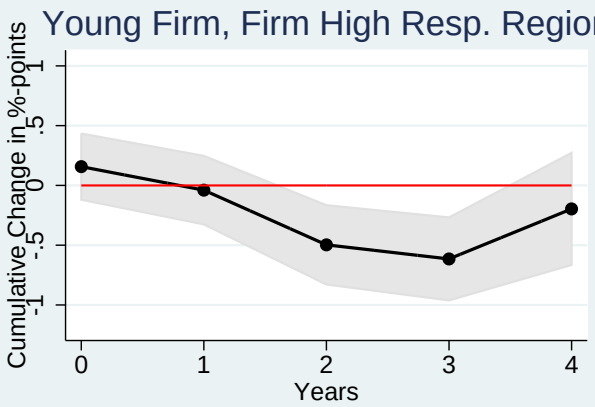
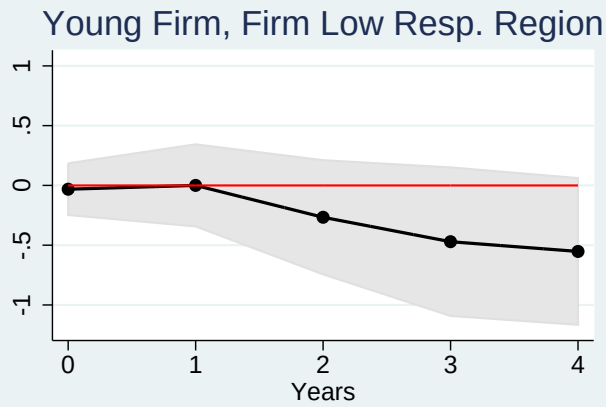
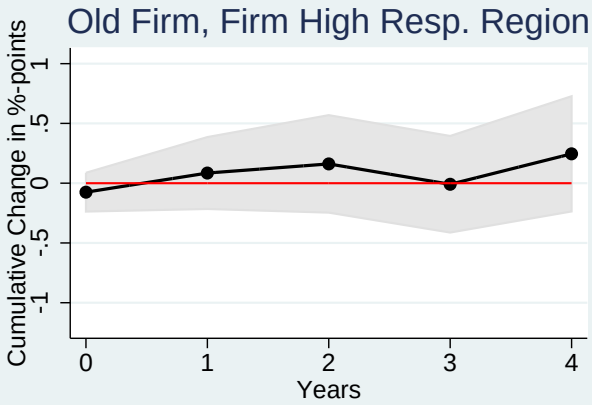
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Employment Response – by Firm Region

Effect Relative to Old Firm With Unresponsive Region







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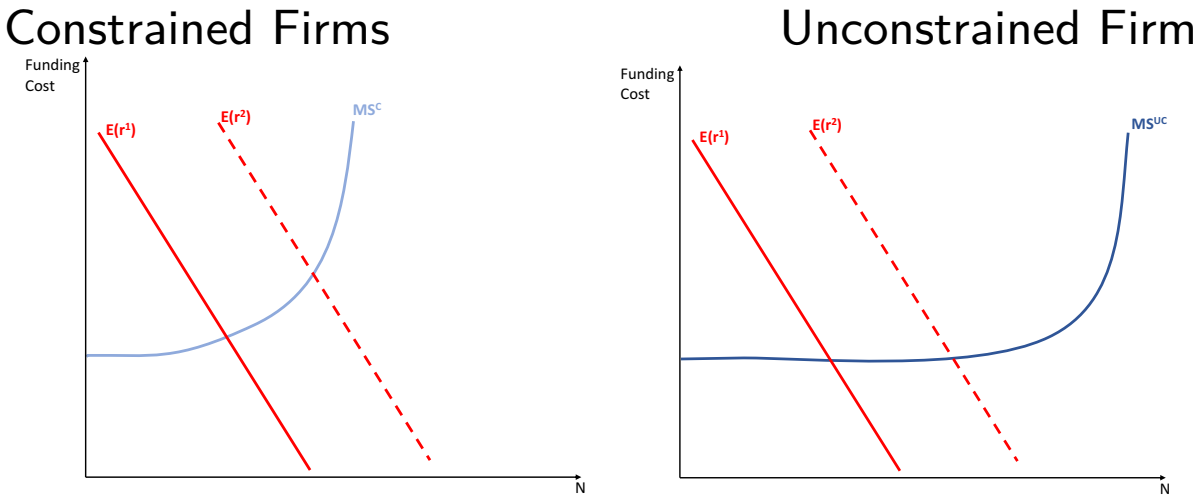
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Insights from Theoretical Models

Do constrained firms respond **more/less** to monetary policy shocks?

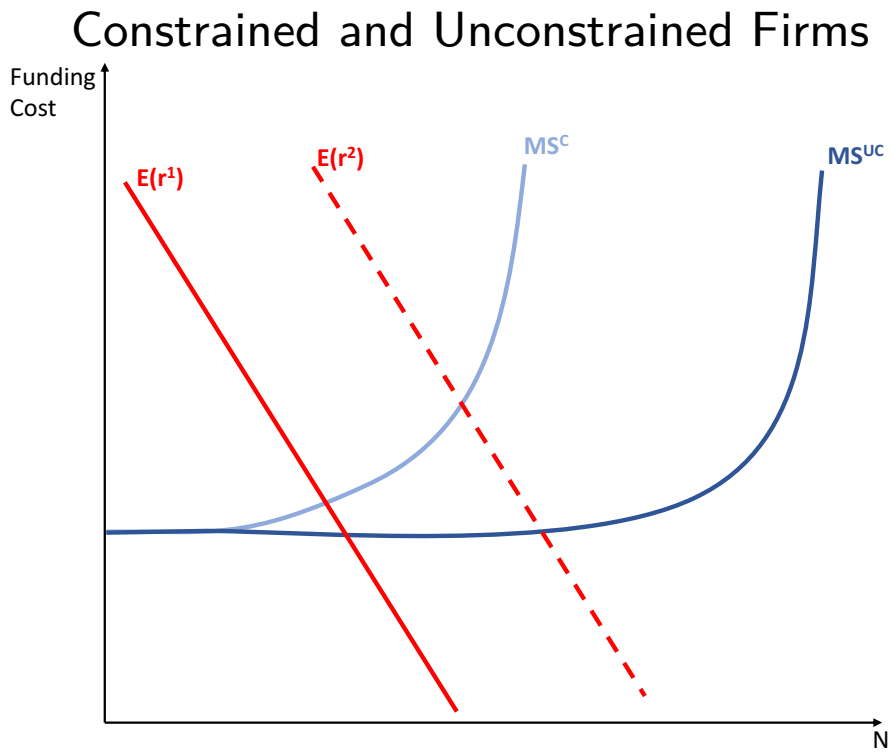
- Seminal papers of Gertler and Gilchrist [1994] and Kashyap et al. [1994] suggest that **financially constrained** firms respond **more**
- Recently Ottonello and Winberry [2018] challenged these findings and shows that **financially less constrained** (low-leverage) firms respond **more**:

Figure : Marginal Benefit (red) and Marginal Cost (blue) Curves



Insights from Theoretical Models

Figure : Marginal Benefit (red) and Marginal Cost (blue) Curves at the Firm-level

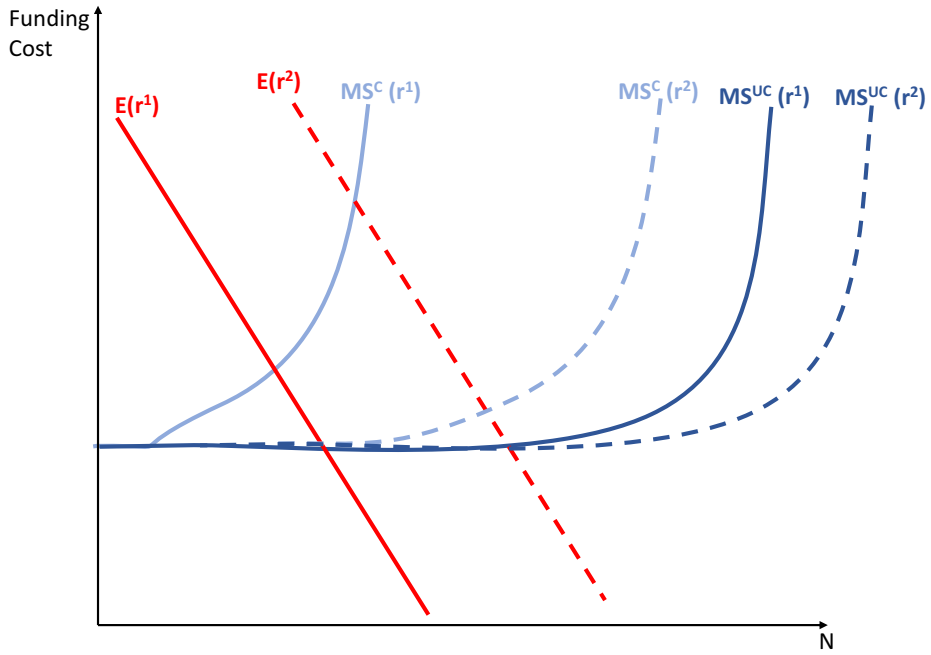


Insights from Theoretical Models

Monetary policy shocks affect asset prices, **shifting the marginal cost curve** too

- The marginal cost curve shift can be larger for constrained firms $\rightarrow$ overall firm activity of constrained firms can respond more!

Constrained and Unconstrained Firms



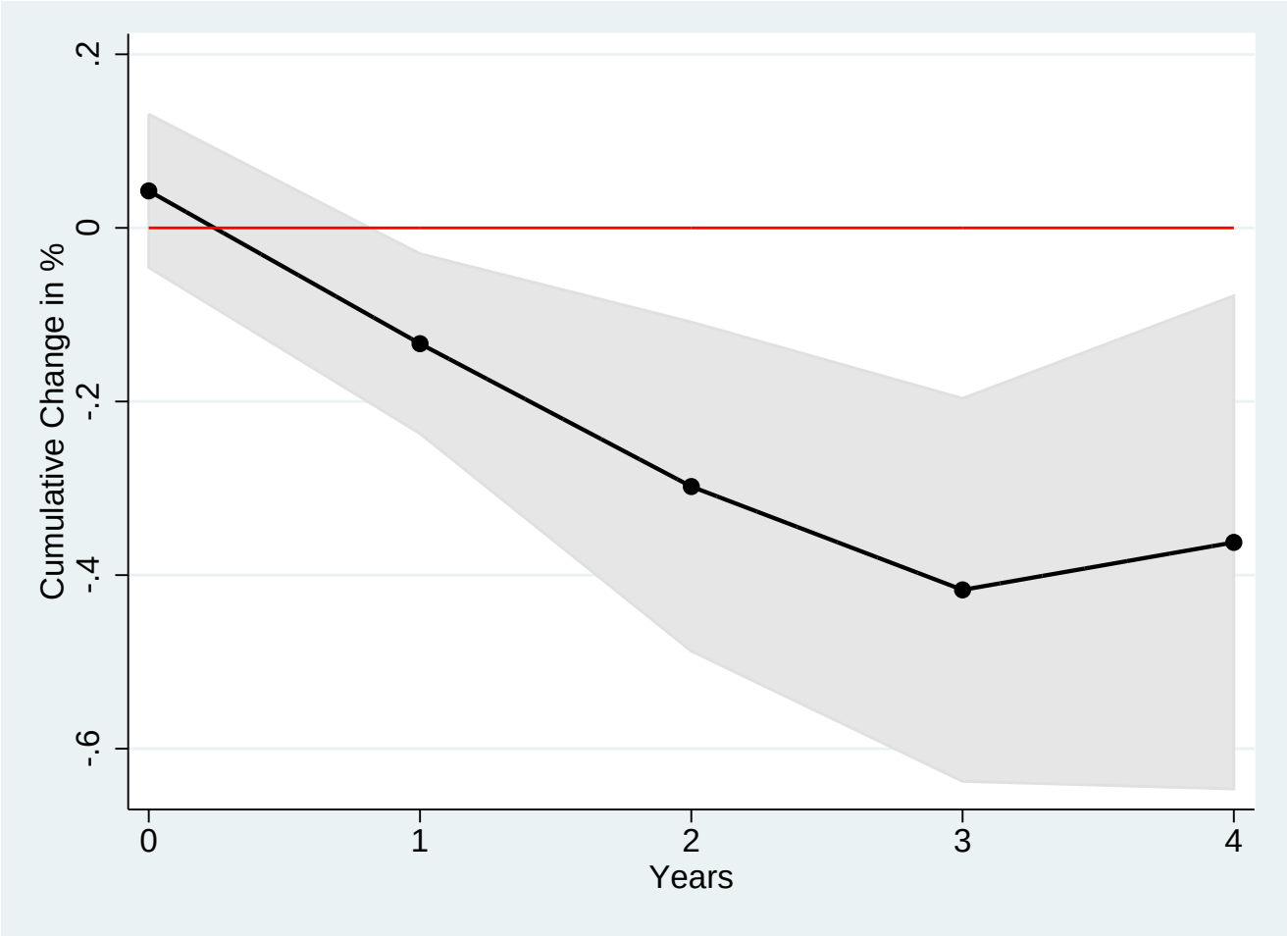
Grouping by Firm Director Age

Below, Above Median

Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Grouping by Firm Director Age

Relative Effect of Having Young Directors



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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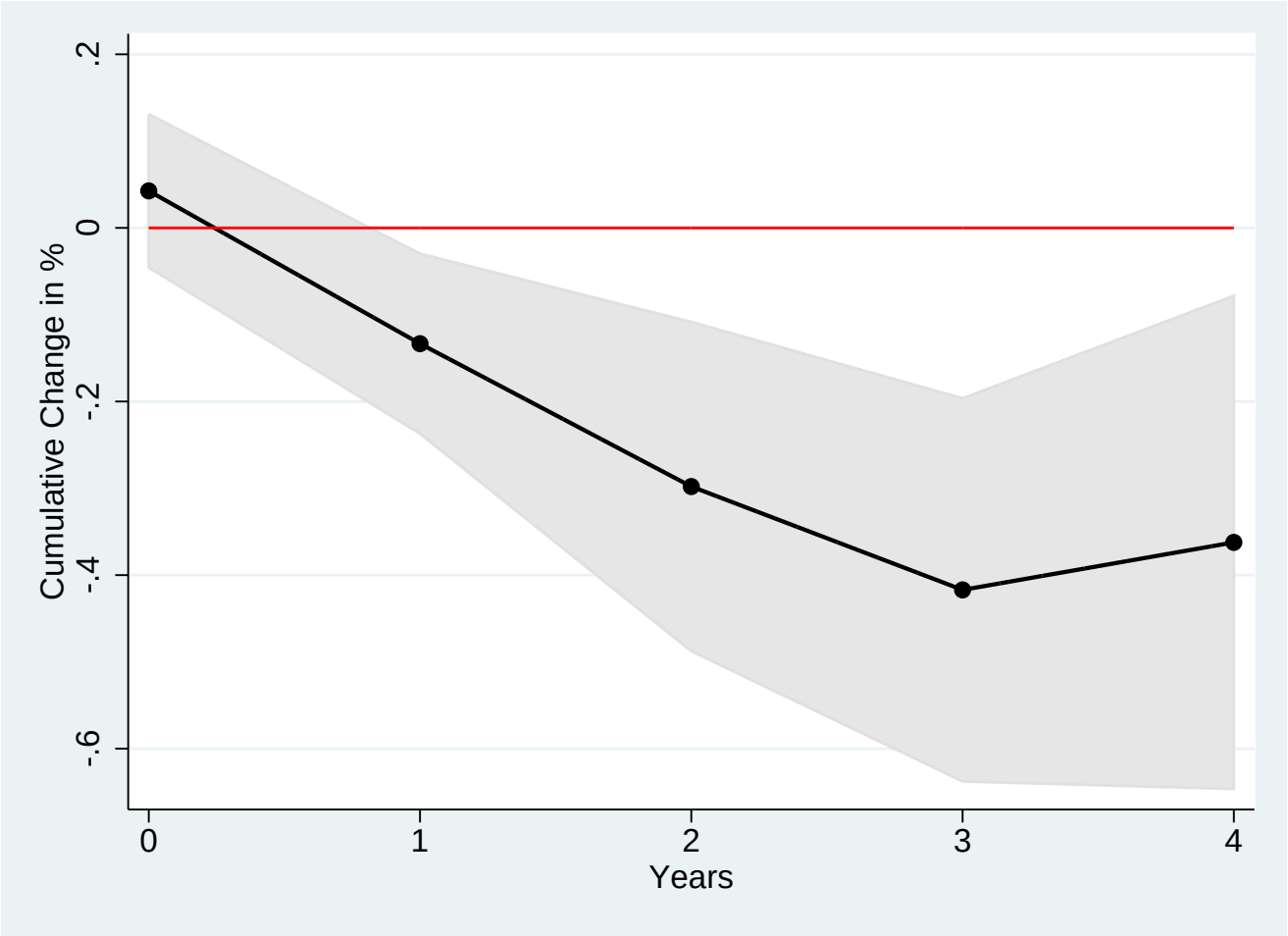
Relative Employment Response of Young Firms

Including Bank-time Fixed Effects



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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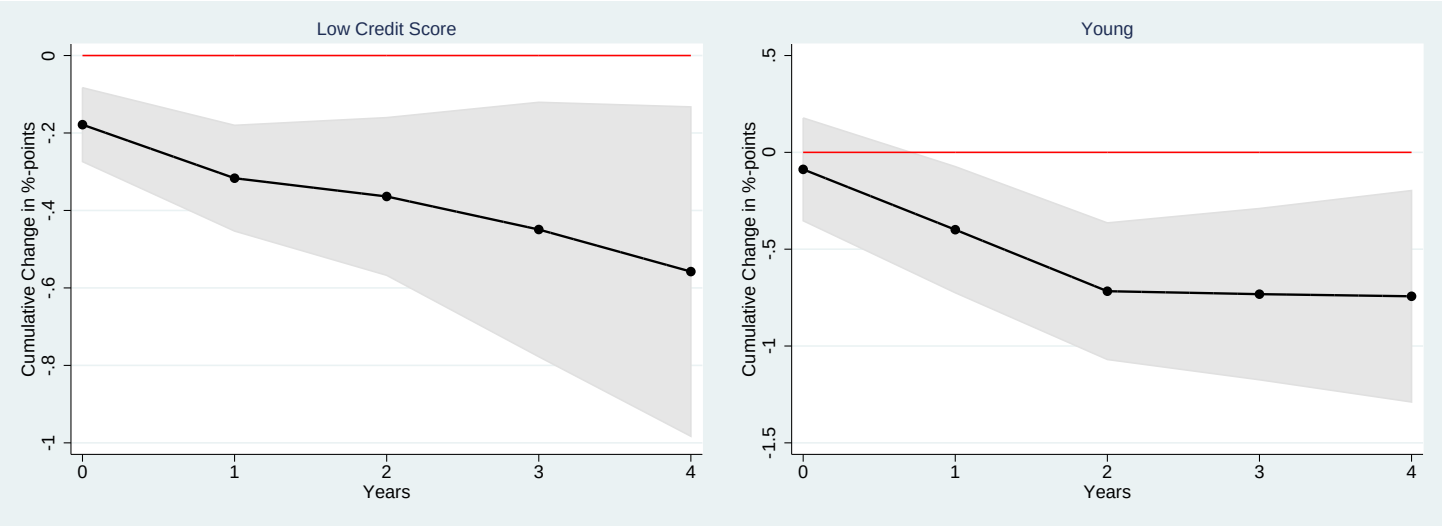
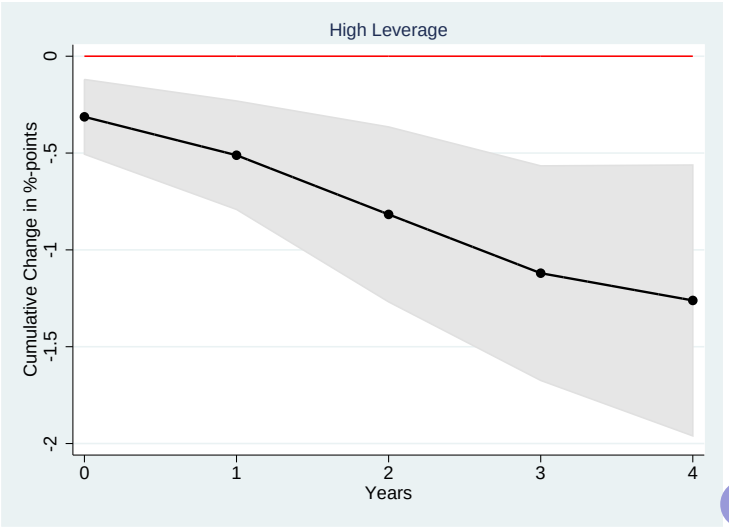
Relative Employment Response – Region-time FE

Grouped by Credit Score, Age, Leverage





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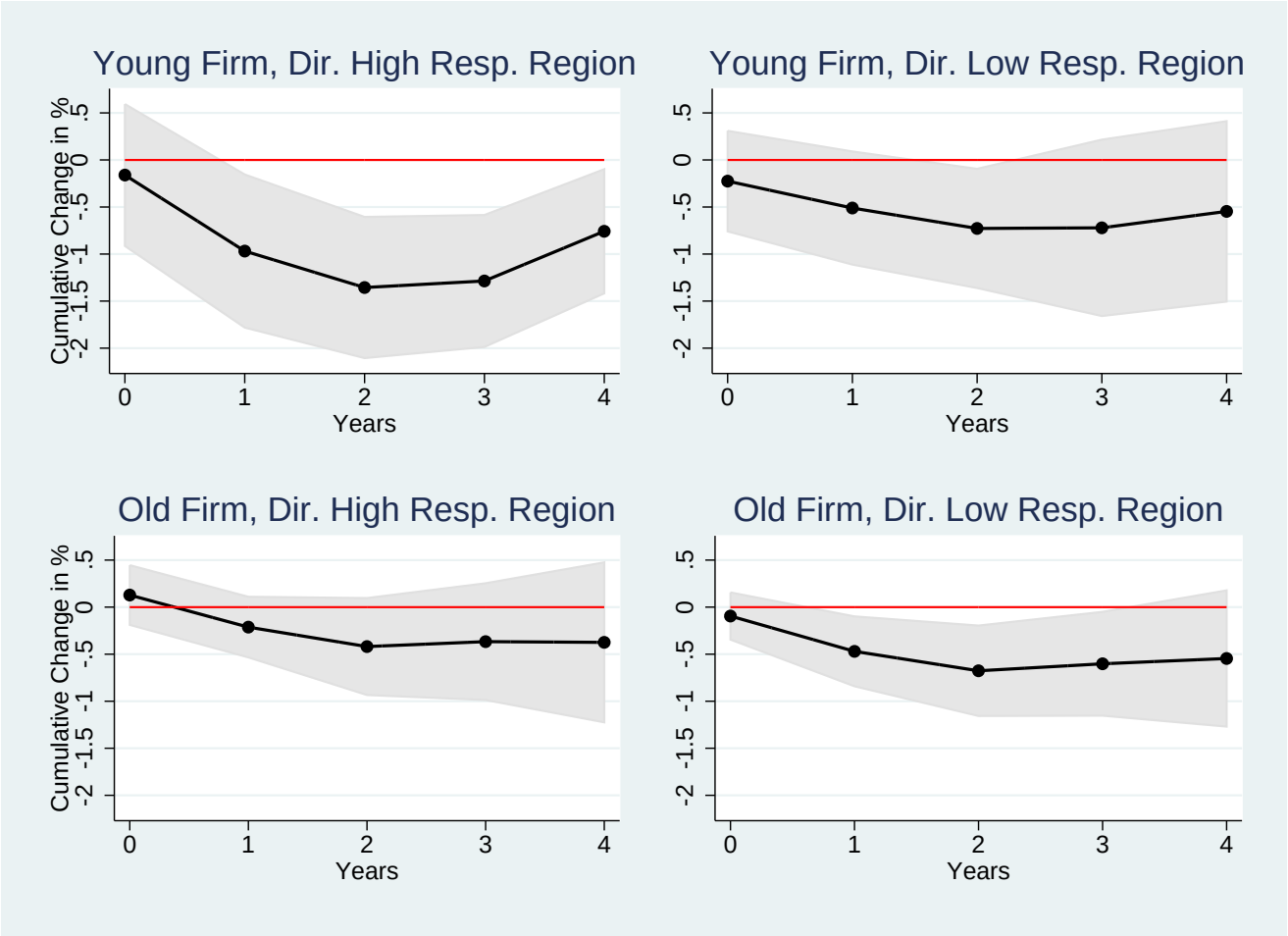
Employment Response – by Director Region

Grouping by Firm Age and House Price Responsiveness of Director Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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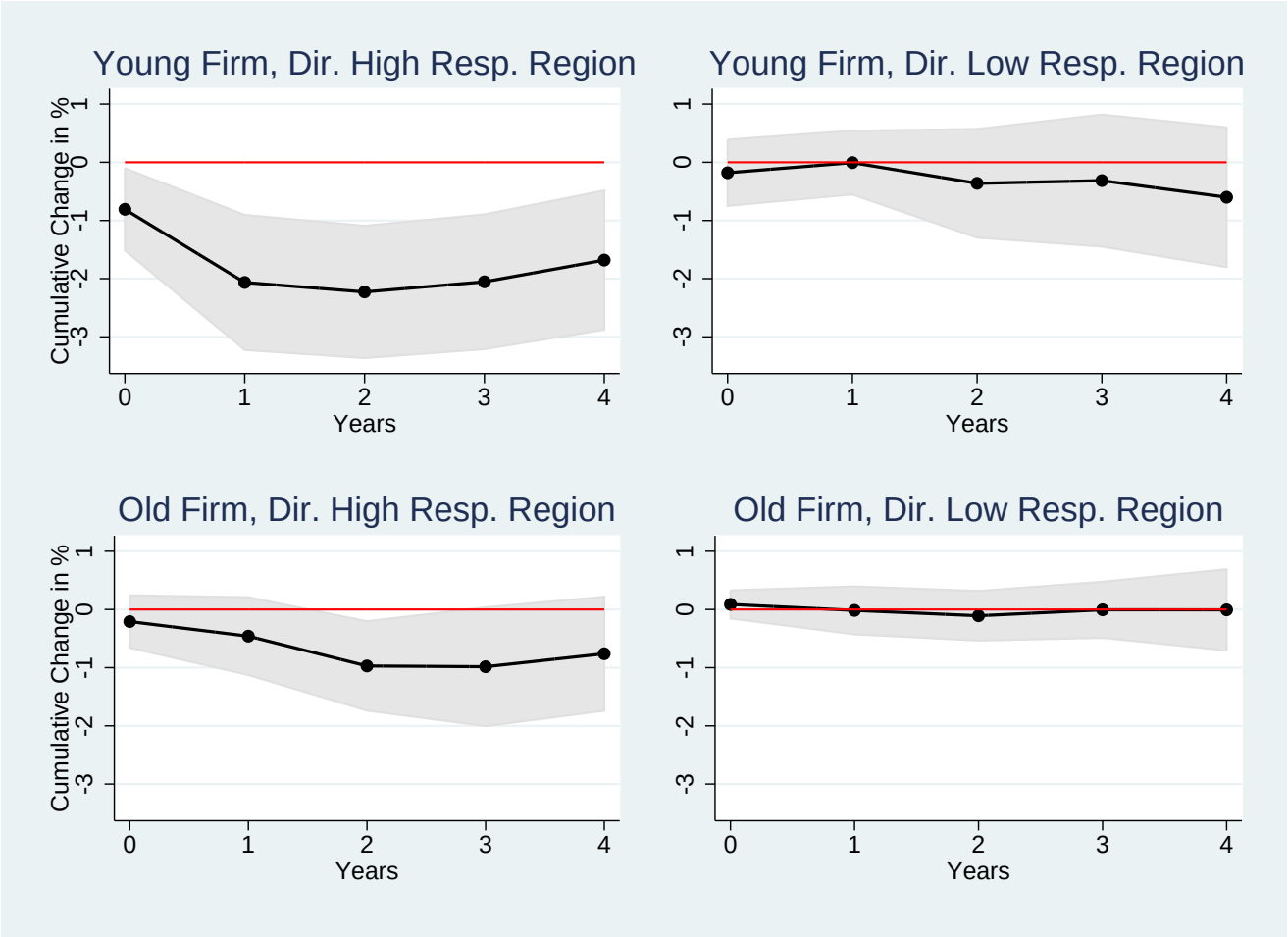
Net Worth (Shareholder's Funds) Response

Grouping by Firm Age and House Price Responsiveness of Director Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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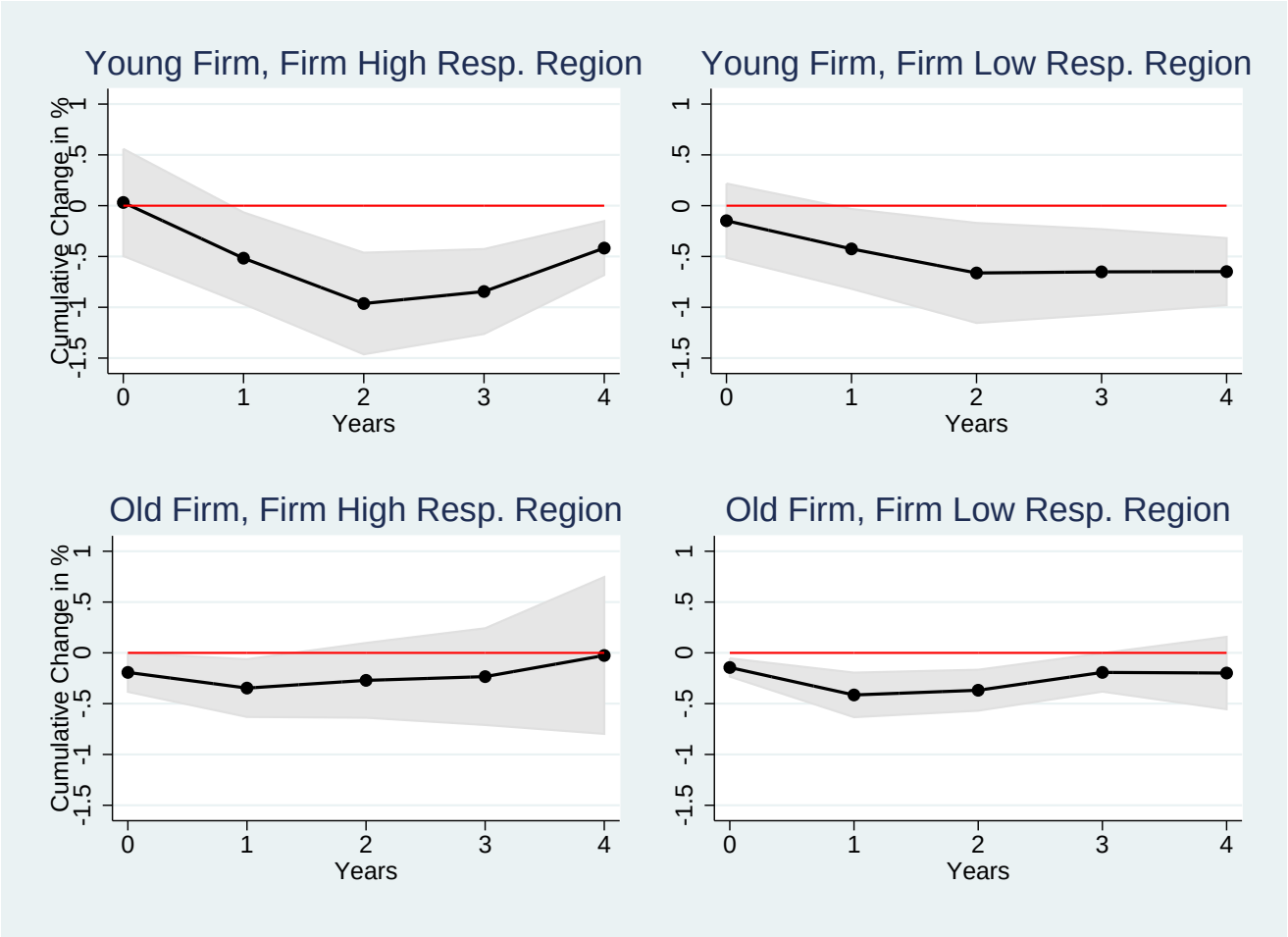
Employment Response – by Firm Region

Grouping by Firm Age and House Price Responsiveness of Director Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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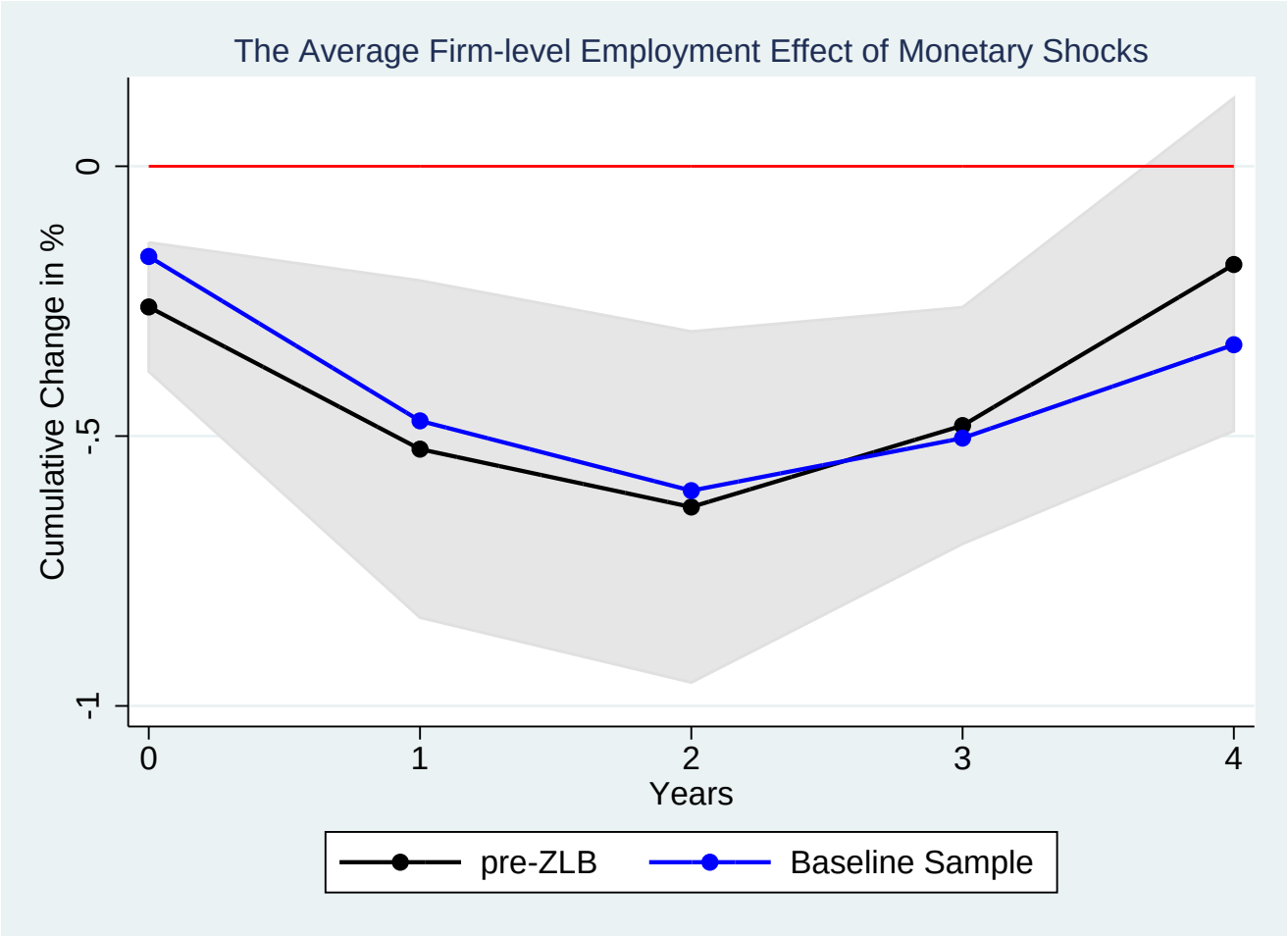
Firm Level Employment Response

25bp Contractionary Shock



Notes: Shaded area corresponds to 90% confidence intervals, associated with the firm-level response.

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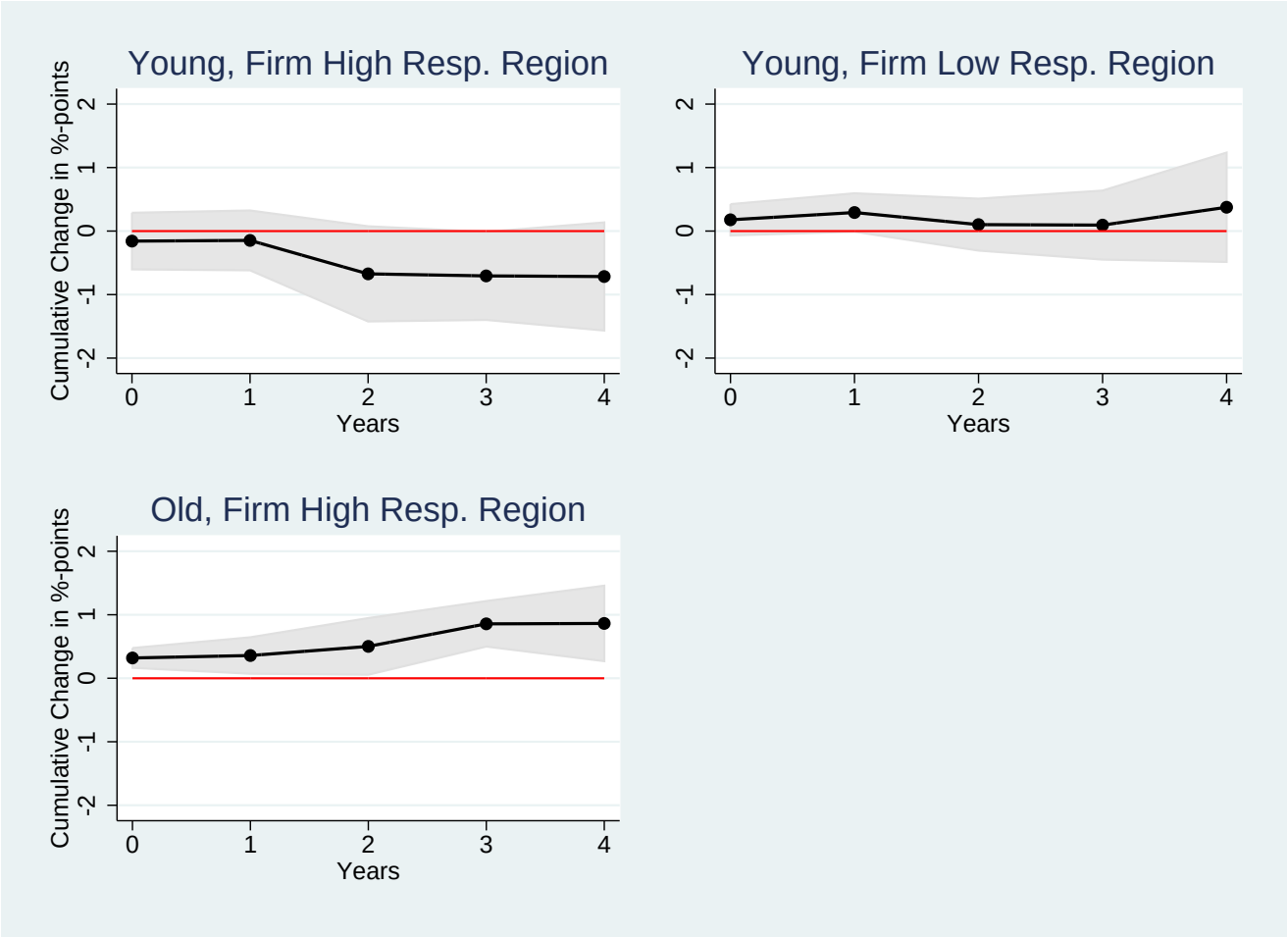
Ruling Out Local Demand – Tradeables Firms

Effect Relative to Low Leverage Firm With Unresponsive Region

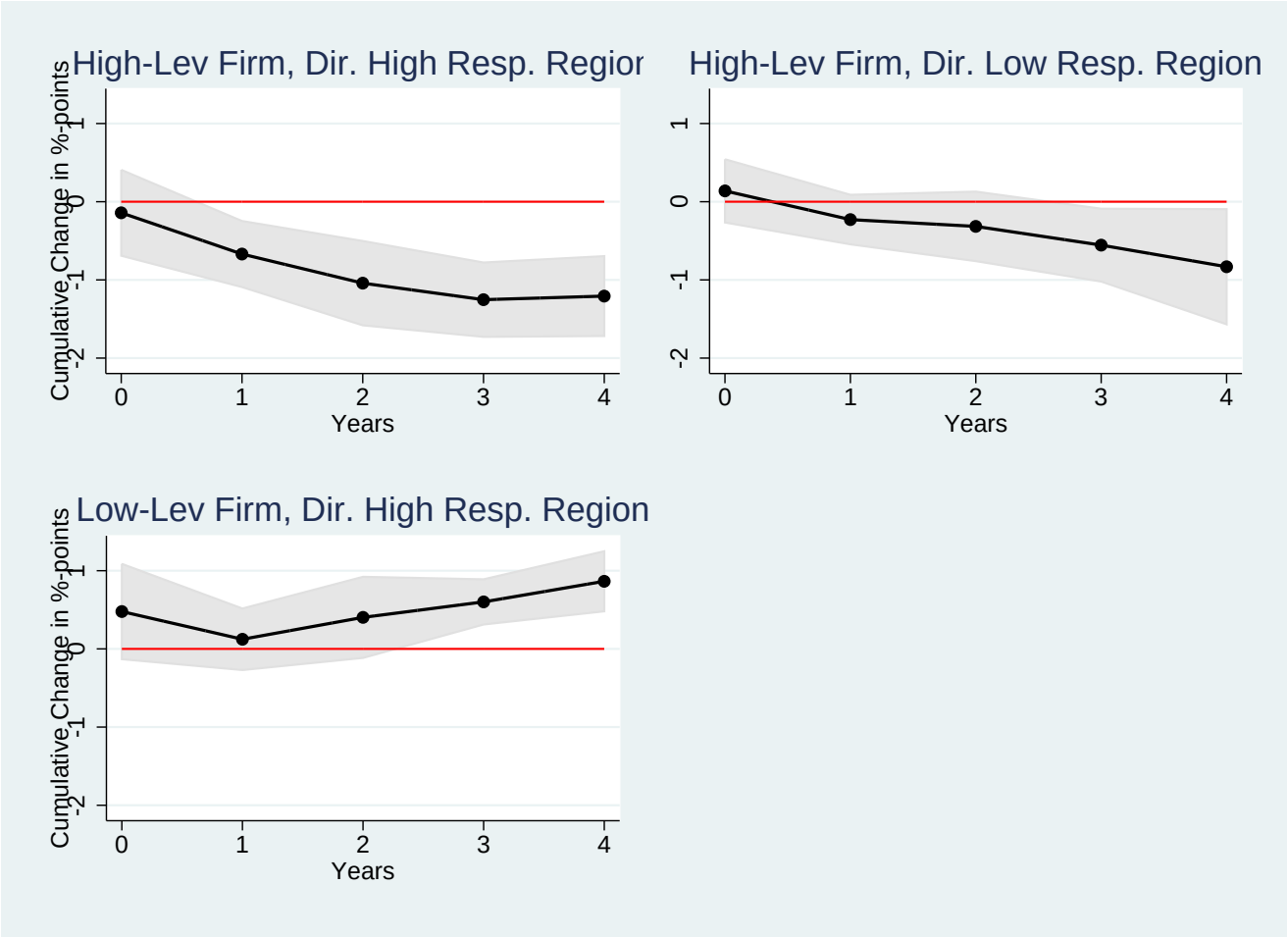


Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Back

Employment Response – Leverager and Region-Sensitivity

Effect Relative to Low Leverage Firm With Unresponsive Region



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

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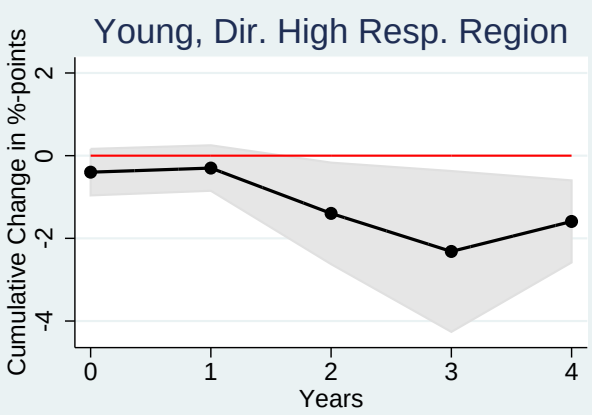
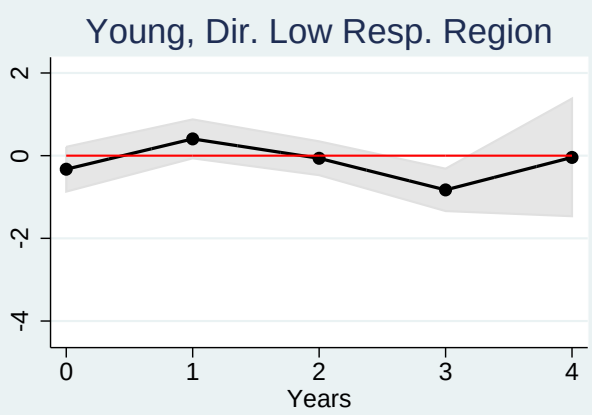
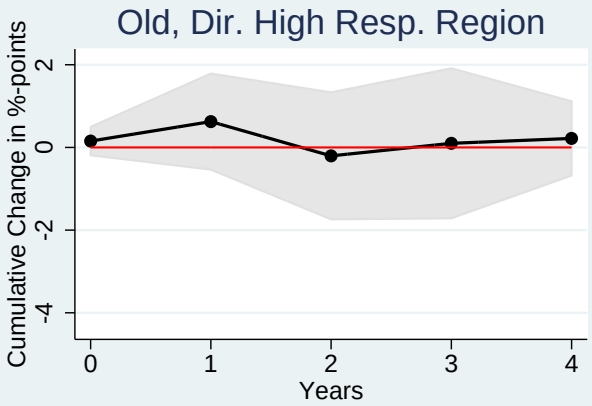
Firms with Directors Living far (>30 miles) away from their Firm

Effect Relative to Old Firm With Unresponsive Region







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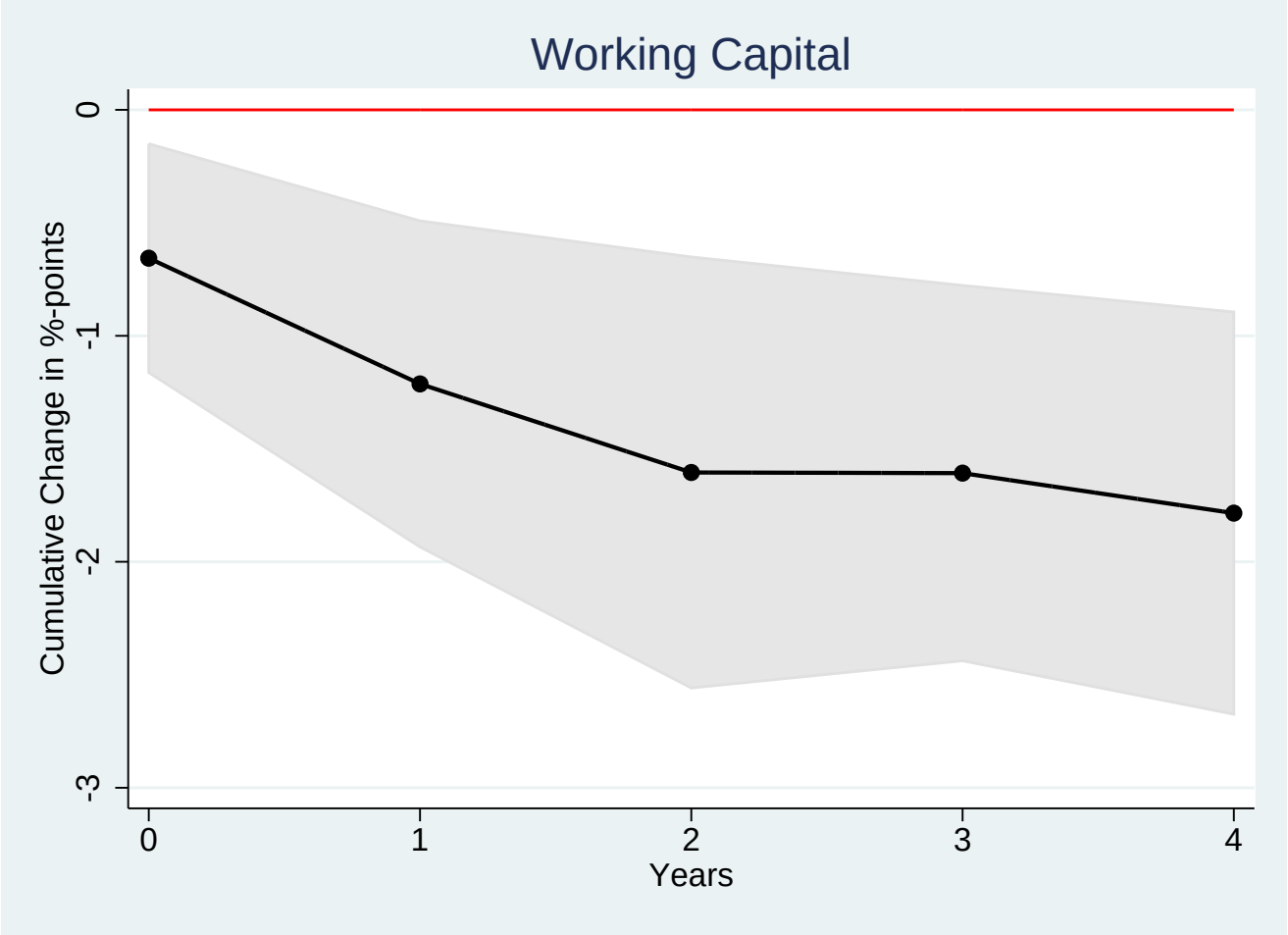
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals

RELATIVE Working Capital Response of YOUNG Firm

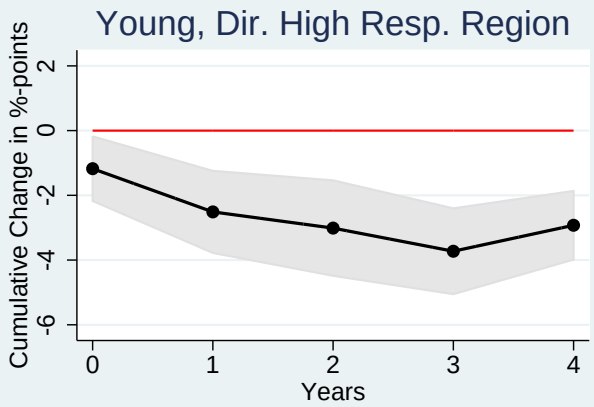
Relative to Old

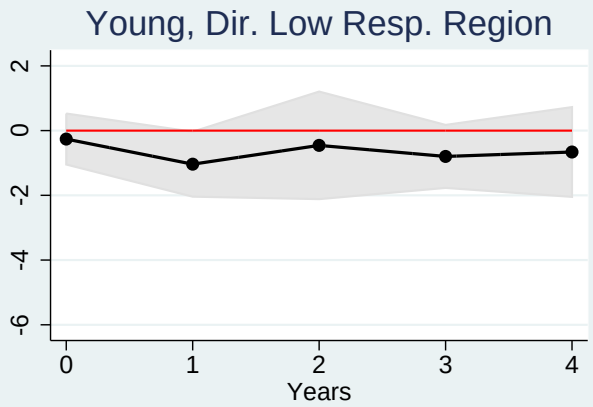


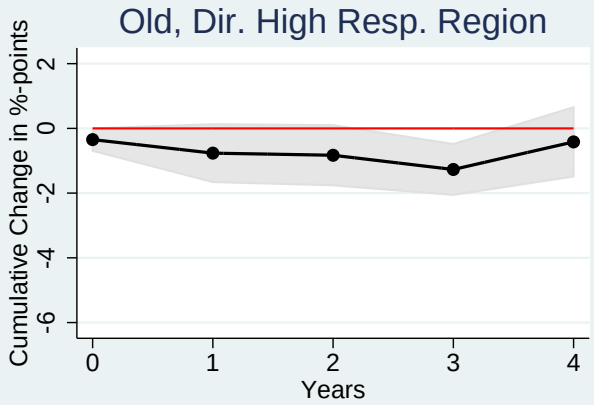
Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Working Capital Response

Effect Relative to Old Firm With Unresponsive Region







Back

Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.

Effect of Monetary Policy on House Prices

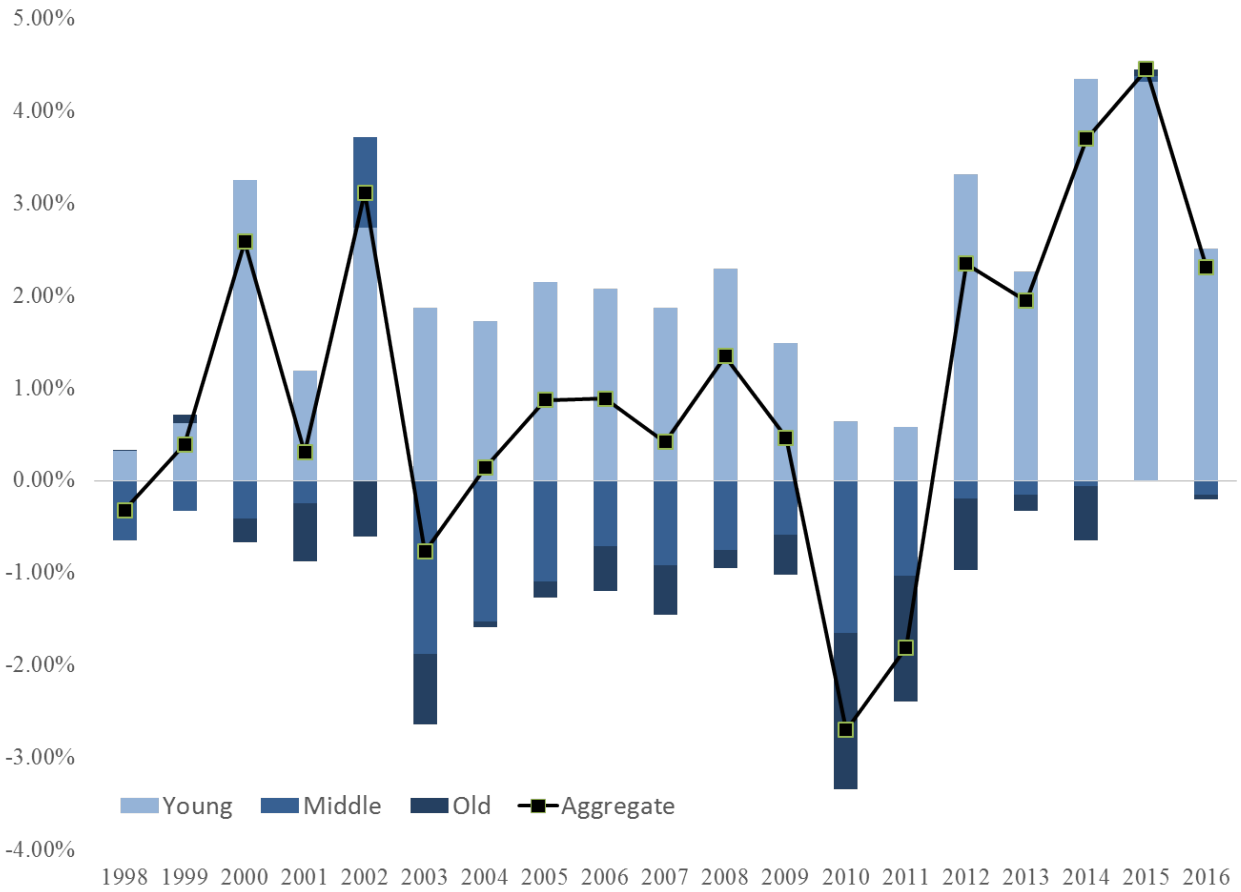
International Evidence from the Literature

		SHOCK	EFFECT AFTER 2Y (-)	Country	SAMPLE
Del Negro-Otrok	2007	100bp	10%	US	1975-2005
John Williams	2015	100bp	6-8%	17 countries	1950-2013
Jarocinski-Smets	2008	100bp	4-8%	US	1987-2007
Iacoviello-Minetti	2006	100bp	8-9%	International	1978-1999
Gerlach-Assenmacher	2009	100bp	4-8%	International	1986-2006

Back

Why should we care about young firms?

Contributions to Changes in Aggregate Employment by Age



Credit Score and Leverage by Firm Age Back

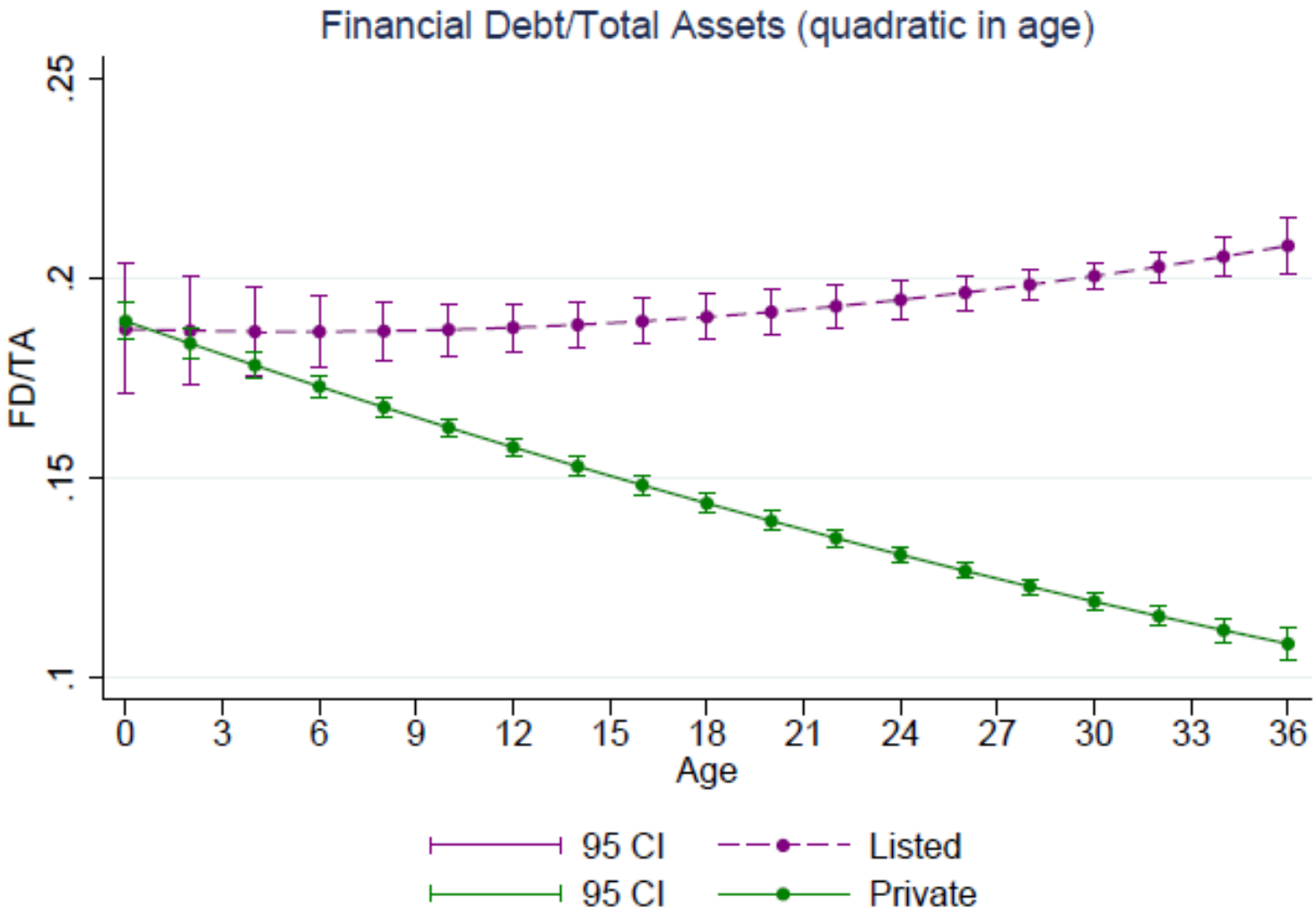
Relation to Ottonello-Winberry

6-step Reconciliation

1. There seems to be only an apparent tension between findings
2. OW show that low-leverage firms respond more – we show that high-leverage respond more
3. **Dinlersoz-Kalemli-Ozcan-Hyatt-Penciakova (2018)**: leverage-age relationship is very different between public and private firms:
   - We use private-firm dominated sample
   - OW uses public firm dominated sample (Compustat)
4. (3) suggests that the common factor between us and OW is that young respond the most
   - we also show that within highly levered firms, young respond more
5. **Cloyne-Ferreira-Froemel-Surico (2018)** confirmed OW result in that low leverage respond more in Compustat
   - but within low leverage firm, only young respond
6. Age is the main determining factor [not leverage]

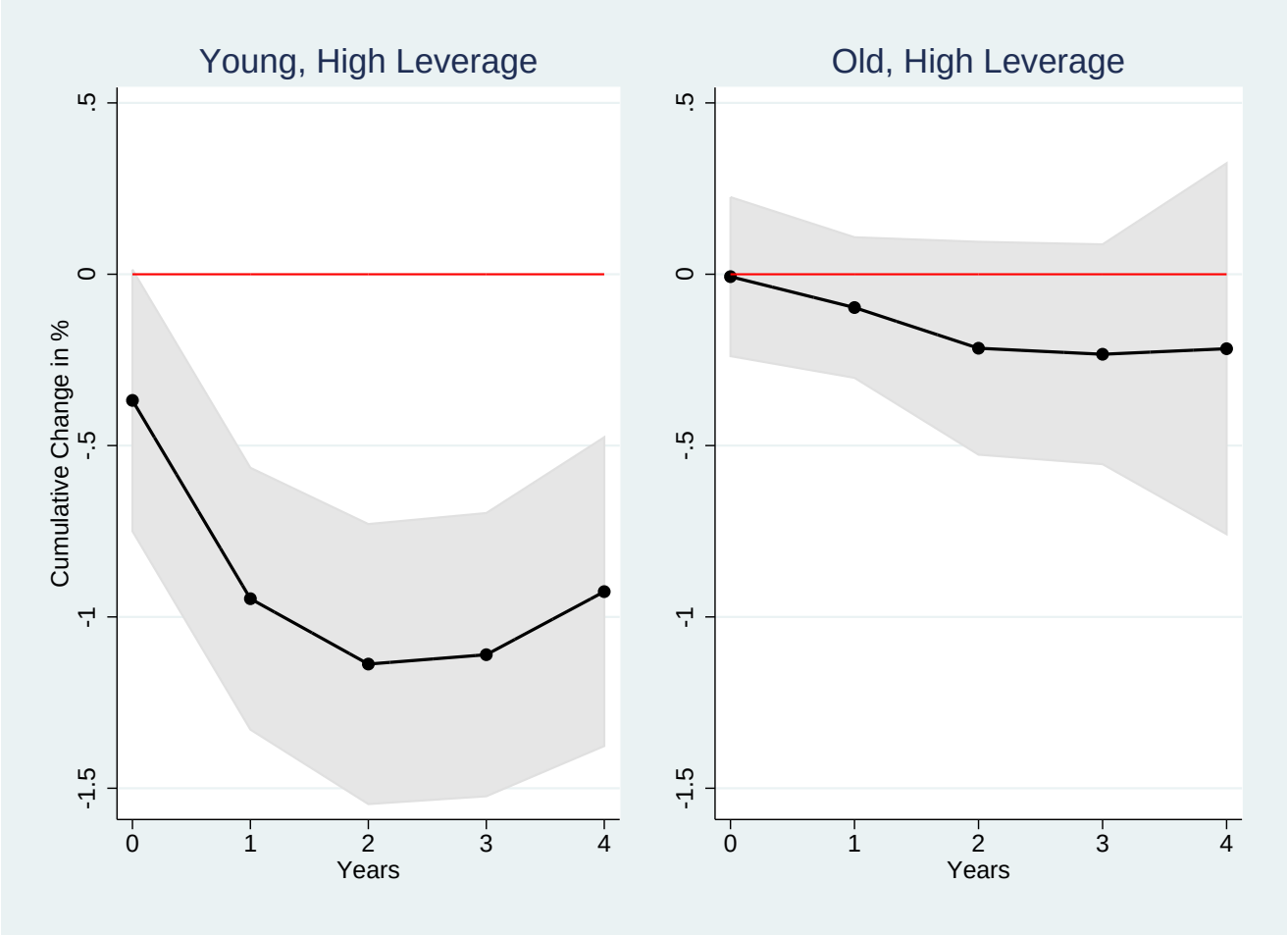
Leverage-Age Relationship Among Private/Public Firms

Emin Dinlersoz, Sebnem Kalemli-Ozcan, Henry Hyatt, Veronika Penciakova (2018)



High Leverage Firms: Young vs Old Firms

The Role of Firm Age



Notes: Responses to a 25bp contractionary monetary policy shock. Shaded area corresponds to 90% confidence intervals.