Firm Heterogeneity and the Capital Market

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Research Question

Question:

What is the role of financial constraints for the transmission of both an external equity financing shock and a monetary policy shock on firm investment rates?

What is an aggregate external equity financing shock here?
An idiosyncratic change in the demand for shares of large firms with positive general equilibrium spill-over effects on both aggregate outstanding shares and share prices of SMEs.

E.g. Investor-side shock on the demand for Google shares.

Motivation

Investment explain large share of business cycle fluctuations.

Role of financial constraints for the most important sources of firms funding:

- external equity and corporate loans

Analyze role of financial constraints by looking at transmission of monetary policy shocks and external equity financing shocks.

Share issuance and share buybacks in the US

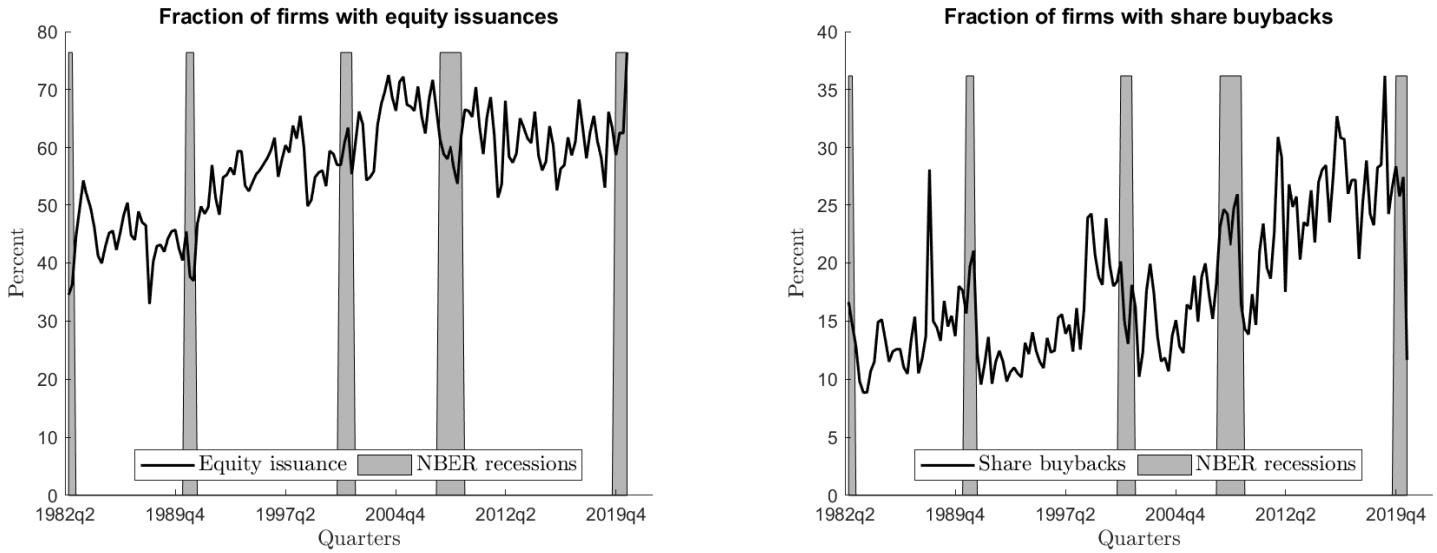

Figure: Fraction of firms that either issue equity or reduce the amount of outstanding shares. Own calculations based on Compustat sample.

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This paper

1. Constructing an instrument for external equity financing shocks by using firm-level data
   - by using a novel method
   - Granular Instrumental Variables, Gabaix and Koijen (2020, NBER)

2. I investigate: role of up to six financial constraints firms face when (i) capital market funding improves, (ii) lending rates are cut via monetary policy.

3. I demonstrate: it is highly relevant to distinguish between diff. types of constraints to explain het. in firms' investment rates.
   - relevant both for including fin. constraints in theoretical models and for empirical research

Literature

Literature

External equity financing shock:

- Belo et al. (2019, RFS), Eisfeldt and Muir (2016, JME)

Financial constraints and heterogeneous firm investment responses:

1. Firm size and monetary policy:
   - Gertler and Gilchrist (1994, QJE), Ferrando et al. (2019, EIB Working Paper)
2. Leverage and monetary policy:
   - Lakdawala and Moreland (2019, REStat), Ottonello and Winberry (2020, Econometrica)
3. Age, dividends and monetary policy:
   - Cloyne et al. (2020, NBER Working Paper)
4. Liquid assets and monetary policy:
   - Jeenas (2019, Working Paper), Cao et al. (2021)
5. Earning-based constraints and monetary policy:
   - Lian and Ma (2021, QJE)

This paper

Results in a nutshell

1. **Equity shock:**
   constrained firms w/ high expected profits (Tobin's Q)
2. **Monetary policy shock:**
   constrained firms w/ high debt burden

	Equity shock	Monetary policy shock
Tobin's Q	+	0
EBC	0	+
ABC	-	-

Table: Sensitivity of firm investment rates relative to the average economy-wide response

EBC: earning-based constraint
ABC: asset-based constraint

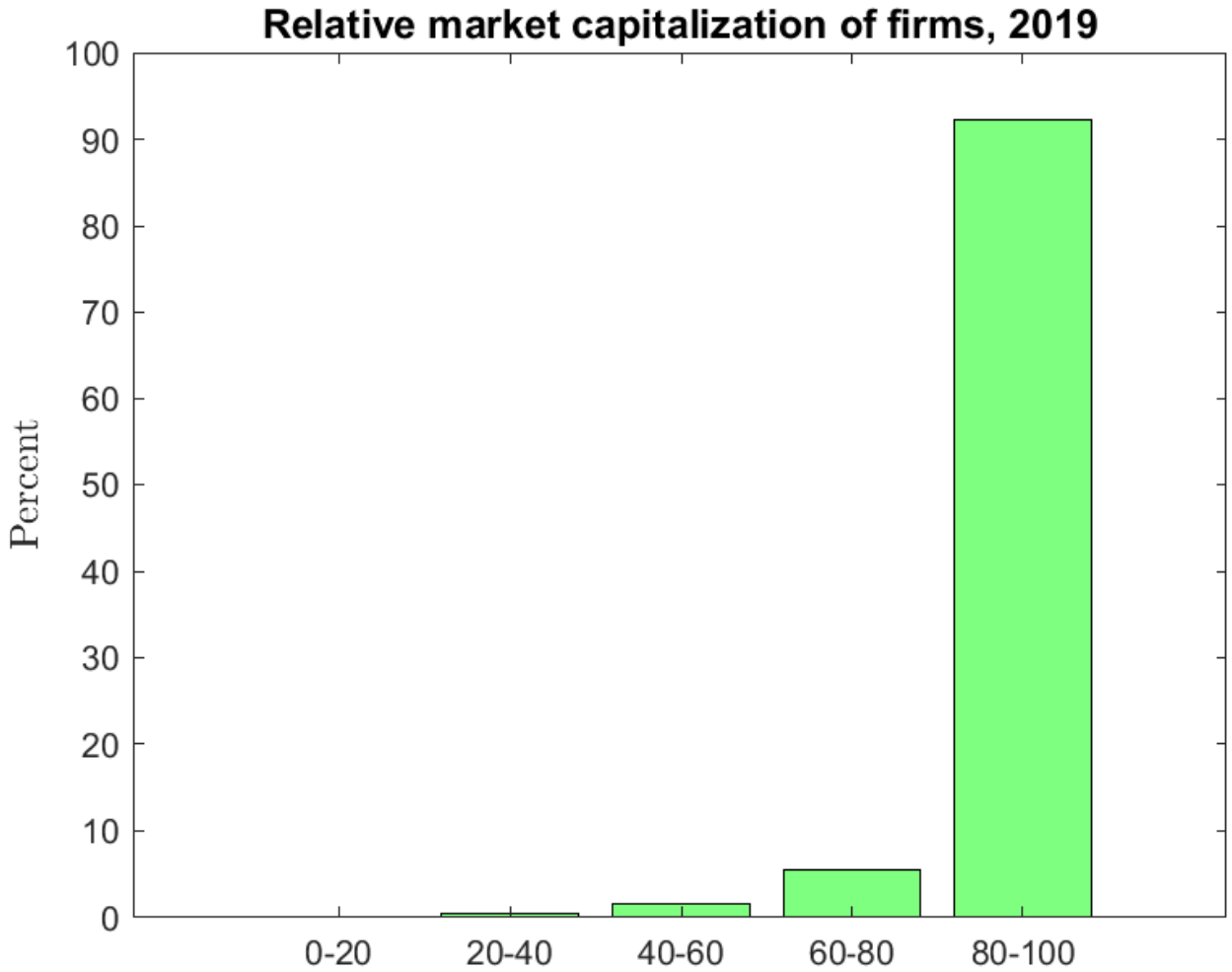
Data set

Data set used:

- Compustat: data set with publicly-listed firms
- Country: United States, 1982Q1 - 2020Q3 (quarterly)
- Net issued equity $\Delta E_{i,t}$: Δ shareholder equity $E^{Sh}_{i,t}$ - Δ retained earnings $RE_{i,t}$, (Covas and den Haan 2011, AER).
- net issued equity rate: $\frac{\Delta E_{i,t}}{E_{i,t-1}} = \frac{E^{Sh}_{i,t} - RE_{i,t} - (E^{Sh}_{i,t-1} - RE_{i,t-1})}{E^{Sh}_{i,t-1} - RE_{i,t-1}}$

Ext. finance | Sample selection | Equity gr. over time | Equity gr. over firm size | Data description

Granularity in the market capitalization distribution



more figures top 10 highest market cap.

Why using Granular Instrumental Variables (GIVs)?

Granular Instrumental Variable

- Relies only on (i) available firm-level data and (ii) positive spill-overs of equity issuance of large firms on share prices and share quantities of SME.
- Micro origin of aggregate shocks (Gabaix 2011, Econometrica).

GIV method

Why using Granular Instrumental Variables (GIVs)?

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Why not using sign restrictions?

- Sign restrictions rely on theoretical models.
- Implied signs of financial variables differ significantly across different financial friction models (Gambetti and Musso, 2016, JAE).
- No consensus in the literature how to infer signs for firm funding shocks.

GIV method

Granular IV Methodology

Gabaix and Koijen (2020)

The GIV for the external equity financing shock is defined as:

$$u_t^{giv} = \sum_{i=1}^{N} \tilde{S}_{i,t-1} \hat{\epsilon}_{i,t} - \frac{1}{N} \sum_{i=1}^{N} \hat{\epsilon}_{i,t}$$

- $\hat{\epsilon}_{i,t}$: estimated innovation to firm's i equity growth rate.
- $\tilde{S}_{i,t-1}$: lagged market val. of firm's i out. shares / by aggr. market cap.

Firm equity innovations: $\epsilon_{i,t} = \lambda_{i,t}\eta_t + u_{i,t}$.

Controlling for different factor loadins: Principal component analysis (PCA) on $\hat{\epsilon}_{i,t}$ to estimate common components η_t^{PCA}.

Identification roadmap Firm innovations GIV Theory more background PCA

Firm-specific innovations to changes in issued equity

I estimate $\hat{\epsilon}_{it}$ via:

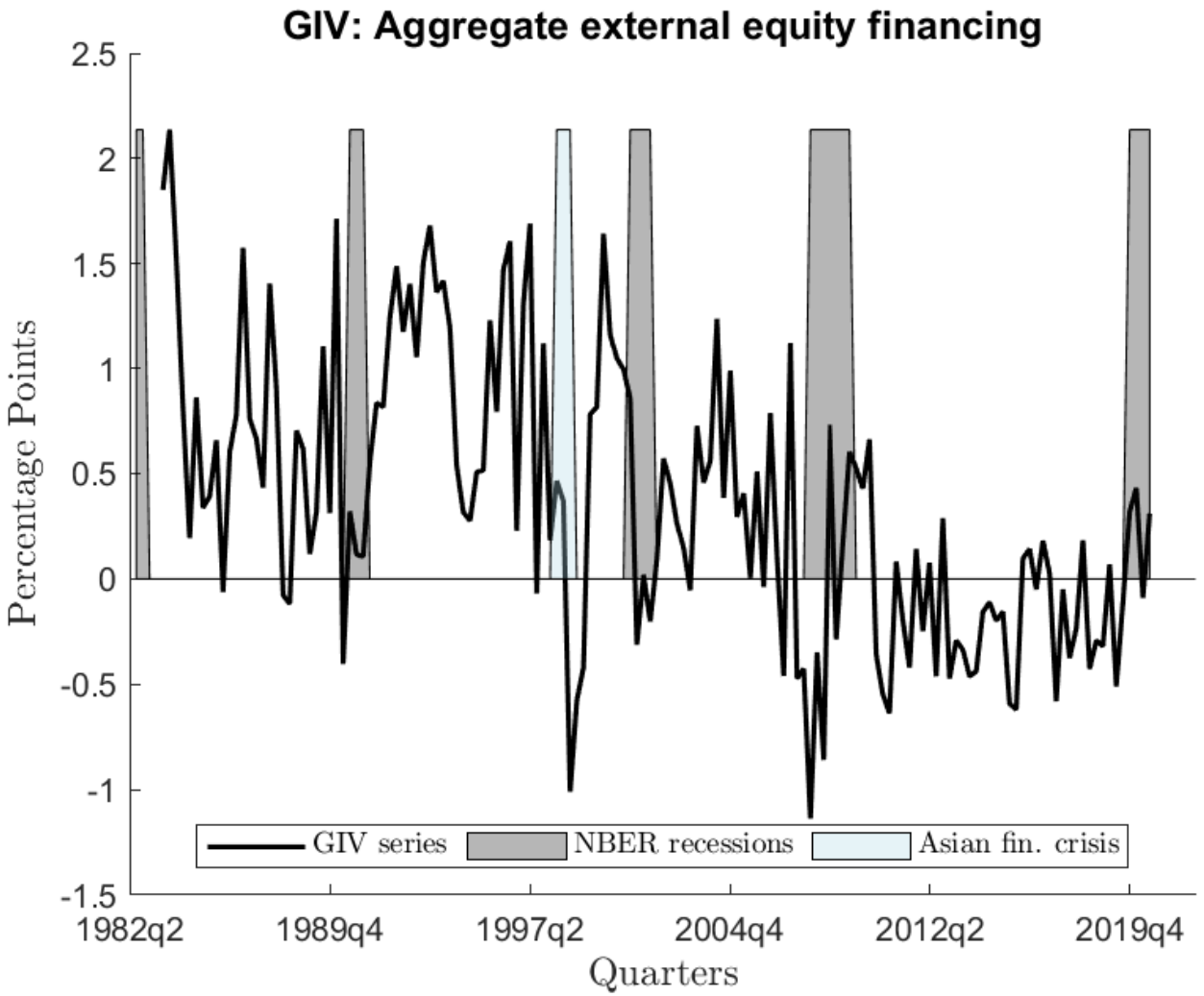
$$\frac{\Delta E_{i,t}}{E_{i,t-1}} = \alpha_i + \nu_{sc} + \sum_{k=1}^{4} \beta_k^f X_{i,t-k} + \sum_{k=1}^{4} \beta_k^m F_{t-k} + \beta_3 t + \beta_4 t^2 + \epsilon_{it} \quad (1)$$

- α_i: firm fixed effects
- ν_{sc}: sector-state fixed effects
- $X_{i,t}$: firm controls
- F_t: macro controls

In spirit to the literature on firm-specific lending innovations (Landier et al.,2017, JFE; Galaasen et al., 2020, Norges Bank WP; Bremus et al. 2021, DIW WP).

Firm controls Histogram GIV definition

Instrument for the external equity shock



size weighted | equally weighted | aggregate shares mk | Sector GIV | Relevance

Average effect of equity issuance

I follow Jorda et al.(2015,JIE) and define a 2-stage LP-IV regression:

1st stage: Mean equity issuance on GIV:

$$\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}} = \beta^{giv,eq} u_t^{giv} + \sum_{k=1}^{4} \Psi_k^{1st} F_{t-k} + \Upsilon^{1st} \eta_t^{PCA} + e_t^{1st}.$$

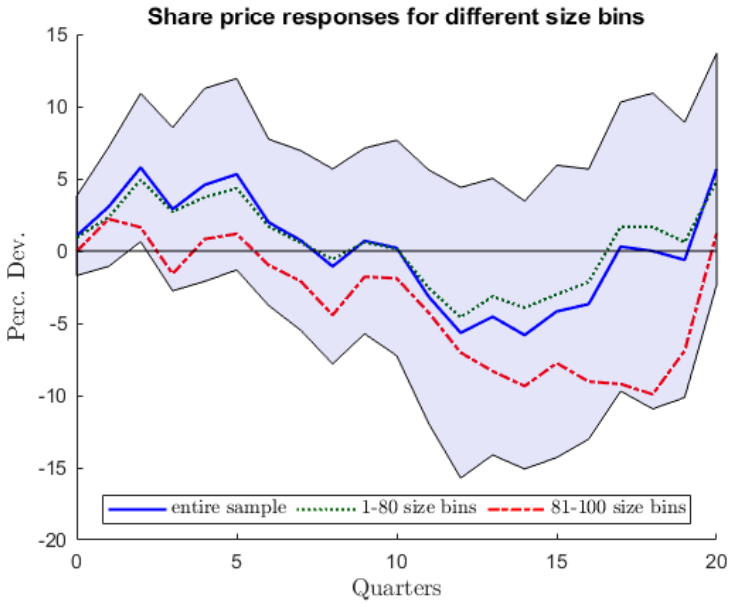
Results 1st stage

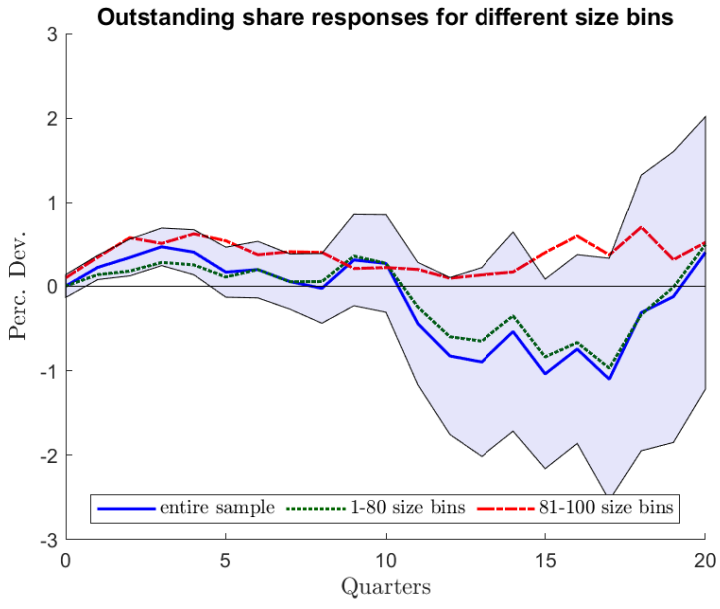
2nd stage: Average firm level response to equity shock:

$$\frac{\Delta y_{i,t+h}}{y_{i,t-1}} = \alpha_i^h + \nu_s^h + \beta^h \frac{\Delta E_t^{aggr}}{E_{t-1}^{aggr}} + \sum_{k=1}^{1} \Gamma_k^h Z_{i,t-k} + \sum_{k=1}^{4} \Psi_k^h F_{t-k} + \Upsilon^h \eta_t^{PCA} + e_{i,t}^h.$$

using u_t^{giv} as an instrument for $\frac{\Delta E_t^{aggr}}{E_{t-1}^{aggr}}$.

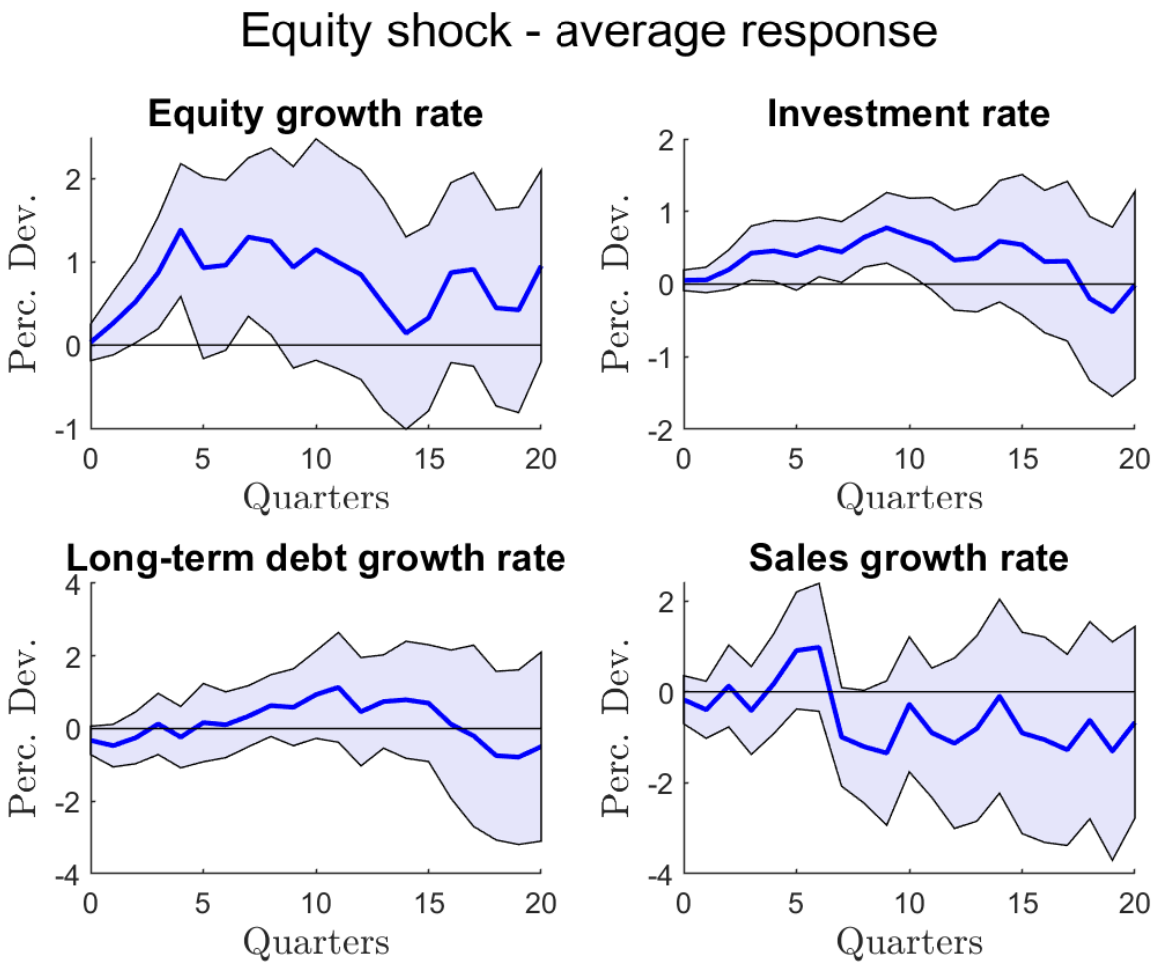
Demand side GIV: Price and Quantities





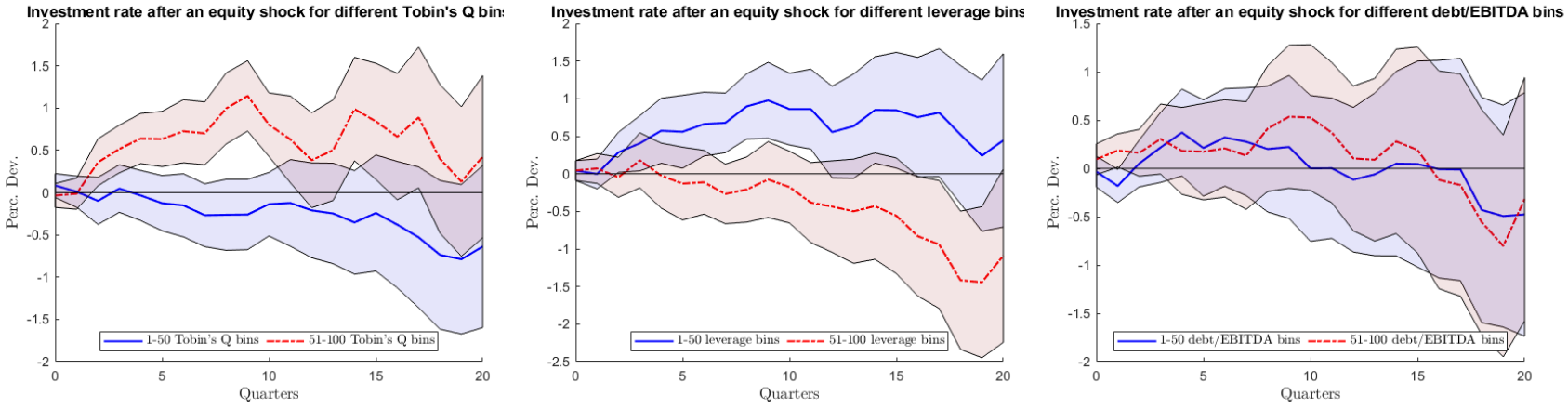
Interpretation: Demand-side ext. equity financing shock.

Average response to Equity Shock



Robustness checks - factors Robustness checks - clustering

Responses along the firm distributions



(a) Tobin's Q (b) Book leverage (c) Debt/EBITDA

Figure: Impulse responses to a 1 standard deviation positive external equity shock along several dimensions of the firm distribution.

- large differences in inv. rates along the Tobin's Q distribution
- We have to look at marginal responses to really determine role of financial constraints.

What causes nonlinear responses in investment?

From the literature we know nonlinear responses in firms' investment might be linked to the degree of financial constraints:

- Tobin's Q (finance theory)
- book leverage (Ottonello and Winberry 2020)
- debt/EBITDA (Lian and Ma 2021)

In the following I investigate the role of those three financial measures for the transmission of the equity shock.

- interacting measures with external equity shock

Correlation Financial Measures

	Size	Leverage	Avg. Q	Liq.	EBC	Div.-paying
$Corr(\cdot, size_{i,t})$	1.00					
$Corr(\cdot, Leverage_{i,t})$	-0.08	1.00				
$Corr(\cdot, TobinsQ_{i,t})$	-0.21	0.27	1.00			
$Corr(\cdot, Liquidity_{i,t})$	-0.14	-0.16	0.28	1.00		
$Corr(\cdot, EBC_{i,t})$	0.56	0.10	-0.05	-0.09	1.00	
$Corr(\cdot, div\_dummy_{i,t})$	0.05	0.08	-0.01	-0.07	0.06	1.00

Table: Correlation matrix of firms' financial conditions

Several financial constraint measures circulating in the literature are correlated.

- control for multiple interactions to identify role of a given measure (Cao et al. 2021).

Marginal effects of firms' financial condition

The marginal responses of firms with a one std. dev. higher financial measure $FC_{i,t-1}$ are simultaneously estimating by:

$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \alpha_i^h + \nu_{st}^h + \gamma^h [FC_{i,t-1} \times \frac{\Delta E_t^{aggr}}{E_{t-1}^{aggr}}] + \sum_{k=1}^{1} \Gamma_k^h X_{i,t-k} + e_{i,t}^h, \quad (2)$$

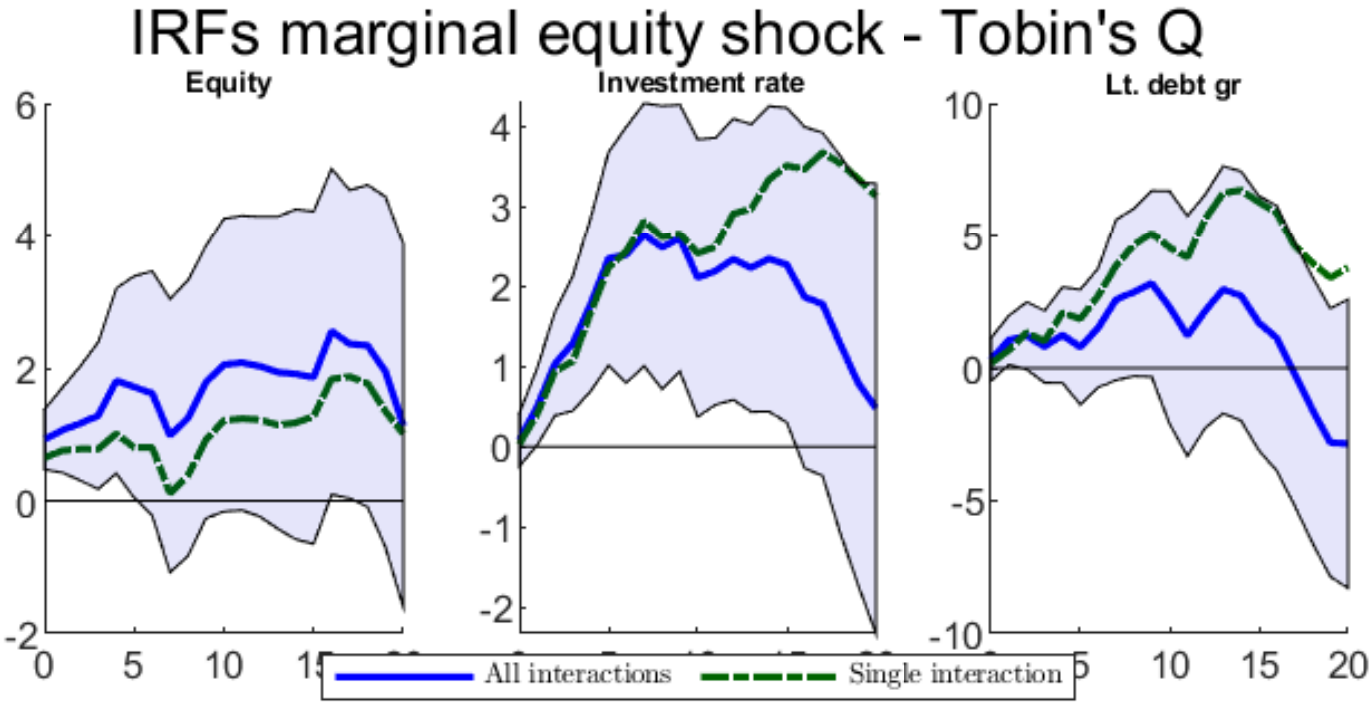
with γ^h measuring the marginal effects.

Robustness:

In addition to the mentioned interactions, I also augment the regression equation by:

- liquidity (Jeenas 2019)
- dividend-paying firms (finance theory)
- size (Gertler and Gilchrist 1994)

Marginal investment responses - Tobin's Q

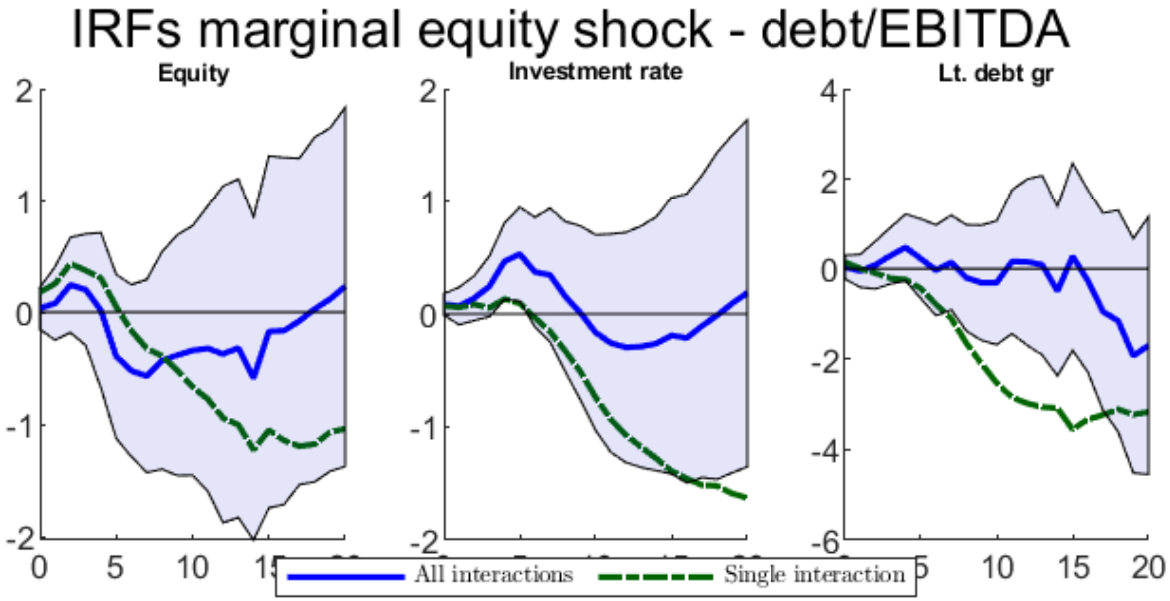


Tobin's Q:

- more sensitive investment response
- Tobin's Q is more sensitive to expected long-term profitability (Cao et al. 2019)

Equity responses with all interactions | Investment response with all interactions

Marginal responses - Debt/EBITDA

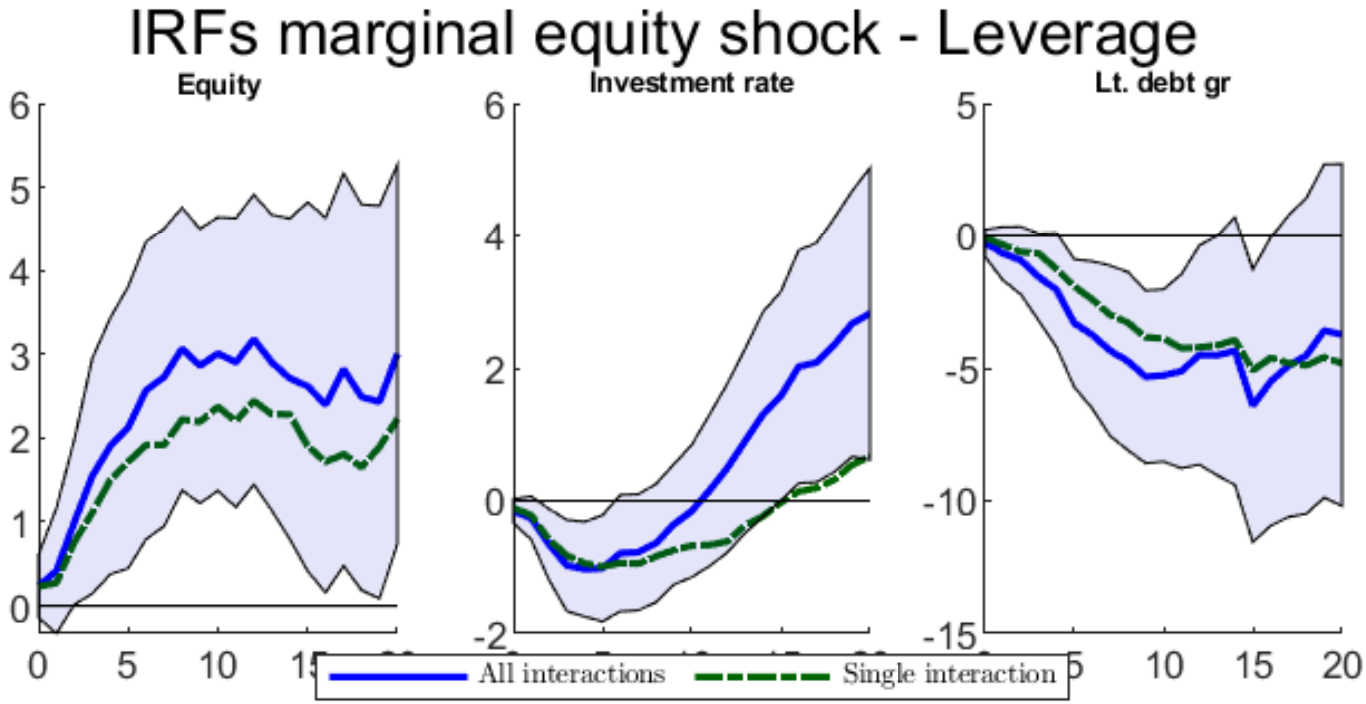


Debt/EBITDA:

- responses not different from average response
- current cash-flow insensitive to ext. equity shock $\Rightarrow$ fin. constraint not relaxed

Equity responses with all interactions Investment response with all interactions

Marginal investment responses - Leverage

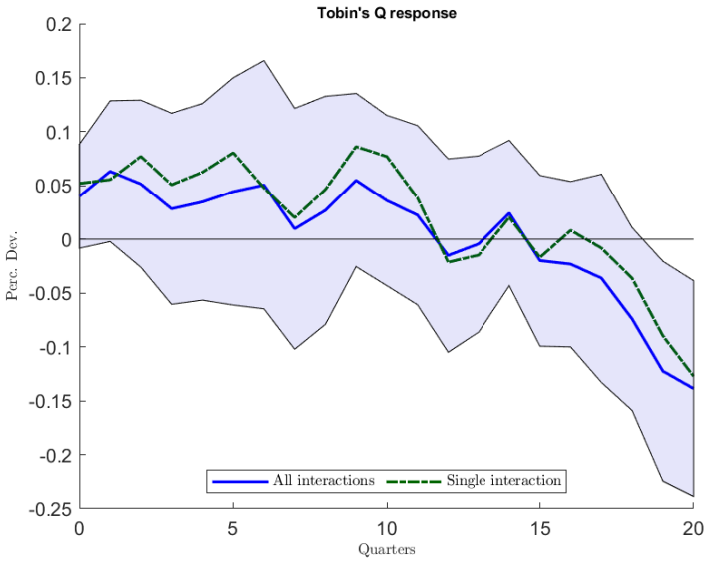


Leverage:

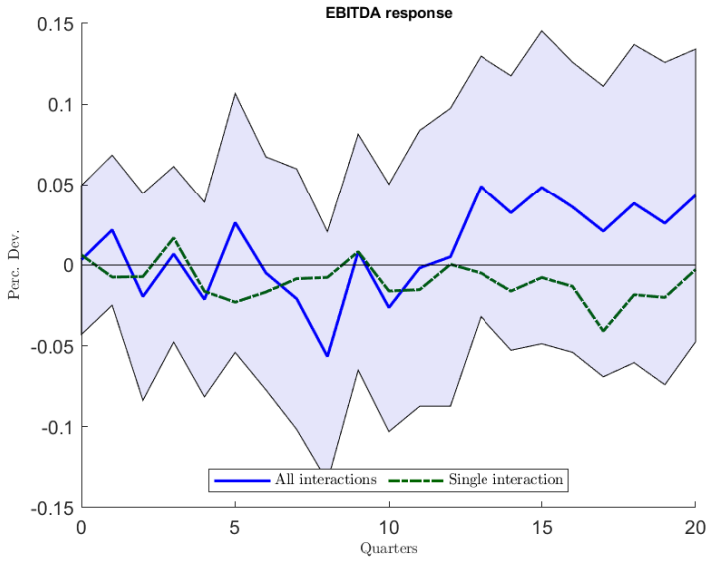
- less sensitive investment response
- substitute equity for debt to appear less constrained (Hennessy and Whited, 2007)

Equity responses with all interactions Investment response with all interactions

Relaxing the fin. constraints



(a) Marginal effects of higher Tobin's Q



(b) Marginal effects of higher debt/EBITDA

Cash-flow does not respond to favorable capital market shocks, but Tobin's Q does.

Transmission of monetary policy shock

Mon. shock series:
High frequency identification.
Gorodnichenko and Weber (2016) and Gurkaynak et al. (2004).

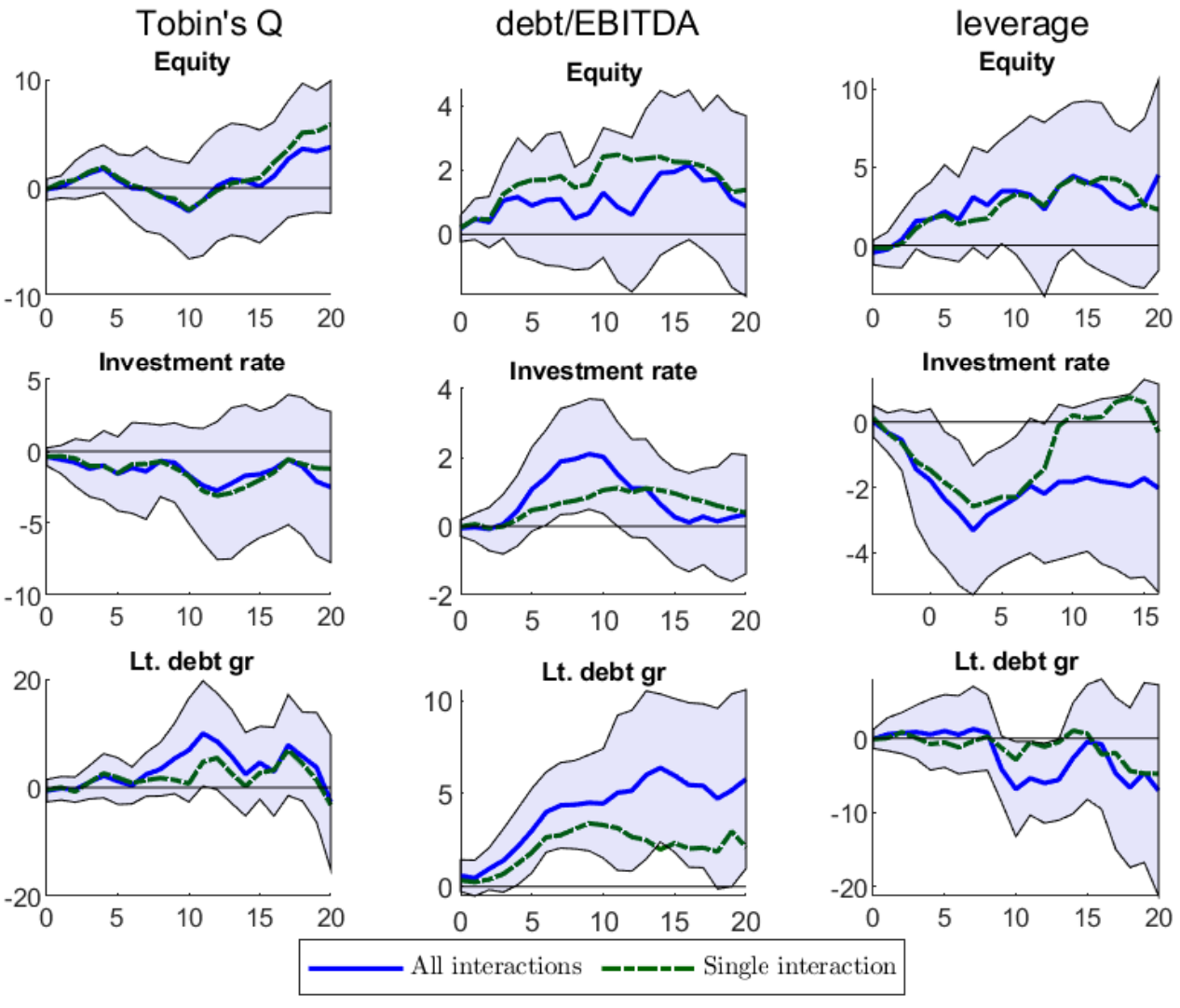
The regression marginal effects regression includes the same controls as before in (2):

$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \alpha_i^h + \nu_{st}^h + \gamma^h [FC_{i,t-1} \times \epsilon_t^{mon}] + \sum_{k=1}^{4} \Gamma_k^h X_{i,t-k} + e_{i,t}^h, \qquad (3)$$

with γ^h measuring the marginal effects.

Average response

Marginal responses to a monetary policy shock



Summary monetary shock marginal effects

Leverage:

- less sensitive investment response (Ottonello and Winberry 2020)

Tobin's Q:

- responses not different from average response
- monetary shock does not affect long-run expected profitability

Debt/EBITDA:

- more sensitive investment response
- monetary shock increases cash-flow of firms $\Rightarrow$ financial constraint gets relaxed.

Conclusion

	Equity shock	Monetary policy shock
Tobin's Q	+	0
EBC	0	+
ABC	-	-

Table: Sensitivity of firm investment rates relative to the average economy-wide response

Modelling perspective: Distinguish between competing measures of financial constraints.

Policy maker: Take into account both monetary policy and access to capital markets to relax firms' financial constraints.

- Relevance of improving the access to capital markets to stimulate firm investment. (e.g. ECMU)

Thank you for your time and your attention!

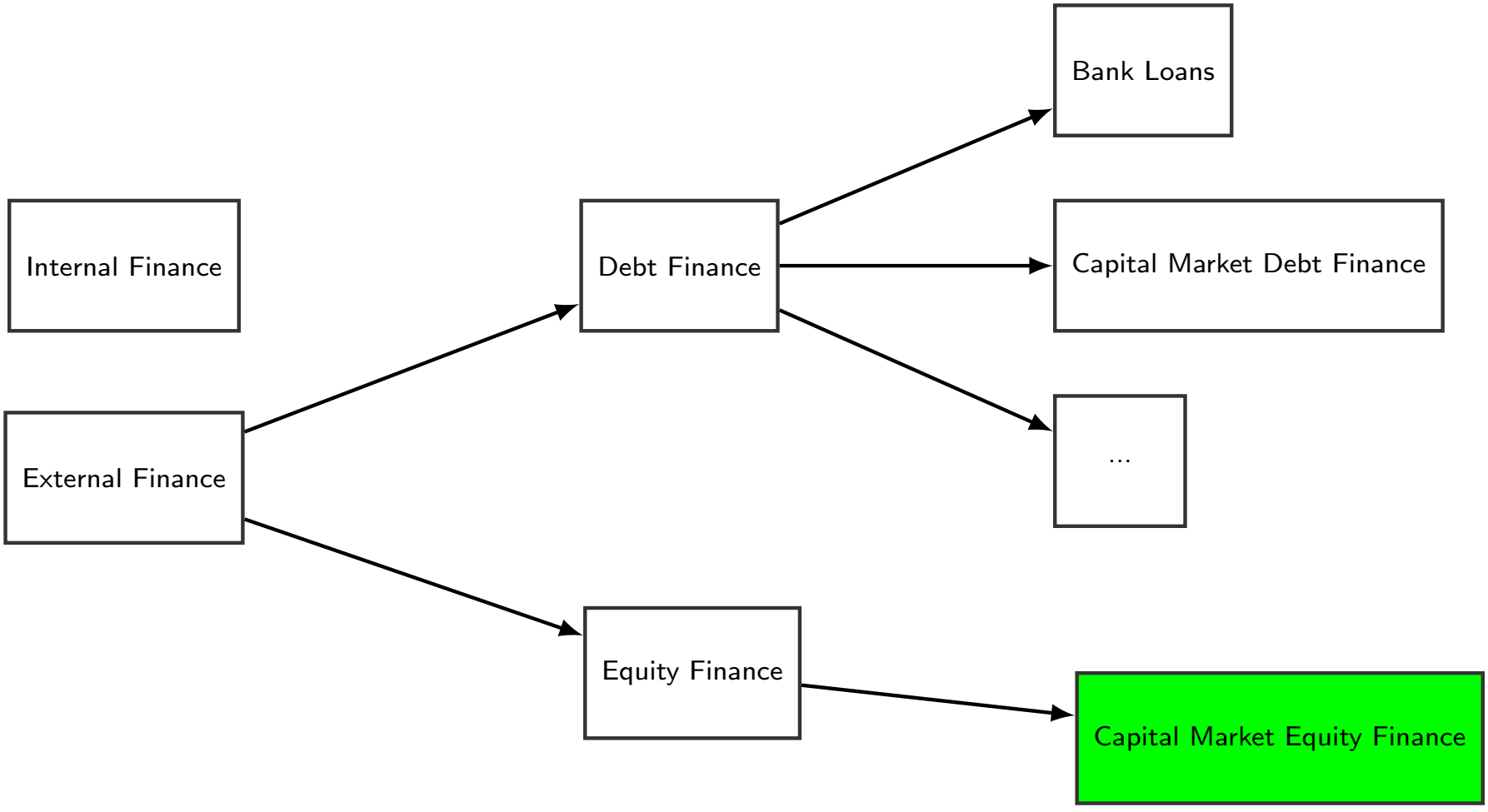
Sample selection

I drop the following firm-quarter observations:

1. observations with negative values in
   - sales, capital, long-term debt, short-term debt, assets, equity
2. utilities and financial firms
3. firm-years where acquisitions $> 5\%$ of assets
4. firms with investment spells < 40 quarters
5. trim leverage between 0 and 10
6. sales growth larger/smaller 100% / -100%
7. trim top and bottom 0.5% percentile of dependent var. in LP

In addition I balance the sample by dropping any missing value in the dependent variables. Back

Measure for firms' external equity financing



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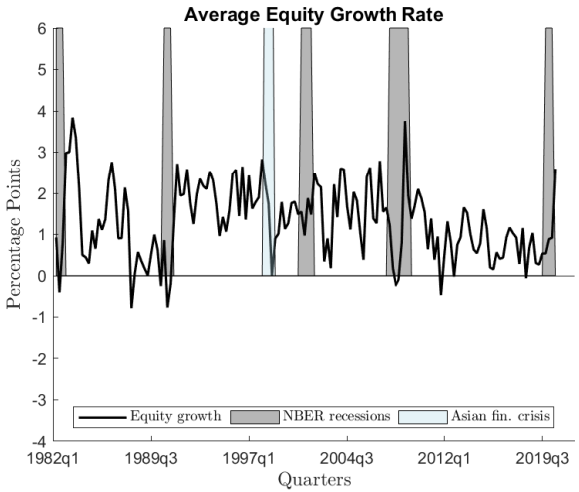
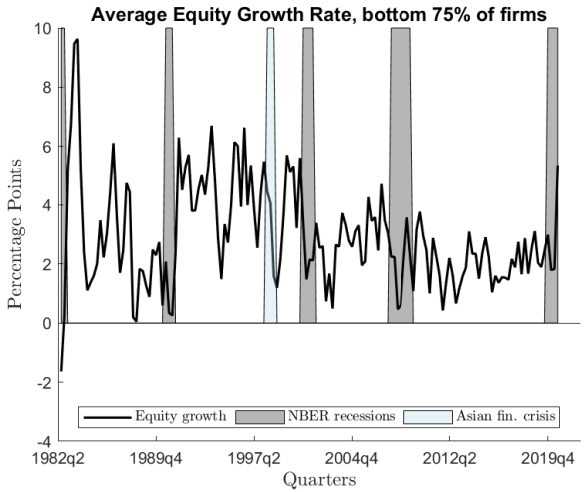
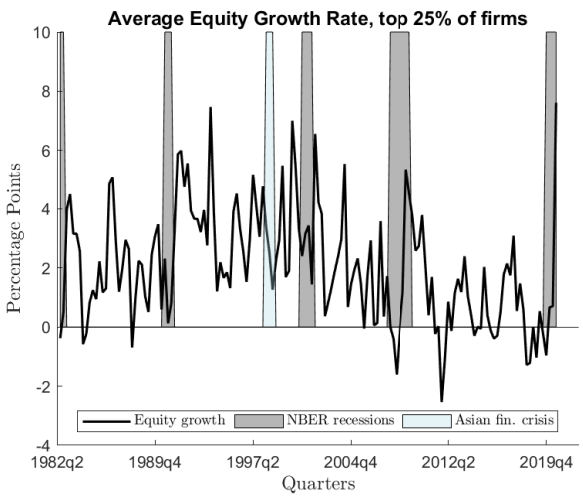
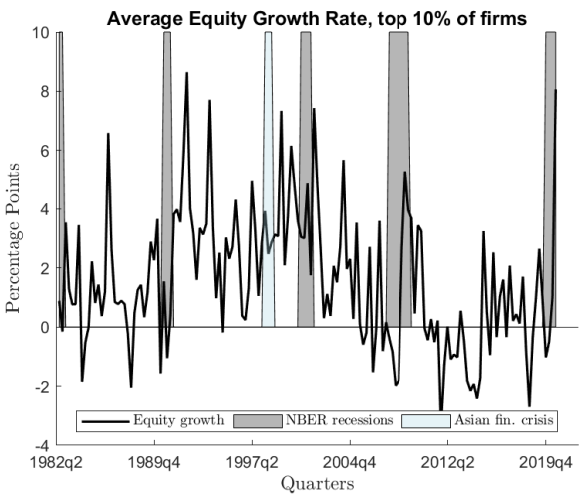
Growth rate of external equity financing over time









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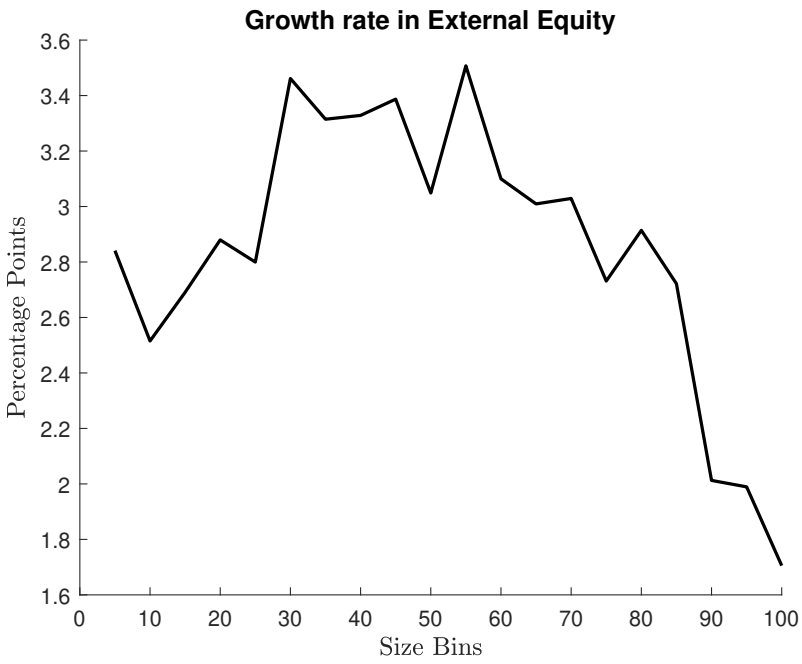
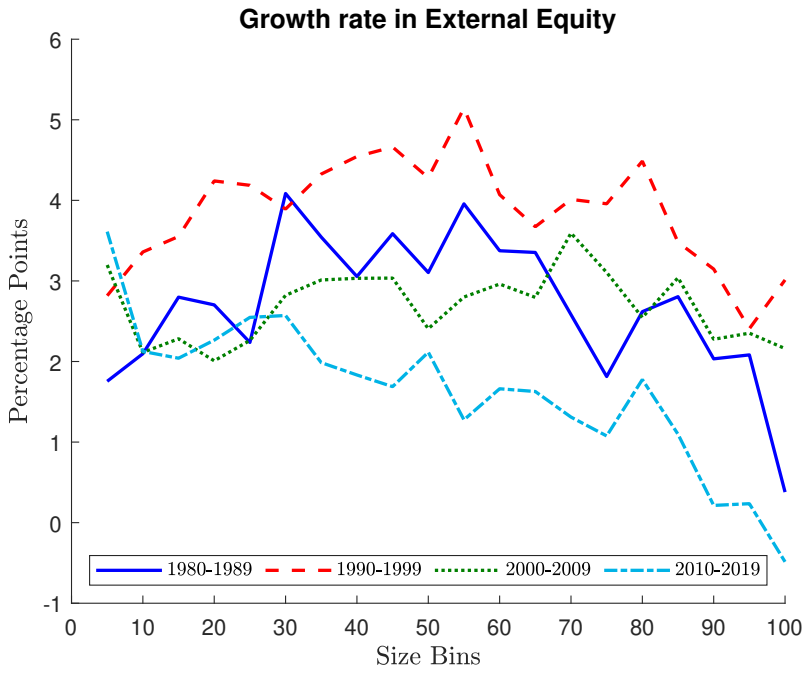
Growth rate of external equity financing over firm size



(a) Entire firm size distribution.



(b) Split by decades.

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Descriptive Statistics

	Mean	Median	S.D.	10th Perc.	90th Perc.	Obs.
Equity gr. rate	1.3639	-0.4408	10.6802	-1.7499	3.9159	276,481
Investment rate	0.3021	-0.5969	6.9422	-4.9364	6.3123	276,481
Sales gr. rate	1.2310	0.8205	18.7936	-19.1303	21.4084	276,481
L.t. debt gr. rate	-4.7690	-1.9577	26.4446	-25.0765	12.2986	276,481
Leverage	0.3177	0.2586	0.3749	0.0343	0.6039	276,481
Tobins' Q	1.9367	1.3942	2.2144	0.9110	3.1904	234,967
Cash/assets	0.1208	0.0568	0.1593	0.0053	0.3285	275,838
Debt/EBITDA	0.0087	0.0007	0.0249	0.0000	0.0207	244,001
Dividend-paying	0.1232	0.0000	0.3287	0.0000	1.0000	276,456

Table: Summary statistics of firm level variables

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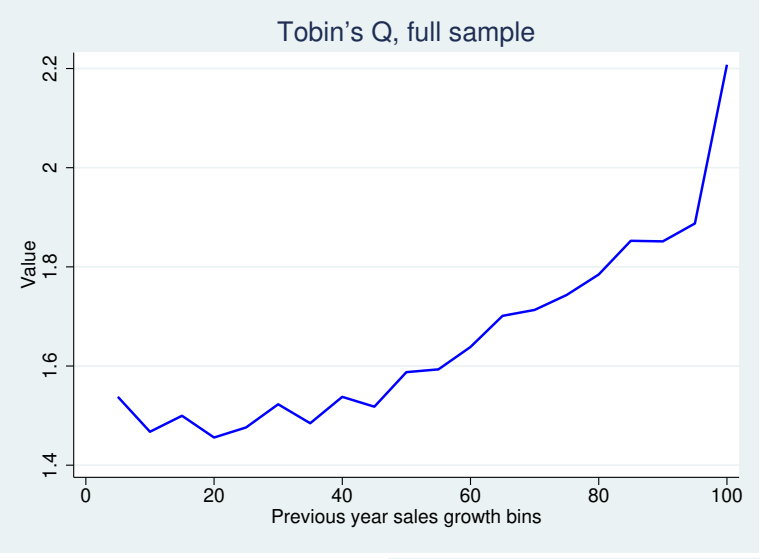
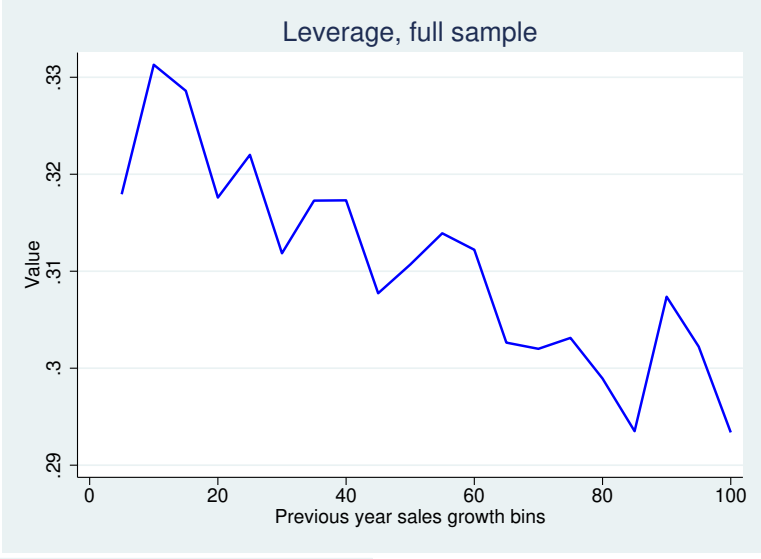
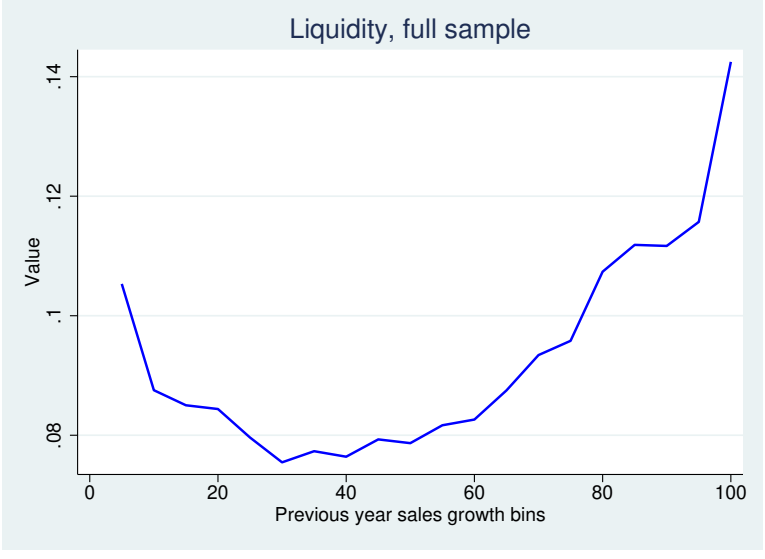
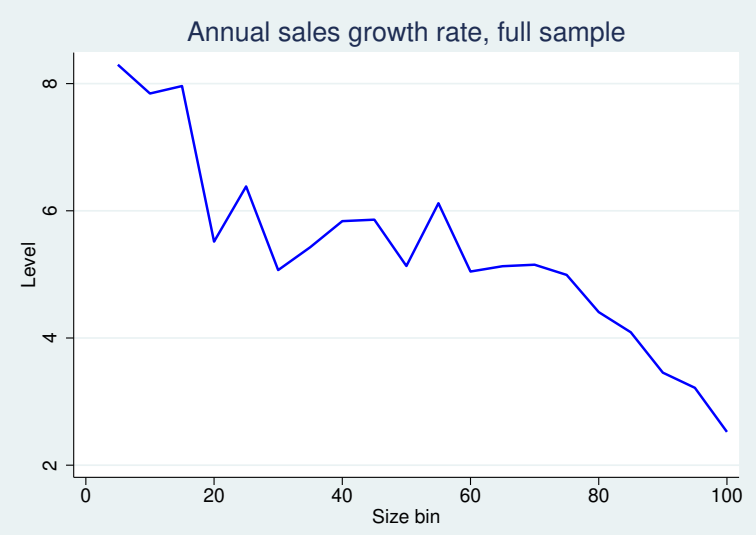
Financial constraints over annualized sales growth bins

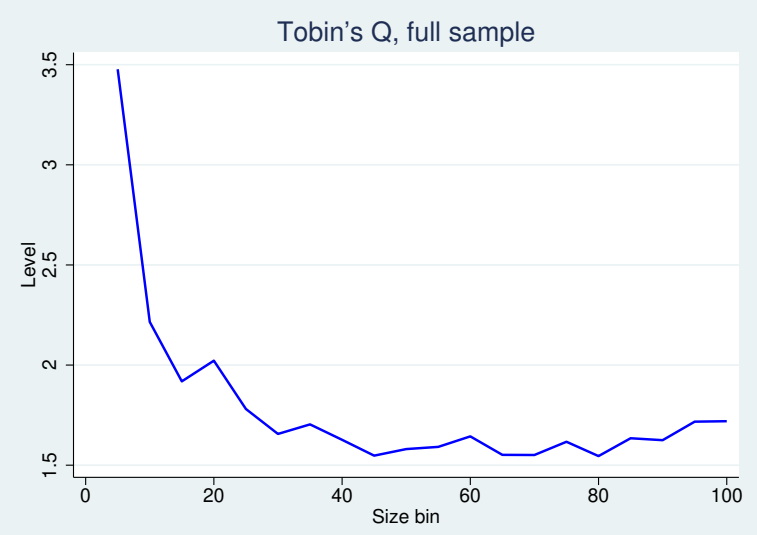


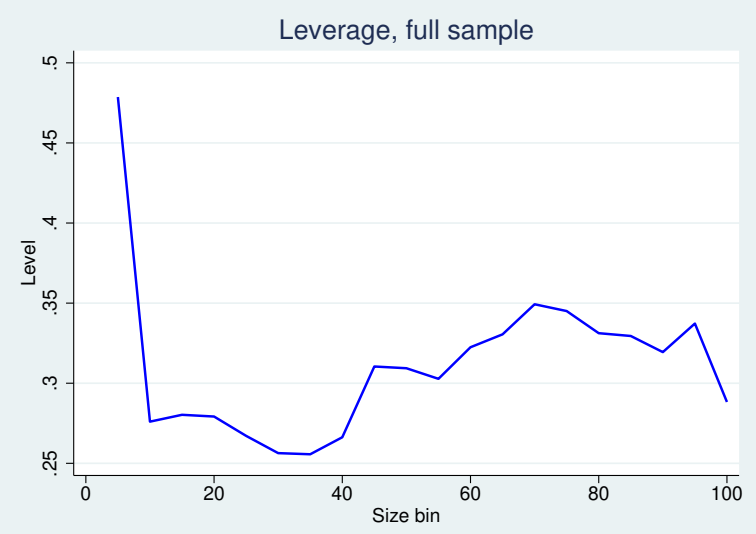


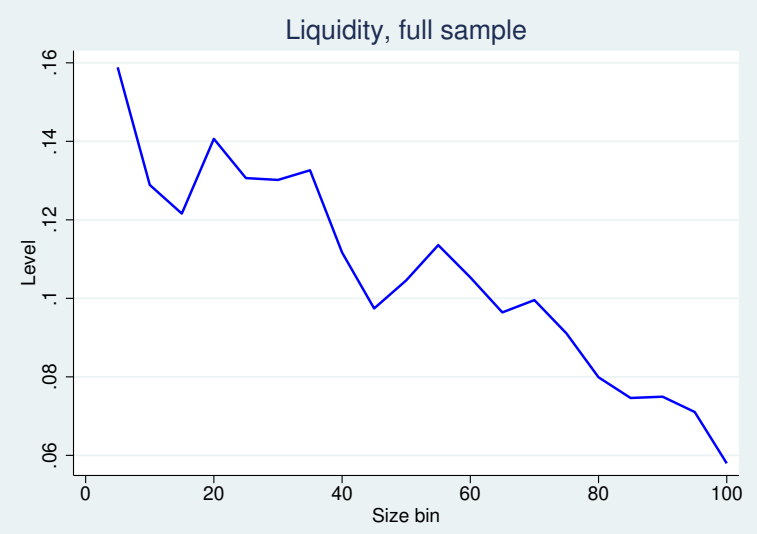


Financial constraints over firm size bins

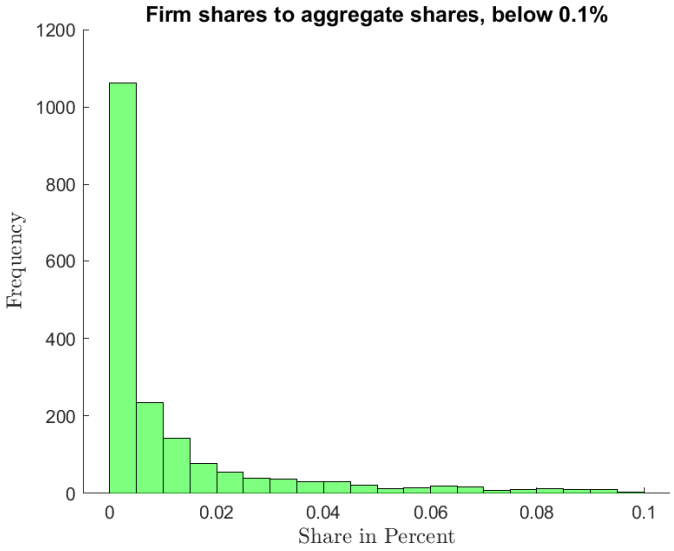


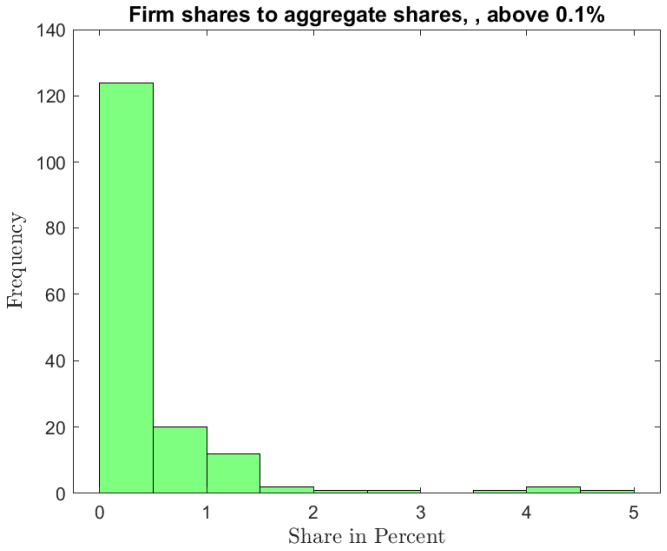






Firm shares at market value to aggregate shares, in percentage points





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Top-10 US firms with highest capitalization

Name of company	Percentage share
MICROSOFT CORP	8.05 %
APPLE INC	7.60 %
AMAZON.COM INC	7.10%
ALPHABET INC	6.79%
BERKSHIRE HATHAWAY	4.23%
WALMART INC	2.51%
AT&T INC	2.02%
VERIZON COMMUNICATIONS INC	1.97%
DISNEY (WALT) CO	1.92%
INTEL CORP	1.83%

Table: Top-10 US firms with highest market capitalization in 2019. Financial firms and utilities are excluded. Facebook inv. spell < 40.

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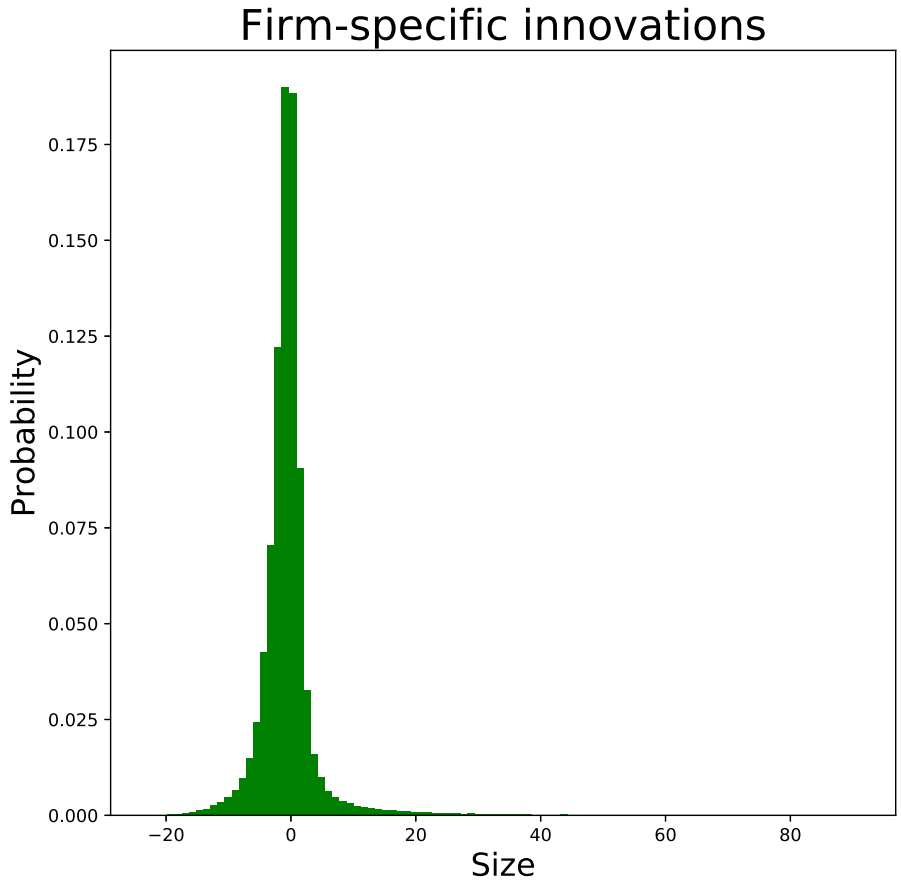
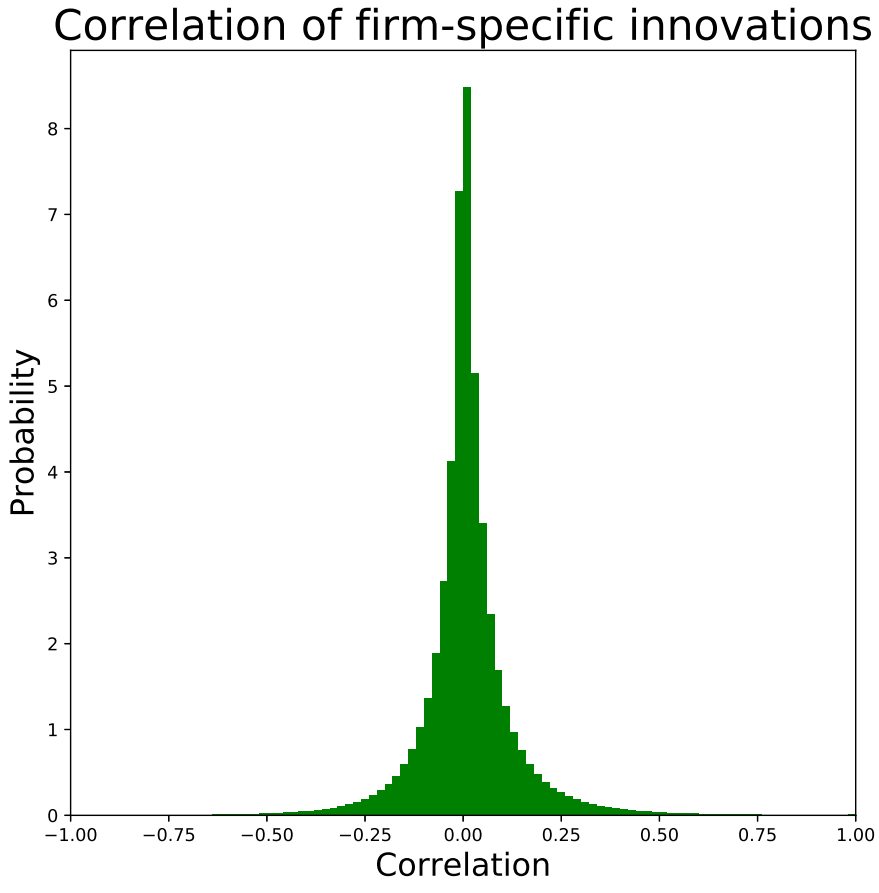
Firm-specific innovations to firms' equity issuance



Correlation Back

Correlation of firm-specific shocks



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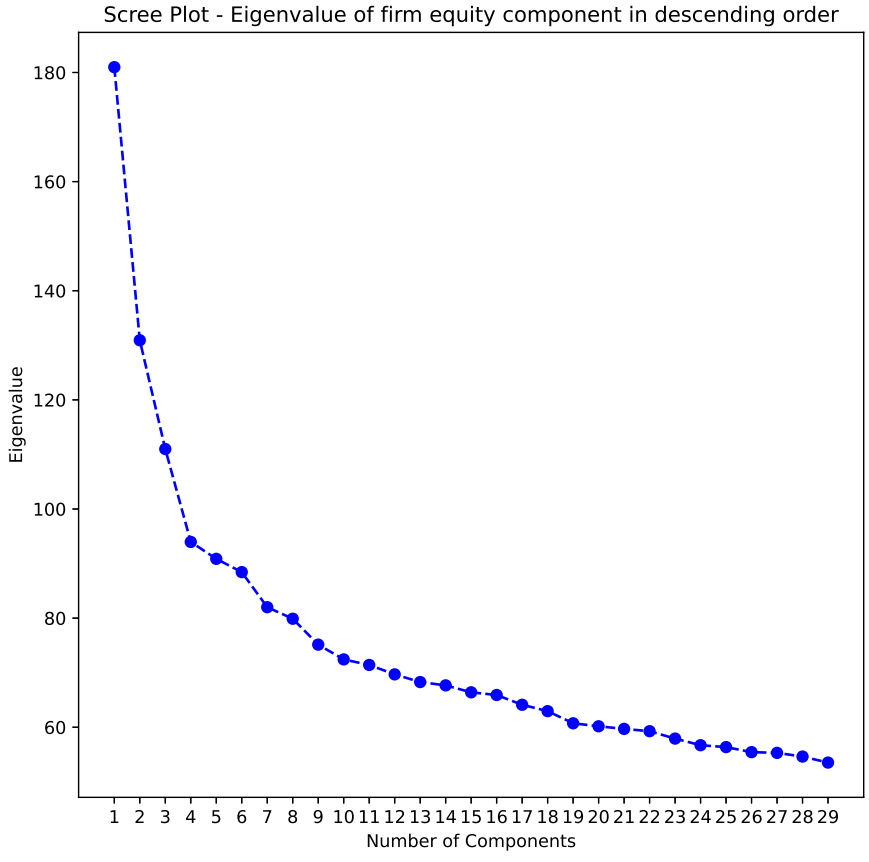
Scree plot - ordered eigenvalues of equity issuance PCA



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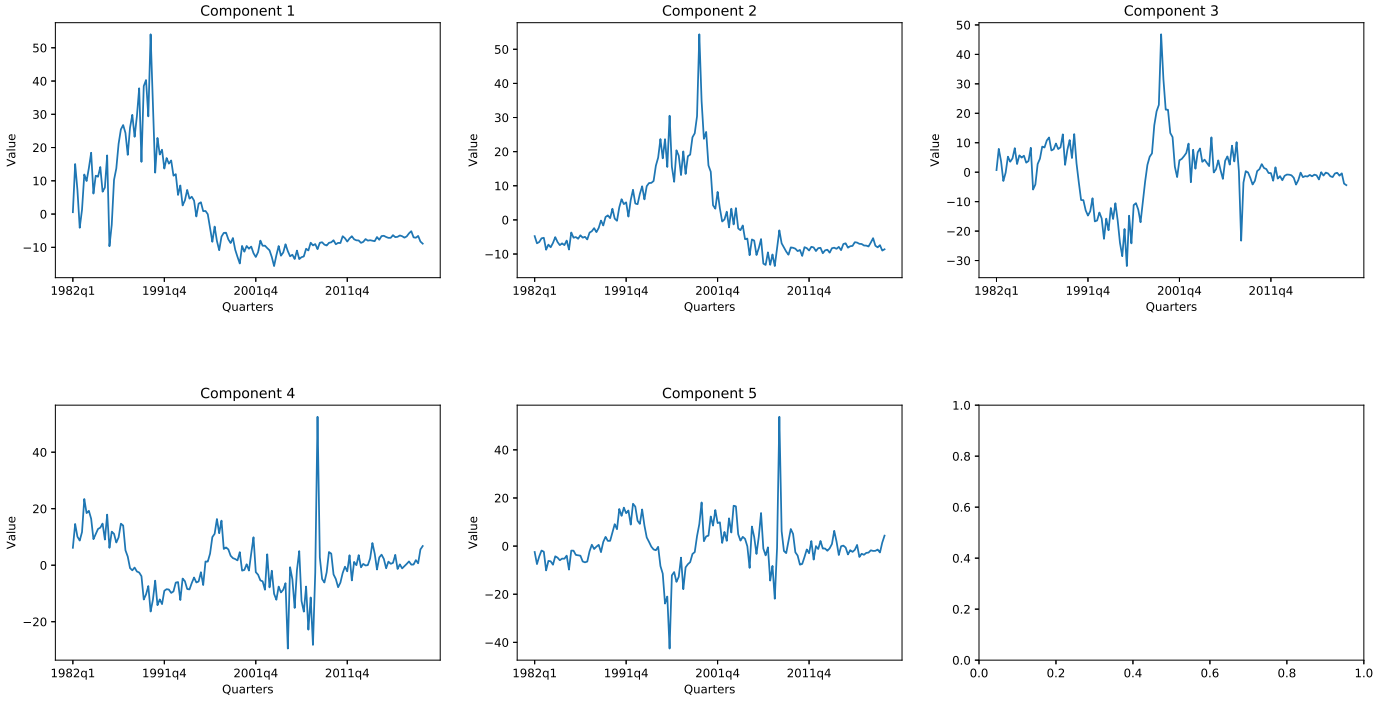
Common Components - Equity Issuance



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Granular Instrumental Variable - Background

Example: Demand shocks

Given a firm-specific demand disturbance $\epsilon_{i,t}$, the distortion potentially consists of (i) a common shock η_t with loading $\lambda_{i,t}$, and (ii) a firm-specific idiosyncratic demand distortion $u_{i,t}$, that is uncorrelated to η_t:

$$\epsilon_{i,t} = \lambda_{i,t}\eta_t + u_{i,t}$$

Problem

The common shock η_t might be correlated with aggregate supply side shocks $\Rightarrow$ we can not regress e.g. output on $\epsilon_{i,t}$

The granular instrumental variable z_t solves this problem. First assume for simplicity common loadings across firms:

$$z_t = \sum_{i=1}^{N} share_{i,t}\epsilon_{i,t} - \frac{1}{N}\sum_{i+1}^{N}\epsilon_{i,t} = \sum_{i=1}^{N} share_{i,t}(\eta_t + u_{i,t}) - \frac{1}{N}\sum_{i+1}^{N}\eta_t + u_{i,t}$$

$$= \sum_{i=1}^{N} share_{i,t}u_{i,t} - \frac{1}{N}\sum_{i=1}^{N} u_{i,t}$$

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Overview GIV

Firm-specific innovations of granular firms are idiosyncratic, and can be regarded as aggregate shocks if (i) uncorrelated across firms, (ii) thus not affected by common components.

But $\epsilon_{i,t}$ here potentially consists of:

$$\epsilon_{i,t} = \lambda_{i,t}\eta_t + u_{i,t}$$

Problem

$\epsilon_{i,t}$ not a valid proxy for aggregate equity shocks.

Solution

1] Construct GIV and 2] take care about factor loadings via PCA.

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Equity issuance components

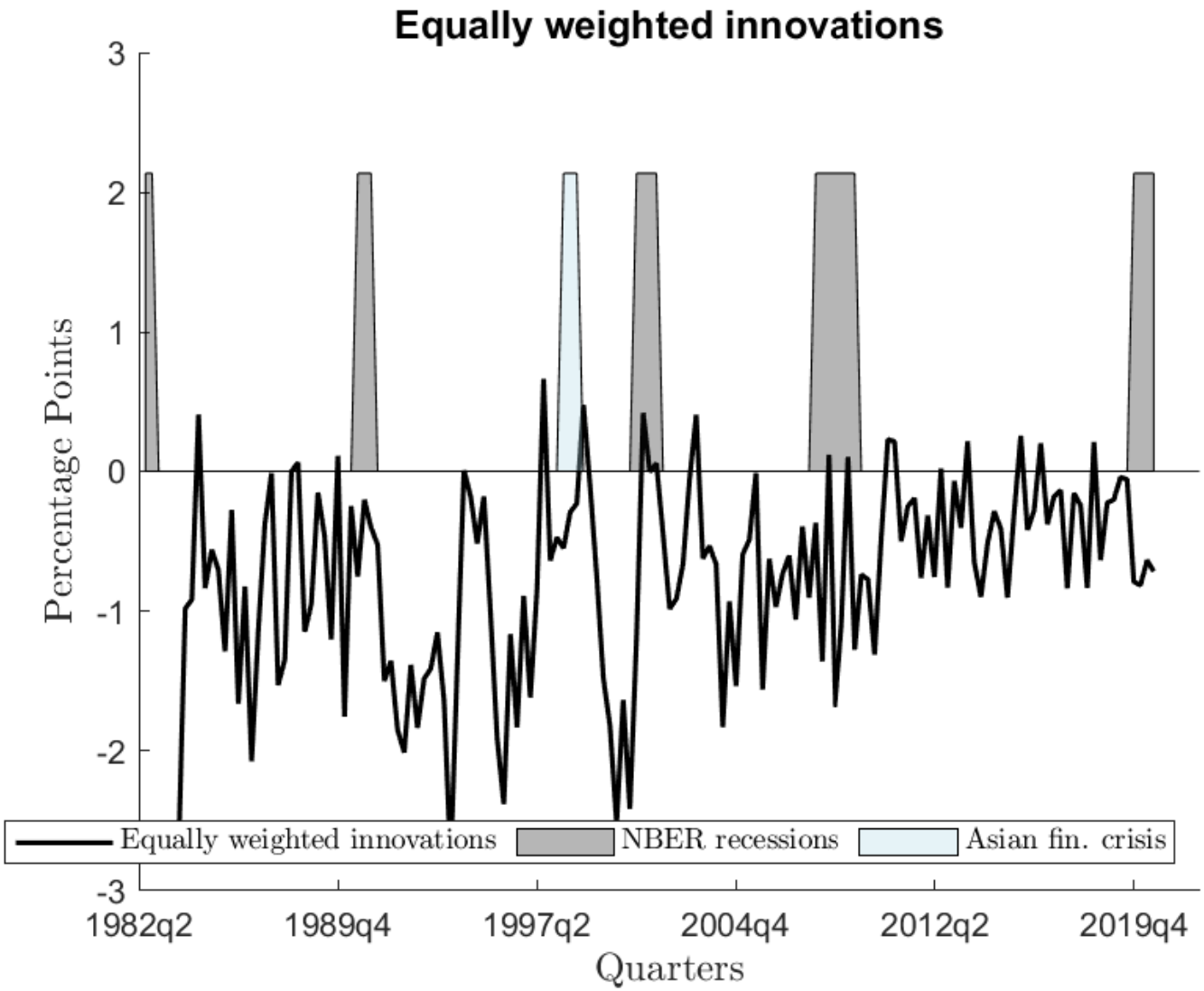
I run a principal component analyzis (PCA) to estimate a vector of components η^{PCA}, to control for different factor loadings $\lambda_{i,t}$ on the common components η_t:

$$\breve{e}_{i,t} = \lambda_i \eta_t^{PCA} + \breve{u}_{i,t}. \tag{4}$$

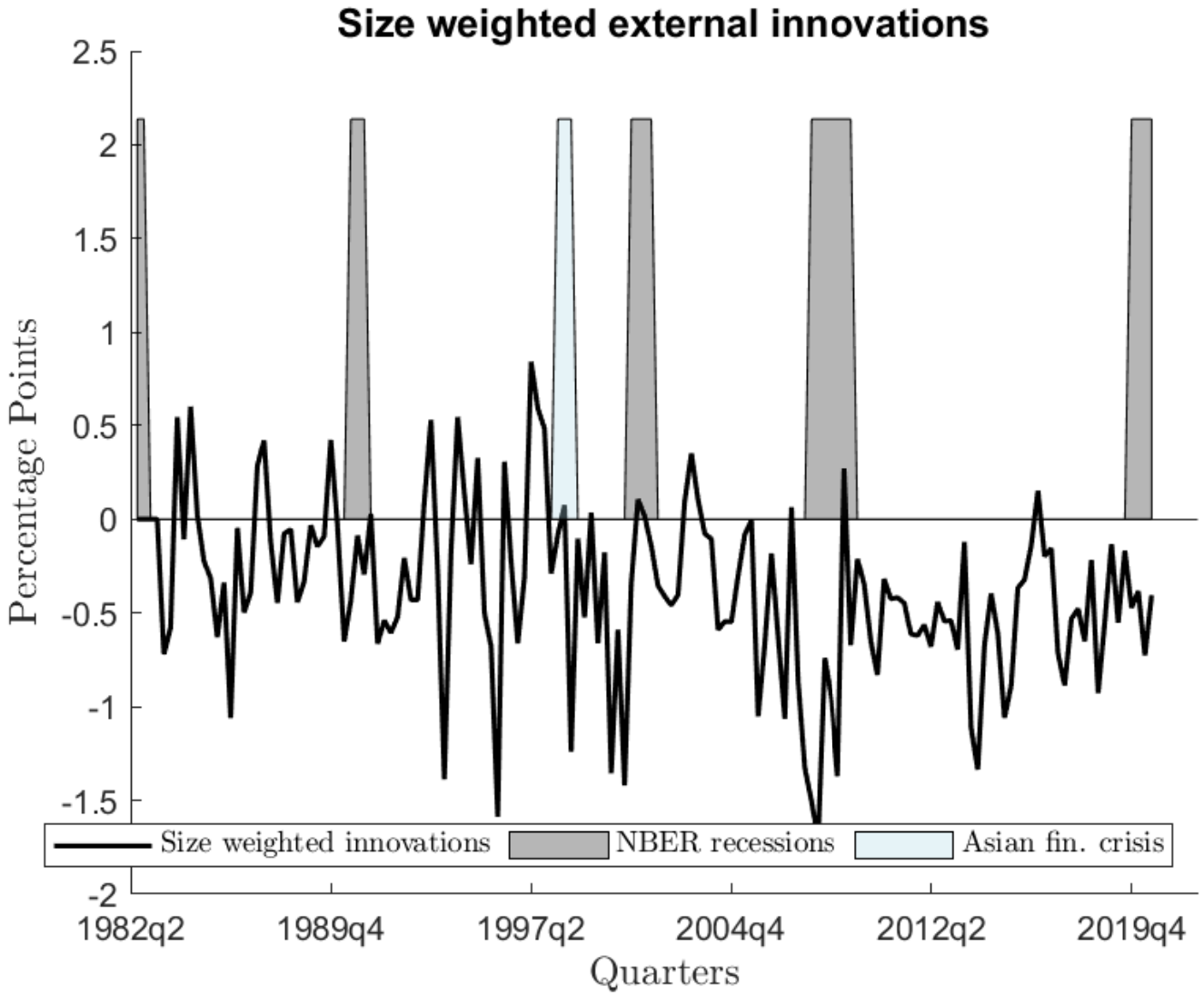
with $\breve{e}_{i,t} = \frac{E_{i,t} - \bar{E}}{\sigma^E}$ denoting the standardized variable of equity issuance.

Number of components is based on (i) the scree plot scree plot , and further (ii) I exclude all components that explain less than 1% of the variance of the data. components Back

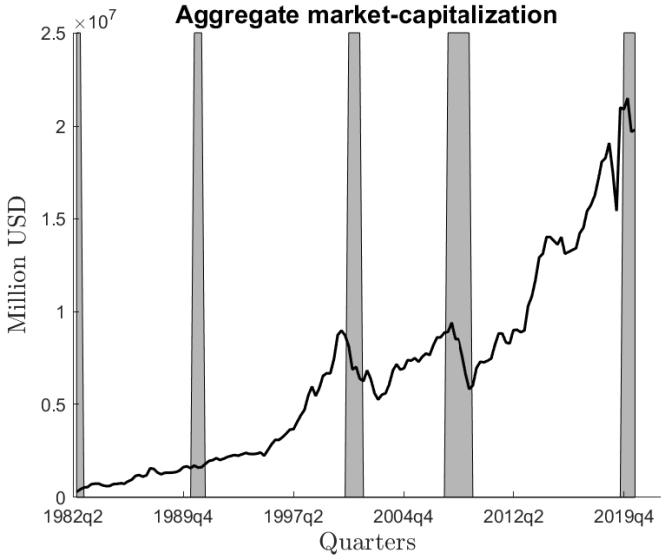
Equally weighted external equity shocks

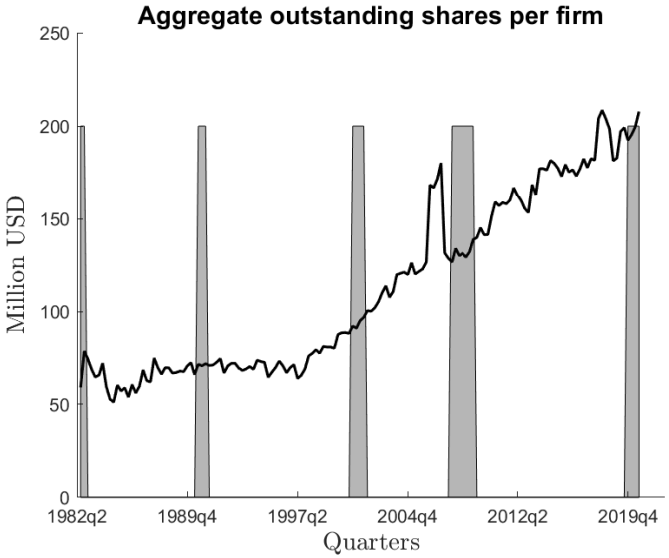


Size weighted external equity shocks



Aggregate shares at market value and shares per firm





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Is the GIV relevant for aggregate equity?

	(1) $\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}}$	(2) $\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}}$	(3) $\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}}$	(4) $\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}}$ r	(5) $\frac{\Delta(E_t^{aggr})}{E_{t-1}^{aggr}}$
u_t^{GIV}	1.866***	2.040***	1.815***	1.153**	1.148**
	(0.272)	(0.325)	(0.315)	(0.346)	(0.341)
equity components 1				-0.0266*	-0.0170
				(0.0133)	(0.0153)
equity components 2				0.0546**	0.0480**
				(0.0166)	(0.0169)
equity components 3				-0.0111	-0.0128
				(0.0108)	(0.0108)
equity components 4				0.0119	0.0167
				(0.0151)	(0.0162)
equity components 5				0.0490***	0.0372*
				(0.0136)	(0.0150)
equity components 6				-0.00257	-0.00782
				(0.0146)	(0.0150)
N	154	154	154	154	154
R^2	0.237	0.305	0.415	0.447	0.516
F	47.12	9.144	6.536	8.699	6.697
macro controls	no	yes	yes	yes	yes
FRED-MD factors	no	no	yes	no	yes

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Correlation GIVs

Table: Correlation table

Variables	u_t^{giv}	$u_t^{giv,manu}$
2-digit SIC codes		
u_t^{giv}	1.0000	-
$u_t^{giv,manu}$	0.8460	1.0000
$u_t^{giv,retail}$	0.6580	0.6327
$u_t^{giv,serv}$	0.6023	0.5126
$u_t^{giv,util}$	0.4414	0.4252
$u_t^{giv,min}$	0.2735	0.1571
$u_t^{giv,constr}$	0.2706	0.3463
$u_t^{giv,whole}$	0.2092	0.1761
$u_t^{giv,public}$	0.0882	0.2544
$u_t^{giv,agri}$	-0.0397	0.0189
3-digit SIC codes		
$u_t^{giv,tech}$	0.5245	0.7464
$u_t^{giv,chem}$	0.3539	0.4710

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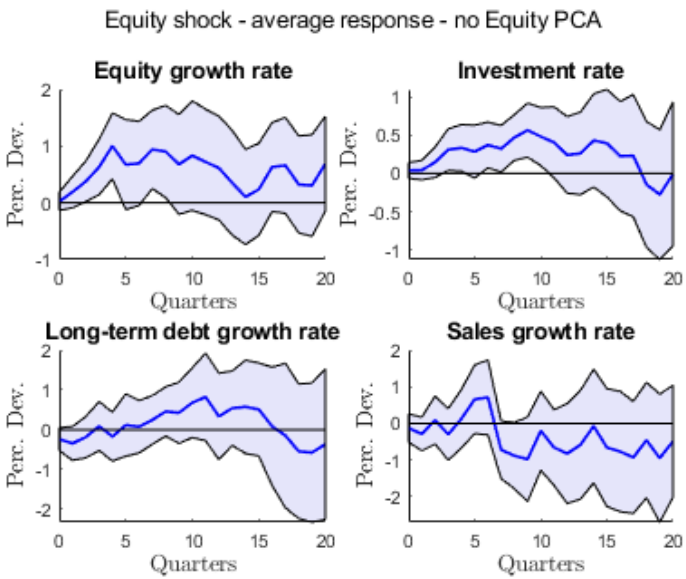
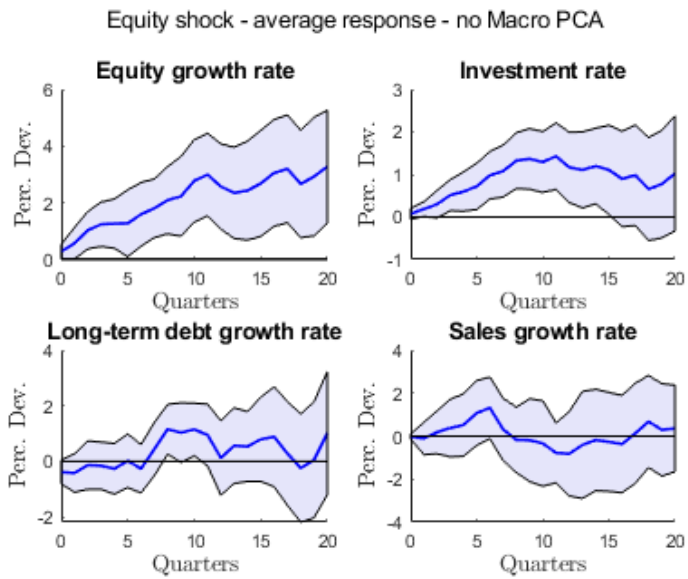
Robustness checks - factors



(a) Excluding equity components.



(b) Without macro. factors.

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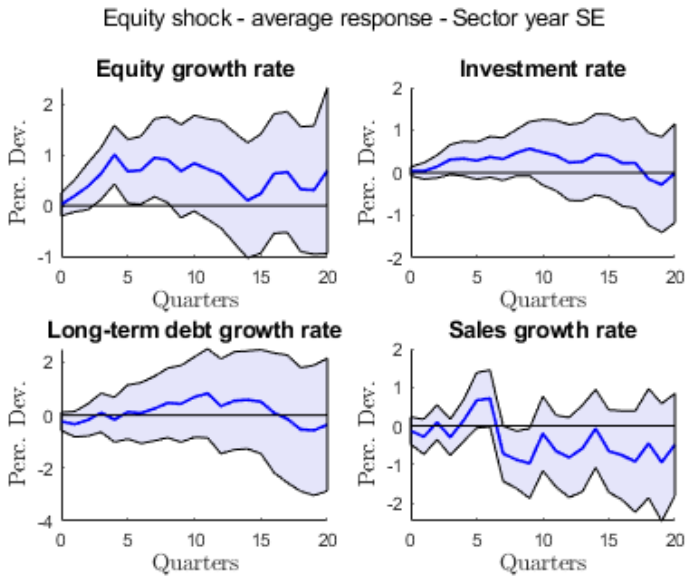
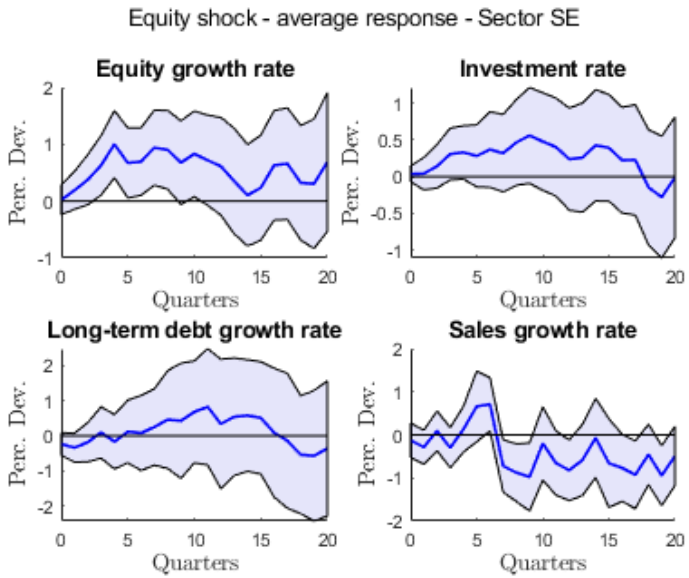
Robustness checks - clustered SE



(a) Clustered SE sector-quarter.



(b) Clustered SE sector.

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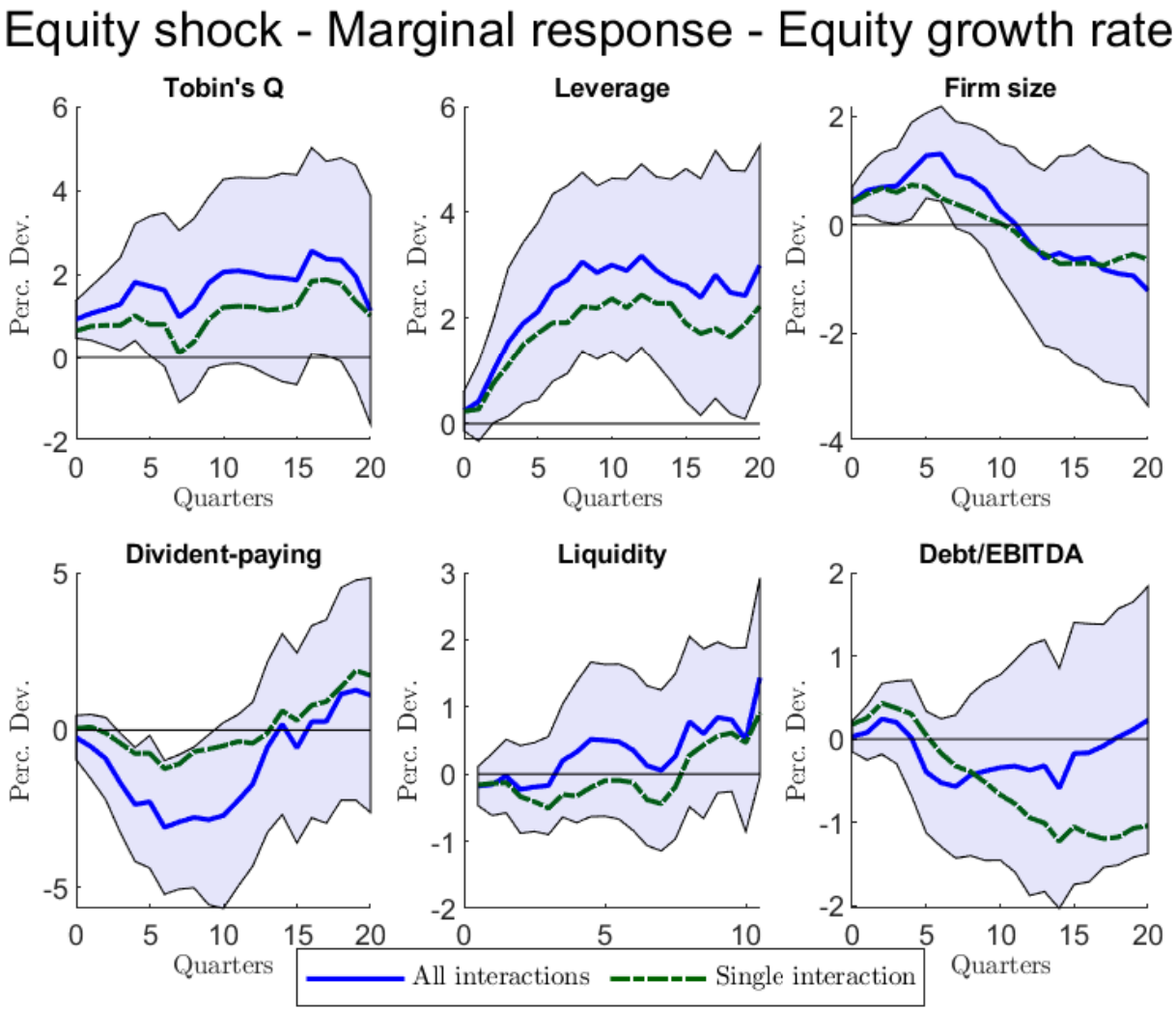
Role of financial constraints - equity



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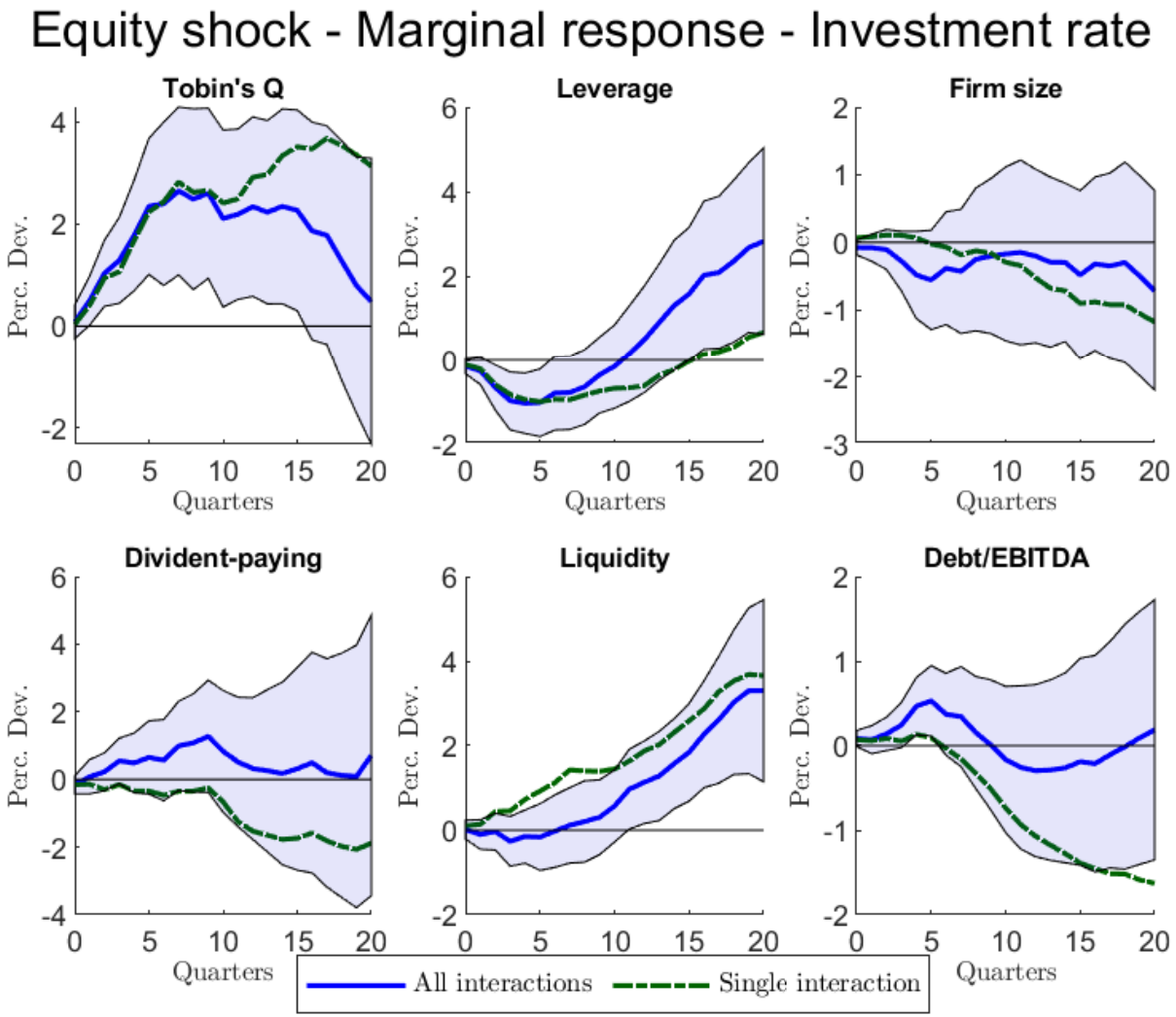
Role of financial constraints - investment



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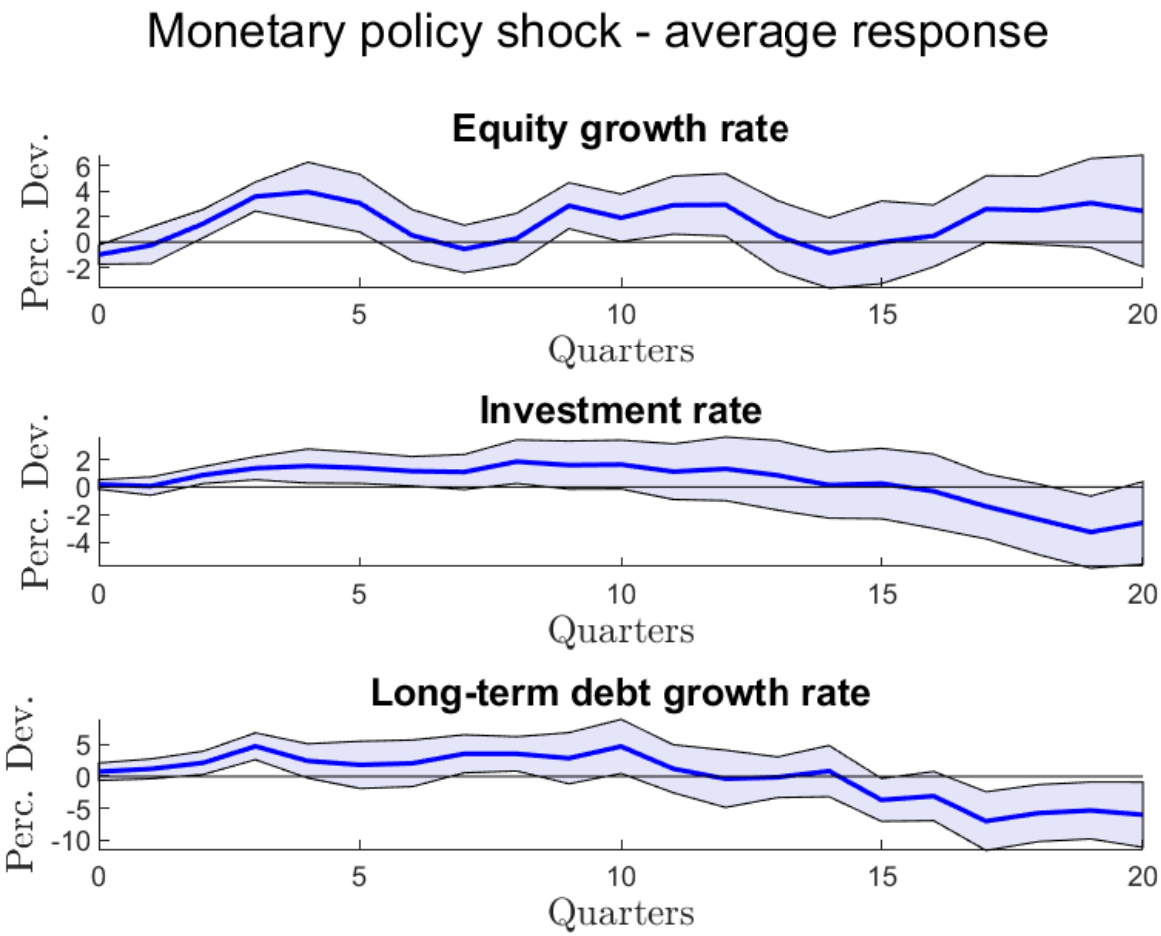
Average response to the monetary policy shock



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