

Lecture 5 - Financial Frictions

UCLA - Econ 221 - Fall 2018

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Outline

- 1 Deterministic Q-theory
- 2 Models with Financial Frictions
- 3 Importance of “Fire Sales”
- 4 A very simplified Brunnermeier-Sannikov economy
- 5 Results, Comparative Statics
- 6 Bernanke and Blinder (1992)
- 7 Kashyap et al. (1993)
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Set-up

- Demand for capital, in neoclassical theory given by the **rental rate of capital** $r_{K,t}$, so that firms solve:

$$\max_{k_t} \int_0^{\infty} e^{-\rho t} (\pi(k_t) - r_{K,t} k_t) dt.$$

- The optimal amount of capital is given by: $\boxed{\pi'(k_t) = r_{K,t}}.$
- But most capital is not rented. (and more importantly, we don't like to look at interest rate evidence. asset prices work better) Q-theory:

$$V(k_0) = \max_{i_t} \int_0^{\infty} e^{-\rho t} (\pi(k_t) - p_t i_t) dt$$
$$s.t. \quad \dot{k}_t = i_t - \delta k_t.$$

Set-up

- The profits nets of capital costs of the firm are given by:

$$\Pi(k_t) = \pi(k_t) - p_t i_t.$$

- If $\Pi(k_t) > 0$, firm pumps out cash in period t (repays debt, pays dividends).
- If $\Pi(k_t) < 0$, firm borrows in period t (issues debt, etc.)
- Implicit in this formulation is that the firm can invest more than it is producing in period t .
- In other words, any positive net present value is undertaken.
- This will remain true under the assumption of adjustment costs to capital.
- Hence, everything we'll do today will be referred to as "frictionless".

Hamiltonian I

- Detour: Optimal Control theory in continuous time.
- Consider the classic:

$$\begin{aligned} \max_{c_t} V(0) &= \int_0^T v(k_t, c_t, t) dt \\ \text{s.t. } \dot{k}_t &= g(k_t, c_t, t), \quad t \in [0, T] \\ \text{s.t. } k_0 &\text{ given} \\ \text{s.t. } k_T &\geq 0 \end{aligned}$$

- T is finite or infinite.
- FOCs are:

$$\begin{aligned} \frac{\partial H}{\partial c_t} &= 0, \quad \frac{\partial H}{\partial k_t} = -\dot{\mu}_t \\ \mu_T &= 0 \quad \text{or} \quad k_T = 0. \end{aligned}$$

- Intuition ?

Set-up

- There is some evidence suggesting that is not true. Recent research emphasizes borrowing constraints:
 - ▶ Holmström and Tirole (1998)
 - ▶ Bernanke et al. (1999)
 - ▶ Brunnermeier and Sannikov (2014)

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Introduction

- Models of frictionless investment (benchmark) imply that the capital structure should not affect firm value or investment, and that investment should depend only on q , and should be forward looking.
- Empirical evidence suggests borrowing constraints may matter.
- We want to build a model with such financial frictions.
- Today: a lecture based on:
 - ▶ Holmström and Tirole (1998)
 - ▶ Brunnermeier and Sannikov (2014)

Set-up

- Objective: presenting the simplest model of a net worth channel.
- Two dates $t = 0, 1$ and one consumption good.
- Two Types of agents:
 - ▶ Entrepreneurs "E's"
 - ▶ Financiers (potential investors) "F's"
- Linear Preferences: $U = C_1 + \beta C_2$. Assume that the interest rate is $r = 1/\beta$.
- Entrepreneur E has endowment (net worth, equity) of N dollars at date 0. He has access to a fixed scale project:
 - ▶ Investing 1 dollar at date 0 yields output at date 1.
 - ▶ We have that $N < 1$ so that entrepreneurs need money.

Entrepreneurs operate productive technologies, but do not have the money.

Moral Hazard

- The average return to the project is R , there are two states: high or low. If it succeeds, the project yields R/p_H , or fail.
- Problem: the entrepreneur may shirk and choose a project with lower chance of probability but that gives him a higher benefit. Because only one version of the project is observed ex-post, it is impossible to know whether the entrepreneur shirked or not. (information friction)
- Two versions of the project: the bad project has probability of success only $p_L < p_H$ but yields a private benefit B to the agent. Project yields 0 if it fails.

Moral Hazard

- A contract specifies a split of the output in case of success between financiers and entrepreneurs:

$$\frac{R^F}{p_H} \text{ and } \frac{R^E}{p_H}, \text{ with } R^F + R^E \leq R.$$

- Assume that the problem is (at least a little bit) interesting so that:

$$\beta \left(p_L \frac{R}{p_H} + B \right) < 1 < \beta R,$$

so the project is positive NPV if E behaves, but negative NPV if he misbehaves.

Feasibility

- For Financiers to want to participate, they need in expectation to at least receive the market rate of return (entrepreneurs make the offer, so get the surplus):

$$\beta p_H \frac{R^F}{p_H} = 1 - N.$$

- For entrepreneurs not to shirk, (and this is necessary because otherwise project is negative NPV, so there is nothing to share) we need:

$$p_H \frac{R^E}{p_H} \geq p_L \frac{R^E}{p_H} + B,$$

which using a well-known notation in this literature (see Tirole, *The Theory of Corporate Finance*), $\Delta p = p_H - p_L$ gives:

$$R^E \geq \frac{p_H}{\Delta p} B.$$

Feasibility

- We then get that the maximum amount in the project which can be pledged to financiers, from the return R , is actually given by ρ such that R^F is never greater than ρ :

$$R^F \leq \rho = R - \frac{\rho_H}{\Delta p} B.$$

- Finance matters ! Some positive NPV projects may not be undertaken, if in particular the financiers are worse off than using the safe interest rate of $1/\beta$, which appears through their participation constraint:

$$1 - N \leq \beta\rho.$$

- That means that net worth of entrepreneurs needs to be at least as large as \bar{N} so that financiers can at least break even and be maintained up against their participation constraint:

$$N \geq \bar{N} = 1 - \beta\rho.$$

Credit Rationing

- E's would be willing to pay a higher interest rate, were they able to commit to doing the "right thing". But they cannot pledge this future revenue because financiers know they will then have an incentive to divert it for their own use. (promise a higher R^F)
- **Credit rationing.** Prices have incentive effects, so market may clear through quantities rather than prices.

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Key feature: Heterogeneity

- One does not only need financial frictions, but also heterogeneity.
- Why heterogeneity ?
- In Kiyotaki-Moore (1997): farmers and gatherers.
- In this paper: experts and households.
- But what are we really talking about? Banks? Types of financial institutions? Very general, but evidence needs to focus on "clean identification": specialized arbitragers, etc.

Mitchell et al. (2007)

- "Slow Moving Capital".

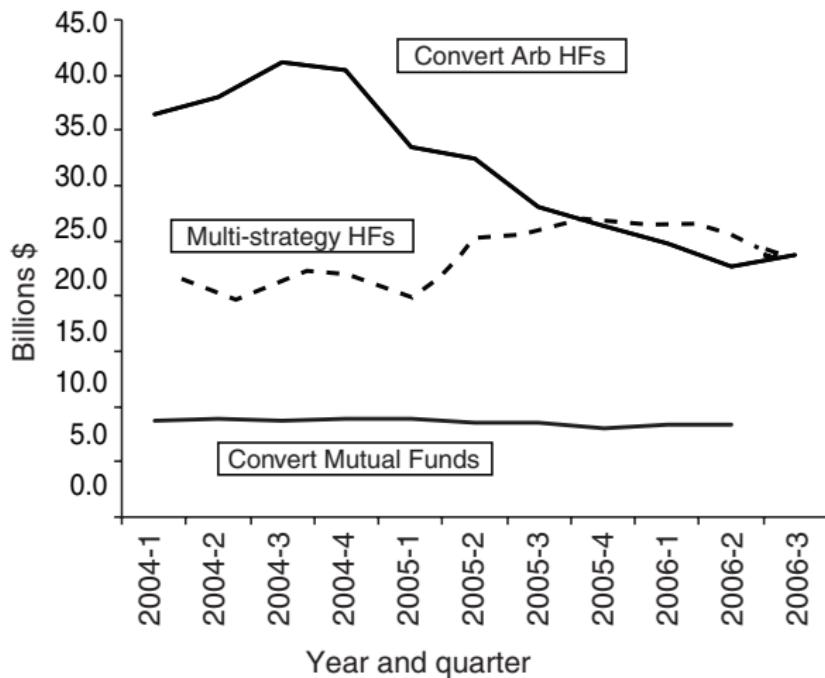


FIGURE 1. ADJUSTED HOLDINGS OF CONVERTIBLE BONDS IN BILLIONS OF DOLLARS

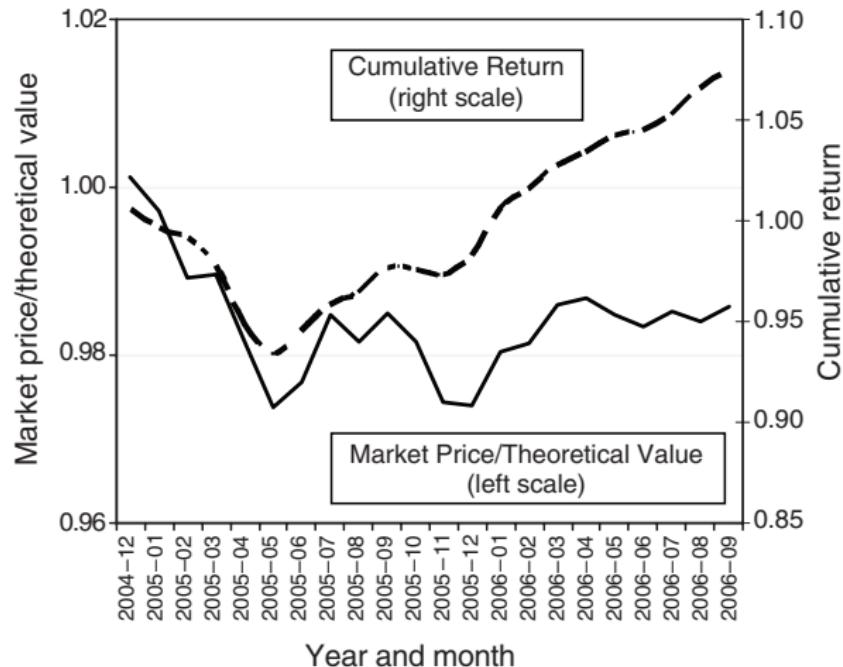


FIGURE 2. PRICE-TO-THEORETICAL-VALUE OF CONVERTIBLE BONDS, AND RETURN OF CONVERTIBLE BOND HEDGE FUNDS (2004/12-2006/09)

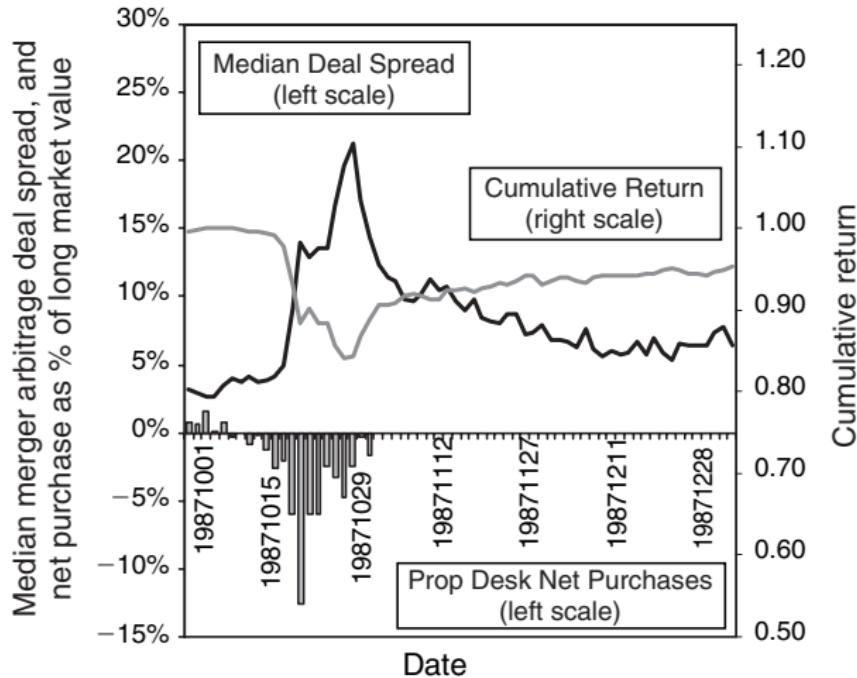
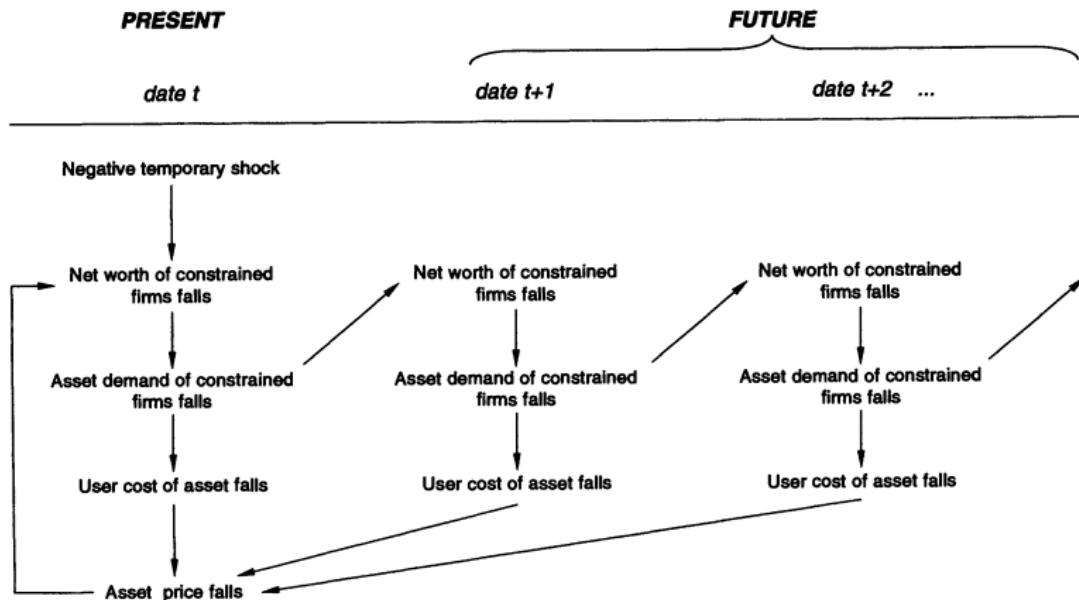


FIGURE 4. MERGER DEAL SPREADS, MERGER ARBITRAGE RETURNS, AND NET PURCHASES BY MERGER-ARB

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Set-up

- Very similar to Kiyotaki and Moore (1997): fire sales to non-experts, reduces prices further, experts' net worth, and so on...
- Only in continuous time instead of discrete time. More simple in some respects, more complicated in others.



Leveraged Financial Institutions

- Is that important? Yes, potentially.

| | Assets (\$bn) | Liabilities (\$bn) | Capital (\$bn) | Leverage |
|----------------------------|------------------|-----------------------|-------------------|-------------|
| Commercial banks | 11194 | 10050 | 1144 | 9.8 |
| Savings Inst | 1815 | 1607 | 208 | 8.7 |
| Credit Unions | 759 | 672 | 87 | 8.7 |
| Finance Companies | 1911 | 1720 | 191 | 10.0 |
| Brokers/hedge funds | 5597 | 5390 | 207 | 27.1 |
| GSEs | 1669 | 1598 | 71 | 23.5 |
| Leveraged Sector | 22945 | 21037 | 1908 | 12.0 |

Source: Authors' calculations based on Flow of Funds, FDIC Statistics on Banking, Adrian and Shin (2007), and balance sheet data for Fannie Mae, Freddie Mac, and broker-dealers under Goldman Sachs equity analysts' coverage.

Disclaimer: Models of information asymmetries usually get a key moment wrong

- Leverage is countercyclical in the model, but procyclical in the data.

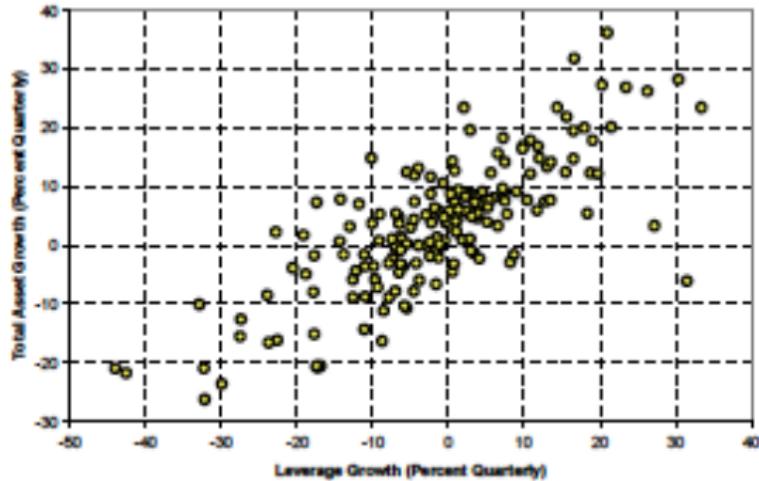


Figure 2.5: Total Assets and Leverage of Security Brokers and Dealers

Set-up in Brunnermeier and Sannikov (2014)

- Experts and Households. Only experts can invest in the asset, and issue riskless debt to households (exogenous).
- Technology available to experts is the following: capital k_t is able to produce an amount of goods y_t equal to:

$$y_t dt = ak_t dt.$$

- Experts' invest at a rate ι_t such that the dividends coming out of capital k_t in period dt are given by:

$$D_t dt = (a - \iota_t) k_t dt \quad \Rightarrow \quad \frac{D_t dt}{q_t k_t} = \frac{a - \iota_t}{q_t} dt.$$

- Agents' utility:

$$\max_{c_t, \text{portfolio}} \left[\int_0^\infty e^{-\rho t} \log(c_t) dt \right].$$

- Experts choose their portfolio, given they want compensation for risk.

Set-up

- The capital accumulation equation is:

$$\frac{dk_t}{k_t} = (\Phi(\iota_t) - \delta) dt + \sigma dZ_t.$$

- The endogenous price of capital is:

$$\frac{dq_t}{q_t} = \mu_t^q dt + \sigma_t^q dZ_t.$$

- q_t is given by the amount of "technological illiquidity":

$$\frac{1}{q_t} = \Phi'(\iota_t).$$

- Example:

$$\phi(\iota) = \frac{\log(\kappa\iota + 1)}{\kappa} \quad \Rightarrow \quad \iota_t = \frac{q_t - 1}{\kappa}$$

Coming back to last Time 1/2

- w_t is a Standard Brownian Motion (next denoted dZ_t):
 - ▶ The increments dw_t between t and $t + dt$ are i.i.d.
 - ▶ The increments are normally distributed with mean 0 and standard error \sqrt{dt} . This is a lot !!

$$\sqrt{dt} = \frac{1}{\sqrt{dt}} dt.$$

- We have:

$$dw_t = w(t + \Delta t) - w(t) = \epsilon_t \sqrt{\Delta t}, \quad \epsilon_t \sim N(0, 1).$$

- It is clear that:

$$\mathbb{E}_t(dw_t) = 0.$$

- We used:

$$\mathbb{E}_t(dw_t^2) = dt.$$

- In fact heuristically we even have:

$$dw_t^2 = dt.$$

Coming back to last Time 2/2

- Because $w(t + \Delta t) - w(t)$ is normal, we have that $(w(t + \Delta t) - w(t))^2$ is a χ_1^2 random variable:

$$\frac{(w(t + \Delta t) - w(t))^2}{\Delta t} \sim \chi_1^2.$$

- We have:

$$\text{var} \left[(w(t + \Delta t) - w(t))^2 \right] = (\Delta t)^2 \text{var}(\chi_1^2) = 2(\Delta t)^2.$$

- This is of order 2 so that we have with certainty:

$$dw_t^2 = dt.$$

Reminder: Ito's Product / Division Rules

- Take two processes X_t, Y_t :

$$\frac{dX_t}{X_t} = \mu_t^X dt + \sigma_t^X dZ_t \quad \frac{dY_t}{Y_t} = \mu_t^Y dt + \sigma_t^Y dZ_t.$$

- Multiplying these two processes (later useful for total capital):

Careful !: $d(X_t Y_t) = X_t dY_t + Y_t dX_t + dX_t dY_t.$

$$\frac{d(X_t Y_t)}{X_t Y_t} = \left(\mu_t^X + \mu_t^Y + \sigma_t^X \sigma_t^Y \right) dt + \left(\sigma_t^X + \sigma_t^Y \right) dZ_t.$$

- Dividing the two processes (later useful for leverage ratios):

$$\frac{d(X_t/Y_t)}{X_t/Y_t} = \left(\mu_t^X - \mu_t^Y + (\sigma_t^Y)^2 - \sigma_t^X \sigma_t^Y \right) dt + \left(\sigma_t^X - \sigma_t^Y \right) dZ_t.$$

Applying

- Applying the formulas:

$$\begin{aligned}\frac{dk_t}{k_t} &= (\Phi(\iota_t) - \delta) dt + \sigma dZ_t & \frac{dq_t}{q_t} &= \mu_t^q dt + \sigma_t^q dZ_t \\ \Rightarrow \frac{dq_t k_t}{q_t k_t} &= (\Phi(\iota_t) - \delta + \mu_t^q + \sigma \sigma_t^q) dt + (\sigma + \sigma_t^q) dZ_t.\end{aligned}$$

- The total return on risky capital:

$$dr_t^K = \underbrace{\frac{a - \iota_t}{q_t} dt}_{\text{Dividend}} + \underbrace{(\Phi(\iota_t) - \delta + \mu_t^q + \sigma \sigma_t^q) dt + (\sigma + \sigma_t^q) dZ_t}_{\text{Capital Gain}}.$$

- Market clearing for consumption:

$$\rho q_t k_t = (a - \iota(q_t)) k_t.$$

- Example:

$$q_t = \frac{a + 1/\kappa}{\rho + 1/\kappa}.$$

- In all cases, note that market clearing for consumption and q rule gives that q_t is constant (therefore i_t also) through:

$$\rho q_t k_t = (a - \iota(q_t)) k_t \quad \Rightarrow \quad \boxed{\rho q_t = (a - \iota(q_t))}.$$

- Therefore $\sigma_t^q = 0$.
- Define the key state variable:

$$\frac{N_t}{q_t K_t} = \eta_t \in [0, 1].$$

- Experts absorb all net worth, so per unit N_t the risk is:

$$\frac{q_t K_t}{N_t} \sigma = \frac{\sigma}{\eta_t}$$

- The portfolio decision (subsumes stochastic discount factor) can be written in the form of the Sharpe Ratio (Volatility of wealth? = Sharpe Ratio of risky investment):

$$\frac{\sigma}{\eta_t} = \frac{\rho + \Phi(\iota) - \delta - r_t^F}{\sigma}.$$

Reminder: Asset Pricing in Continuous Time 1/2

- The analog to the one-period pricing equation $p = \mathbb{E}(mx)$, in an interval dt is, if θ_t is the marginal utility of consumption above $\theta_t = u'(c_t)$:

$$\mathbb{E}_t [d(e^{-\rho t} \theta_t p_t)] = 0$$

- Imagine that p_t is the price of a risky asset A paying no dividend, such that:

$$dr_t^A = \mu_t^A dt + \sigma_t^A dZ_t.$$

- Denoting the process for the marginal utility of consumption as:

$$\frac{d\theta_t}{\theta_t} = \mu_t^\theta dt + \sigma_t^\theta dZ_t.$$

- We have:

$$\frac{\mu_t^A - r_t^F}{\sigma_t^A} = -\sigma_t^\theta.$$

Reminder: Asset Pricing in Continuous Time 2/2

- Imagine that utility is CRRA with parameter γ :

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma} \Rightarrow \theta_t = c_t^{-\gamma}.$$

- From Ito's lemma:

$$\frac{dc^{-\gamma}}{c^{-\gamma}} = \left(-\gamma \mu_t^c + \frac{\gamma(\gamma+1)}{2} (\mu_t^c)^2 \right) dt - \gamma \sigma_t^c dZ_t.$$

- We then have that the portfolio condition writes:

$$\frac{\mu_t^A - r_t^F}{\sigma_t^A} = \gamma \sigma_t^c.$$

- We have:

$$\frac{dN_t}{N_t} = r_t^F dt + \frac{\sigma}{\eta_t} dZ_t + \frac{\sigma}{\eta_t} \frac{\sigma}{\eta_t} dt - \rho dt.$$

- And also (same dividend yield):

$$\frac{d(q_t K_t)}{q_t K_t} = r_t^F dt + \sigma \frac{\sigma}{\eta_t} dt + \sigma dZ_t - \rho dt.$$

- Using the division rule we get the law of motion for state variable:

$$\boxed{\frac{d\eta_t}{\eta_t} = \left(\frac{\sigma}{\eta_t} - \sigma \right)^2 dt + \left(\frac{\sigma}{\eta_t} - \sigma \right) dZ_t}.$$

- Price of capital q_t and ι_t do not fluctuate, risk free rate fluctuates, therefore risk premium fluctuates:

$$\boxed{r_t^F = \rho + \phi(\iota) - \delta - \frac{\sigma^2}{\eta_t}}.$$

- Total volatility is $\eta_t \sigma_t^\eta$ (relative volatility is σ_t^η):

$$\eta_t \sigma_t^\eta = \sigma(1 - \eta_t).$$

Summary of the model

- Mapping from shocks dZ_t to state variable:

$$\frac{d\eta_t}{\eta_t} = \left(\frac{\sigma}{\eta_t} - \sigma \right)^2 dt + \left(\frac{\sigma}{\eta_t} - \sigma \right) dZ_t.$$

- Mapping from state to endogenous variables:
 - ▶ Expected return on risky capital constant:

$$dr_t^K = (\rho + \phi(\iota) - \delta)dt + \sigma dZ_t \quad \Rightarrow \quad \mathbb{E} \left[\frac{dr_t^K}{dt} \right] = \rho + \phi(\iota) - \delta$$

- ▶ All movements in risk premia come from risk free rate:

$$r_t^F = \rho + \phi(\iota) - \delta - \frac{\sigma^2}{\eta_t}.$$

- q, ι constant. No endogenous risk. All risk comes from fundamental risk. Risk premia come from reductions in risk free interest rate.

Next time

- We will see a more complicated version of that model, where households can also invest in equity, but will be more productive.
- Prices q_t will then fluctuate, there will be "endogenous risk" σ_t^q .
- We will treat risk neutral case/ log case in all generality.
- We will learn how to solve computationally these kinds of problems in different ways. ("shooting problems")

Conclusion of this simple model

- In this lecture, we continue on the Brunnermeier-Sannikov (2014) model.
- Last time, we saw a very simplified version of this model. Basic ingredient: **households could never hold capital, by assumption.**
- Therefore, all capital had to be held by experts. Because of log utility for everyone, we had the key equation:

$$\rho q_t k_t = (a - \iota(q_t))k_t$$

This determines q_t as a constant through time, just as ι .

- Therefore $\sigma_t^q = 0$, etc. Everything went through risk free rate.

More interesting model

- Key assumption now: HH can actually hold capital, they are just less productive at using it. This will change everything, and give interesting insights.
- More precisely, with experts the total return on risky capital was:

$$dr_t^K = \underbrace{\frac{a - \iota_t}{q_t} dt}_{\text{Dividend}} + \underbrace{(\Phi(\iota_t) - \delta + \mu_t^q + \sigma \sigma_t^q) dt}_{\text{Capital Gain}} + (\sigma + \sigma_t^q) dZ_t.$$

- Households can also buy equity but get return:

$$d\underline{r}_t^K = \underbrace{\frac{a - \iota_t}{q_t} dt}_{\text{Dividend}} + \underbrace{(\Phi(\iota_t) - \delta + \mu_t^q + \sigma \sigma_t^q) dt}_{\text{Capital Gain}} + (\sigma + \sigma_t^q) dZ_t.$$

- We assume $\underline{a} < a$.

Additional ingredients

- We want entrepreneurs to potentially be hit badly by shocks.
- This will not happen if they can save their way out of constraints. So like in those models (HK or BGG do the same), we could "kill" entrepreneurs or make them become households stochastically.
- Instead, we make entrepreneurs more impatient so they really want to consume (issue dividends):

$$\underbrace{\mathbb{E} \left[\int_0^{\infty} e^{-\rho t} u(c_t) dt \right]}_{\text{Utility of experts}}, \quad \underbrace{\mathbb{E} \left[\int_0^{\infty} e^{-rt} u(\underline{c}_t) dt \right]}_{\text{Utility of households}}.$$

- r discount rate of households $r < \rho$.
- ψ_t is the fraction of capital allocated to experts.

Additional ingredients

- Denoting by r_t^F the risk free rate, again asset pricing condition for experts is that:

$$\frac{\frac{a-\iota_t}{q_t} + \Phi(\iota_t) - \delta + \mu_t^q + \sigma\sigma_t^q - r_t^F}{\sigma + \sigma_t^q} = -\sigma_t^\theta.$$

- With σ_t^θ the marginal utility of wealth of experts:

$$\frac{d\theta_t}{\theta_t} = \mu_t^\theta dt + \sigma_t^\theta dZ_t$$

- Analogous relationship for households:

$$\text{if } \psi_t < 1, \quad \frac{\frac{a-\iota_t}{q_t} + \Phi(\iota_t) - \delta + \mu_t^q + \sigma\sigma_t^q - r_t^F}{\sigma + \sigma_t^q} = -\sigma_t^\theta$$

$$\text{if } \psi_t = 1, \quad \frac{\frac{a-\iota_t}{q_t} + \Phi(\iota_t) - \delta + \mu_t^q + \sigma\sigma_t^q - r_t^F}{\sigma + \sigma_t^q} \leq -\sigma_t^\theta$$

Additional ingredients

- Simple way to write this:

$$\psi_t = 1 \quad \text{or} \quad \frac{\frac{a - \iota_t}{q_t} + \Phi(\iota_t) - \delta + \mu_t^q + \sigma\sigma_t^q - r_t^F}{\sigma + \sigma_t^q} = -\sigma_t^\theta$$

- We will not be using the second one, since we'll focus on the "normal regime".
- But this second equation potentially determines ψ_t .

Solving for Log-utility

- Assume log-utility for experts and households. It simplifies things a lot (as often with log...). Resource constraint is now:

$$r(1 - \eta_t)q_t k_t + \rho\eta_t q_t k_t = \psi_t a k_t + (1 - \psi_t)\underline{a} k_t - \iota(q_t)k_t.$$

- "Normal regime": experts manage all capital (no fire sale prices). Then $\psi_t = 1$.
- Remember in the simple case last time we had:

$$\frac{dN_t}{N_t} = r_t^F dt + \frac{\sigma}{\eta_t} dZ_t + \frac{\sigma}{\eta_t} \frac{\sigma}{\eta_t} dt - \rho dt.$$

$$\frac{d(q_t K_t)}{q_t K_t} = r_t^F dt + \sigma \frac{\sigma}{\eta_t} dt + \sigma dZ_t - \rho dt.$$

Close the model: Ito's Lemma

- Assume log-utility for experts and households. It simplifies things a lot (as often with Ito's Lemma is that if:

$$dx_t = \mu(x_t)dt + \sigma(x_t)dZ_t.$$

then the process $y_t = f(x_t)$ follows:

$$dy_t = \left[f'(x_t)\mu(x_t) + \frac{1}{2}f''(x_t)\sigma(x_t)^2 \right] dt + f'(x_t)\sigma(x_t)dZ_t.$$

- Use Ito's Lemma repeatedly, for a function of η_t . For example, for $q(\eta_t)$:

$$\sigma_t^q = \frac{q'(\eta_t)}{q(\eta_t)}\eta_t\sigma_t^\eta.$$

- Similarly:

$$\sigma_t^\theta = \frac{\theta'(\eta_t)}{\theta(\eta_t)}\eta_t\sigma_t^\eta$$

Close the model: Ito's Lemma

- Symmetrically we have:

$$\frac{dN_t}{N_t} = r_t^F dt + \frac{\psi_t}{\eta_t} (\sigma + \sigma_t^q) (-\sigma_t^\theta) dt + \dots$$

$$\frac{\psi_t}{\eta_t} (\sigma + \sigma_t^q) dZ_t - \frac{C_t}{N_t} dt$$

$$\frac{d(q_t K_t)}{q_t K_t} = r_t^F dt + (\sigma + \sigma_t^q) \left(\psi_t (-\sigma_t^\theta) + (1 - \psi_t) (-\sigma_t^\theta) \right) dt + \dots$$

$$(\sigma + \sigma_t^q) dZ_t - \frac{\psi_t a + (1 - \psi_t) a - \iota_t}{q_t} dt.$$

- This gives through Ito's division Rule, a formula for $\eta_t = N_t / (q_t K_t)$:

$$\frac{d\eta_t}{\eta_t} = \dots$$

with, for example:

$$\sigma_t^\eta = \left(\frac{\psi_t}{\eta_t} - 1 \right) (\sigma + \sigma_t^q).$$

Close the model: Ito's Lemma

- From this we get:

$$\sigma + \sigma_t^q = \frac{\sigma}{1 - \frac{q'(\eta_t)}{q(\eta_t)}(\psi_t - \eta_t)}.$$

- Similarly:

$$\sigma_t^\theta = \frac{\theta'(\eta_t)}{\theta(\eta_t)} \frac{(\psi_t - \eta_t)\sigma}{1 - \frac{q'(\eta_t)}{q(\eta_t)}(\psi_t - \eta_t)}.$$

- First is the no-crisis regime, with $\psi_t = 1$.
- Second if the crisis regime, with $\psi_t < 1$.
- For lack of time, let us look only at the no-crisis regime, to see how one can numerically solve the model.

No-crisis Regime $\psi_t = 1$

- Don't forget the resource constraint with $\iota(q_t)$ defined by the q -theory (equation $\Phi'(\iota_t) = 1/q_t$):

$$(r(1 - \eta_t) + \rho\eta_t)q_t = a - \iota(q_t).$$

- This gives straightforwardly $q(\eta_t)$. Then compute the volatility of q_t which is given by:

$$\sigma + \sigma_t^q = \frac{\sigma}{1 - \frac{q'(\eta_t)}{q(\eta_t)}(1 - \eta_t)}.$$

- From there one finds that of η_t through:

$$\sigma_t^\eta = \left(\frac{\psi_t}{\eta_t} - 1 \right) (\sigma + \sigma_t^q).$$

- And the drift of η_t through:

$$\mu_t^\eta = (r - \rho)(1 - \eta_t) + \frac{1 - \psi_t}{1 - \eta_t} (\sigma + \sigma_t^q) \sigma_t^\eta + (\sigma_t^\eta)^2.$$

No-crisis Regime $\psi_t = 1$

- One then has the law of motion of η_t in the no-crisis regime.
- One can then draw functions $q(\eta_t)$, $\theta(\eta_t)$, and so on.
- The same can be done for the case where $\psi_t < 1$, that is the crisis regime. In that case one needs another equation, to determine $\psi_t < 1$. Again, it is the fact that households now invest (fire sales) so the sharpe ratio of the risky investment has to be equal to the marginal utility of their wealth.
- Everything else follows.
- Brunnermeier-Sannikov first go through the **risk neutral case**. Problem: maybe this is why agents are taking all this risk !
- They do the extension with log utility, as a robustness check.

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Risk-Neutral Case

- Equilibrium functions obtained.
- η_ψ is the value for the state variable delimiting the crisis and the normal regimes.
- Note that agents are effectively risk averse, despite being really risk neutral ! (marginal utility of wealth is higher in crises...)
- Would like to buy cheap capital in crisis periods.

• z

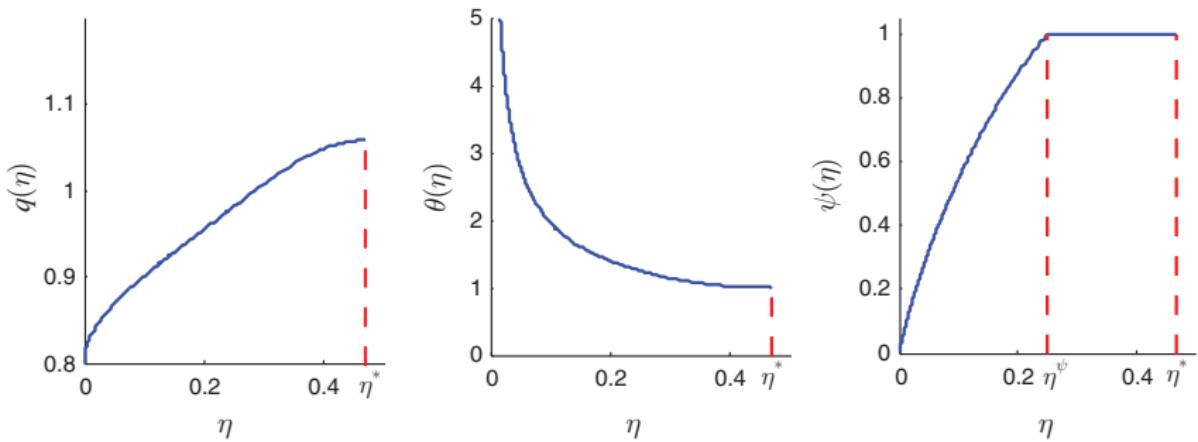


FIGURE 1. EQUILIBRIUM FUNCTIONS $q(\eta)$, $\theta(\eta)$, AND $\psi(\eta)$

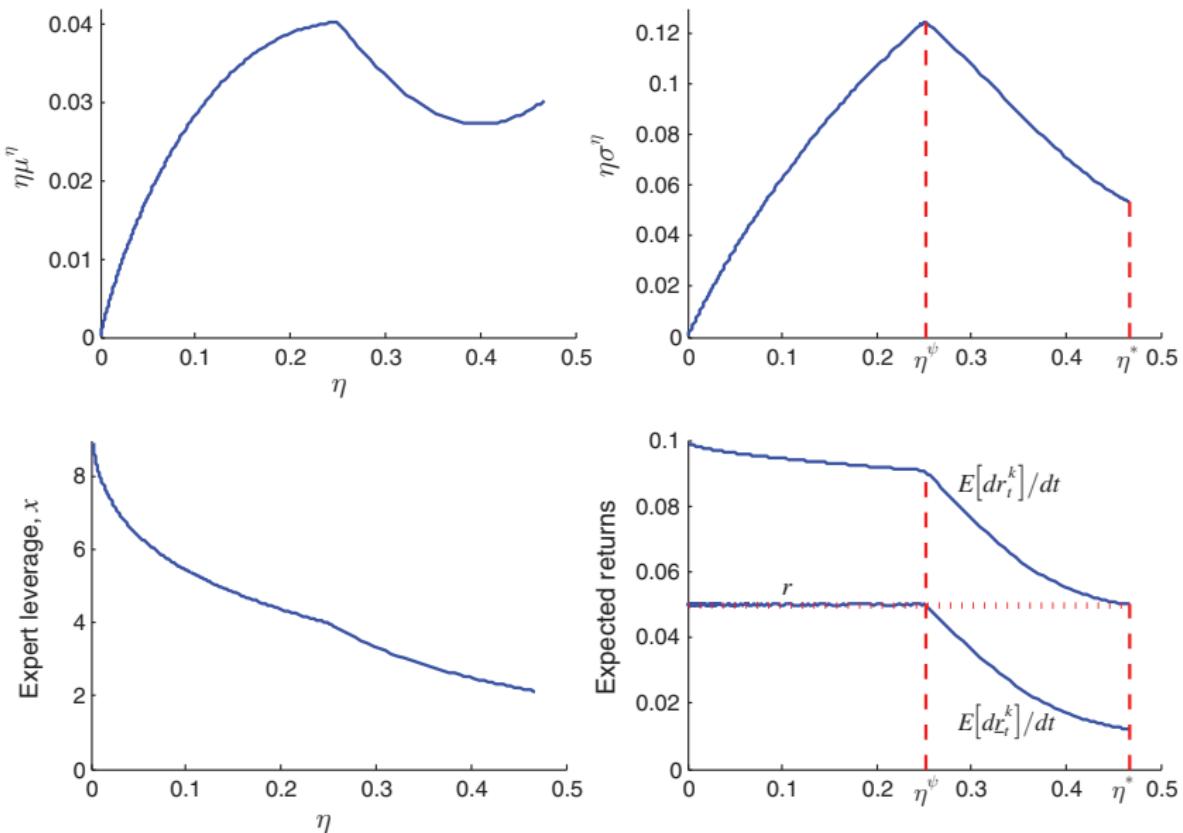


FIGURE 2. THE DRIFT AND VOLATILITY OF η_t , EXPERT LEVERAGE, AND EXPECTED ASSET RETURNS

Kiyotaki-Moore mechanism

- Feedback mechanism, like Kiyotaki-Moore.

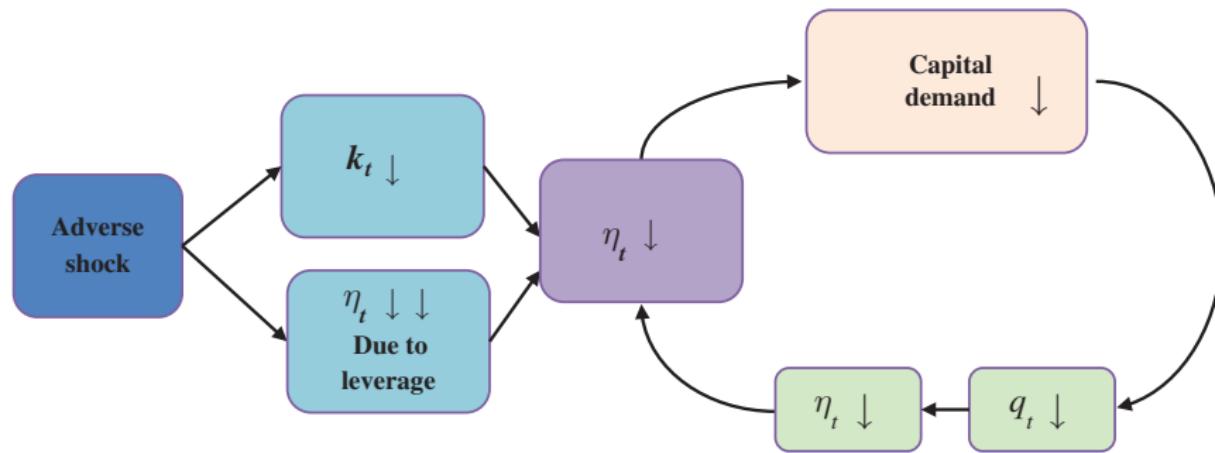


FIGURE 3. ADVERSE FEEDBACK LOOP

- Stationary density: coming from Kolmogorov forward equation.

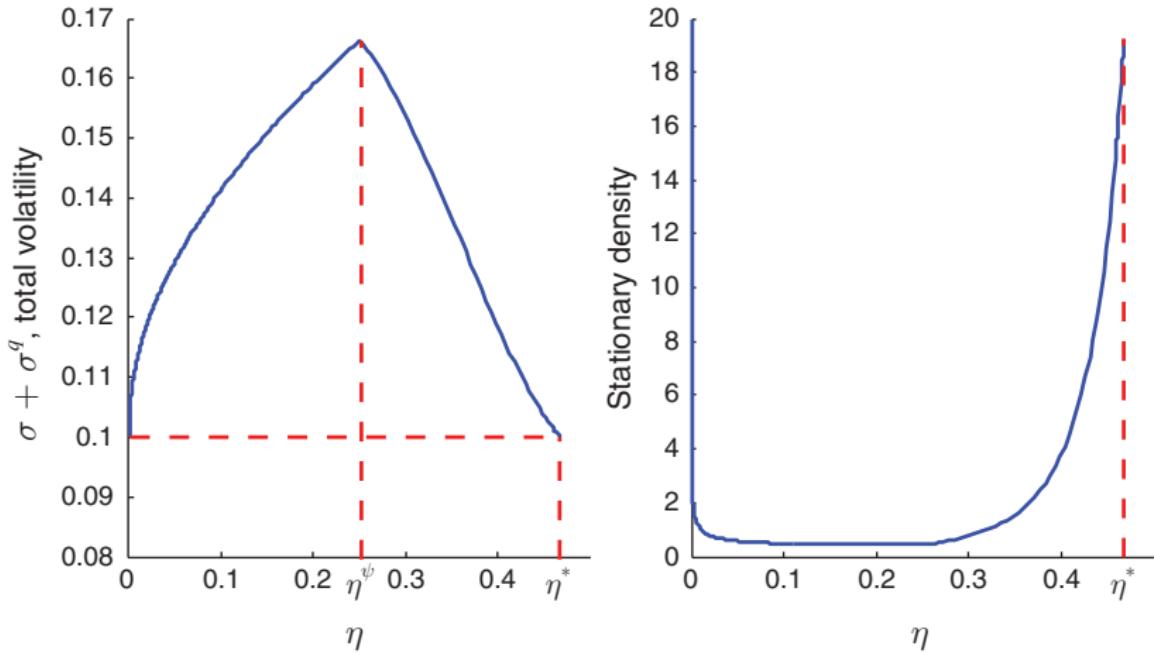


FIGURE 4. SYSTEMIC RISK: TOTAL VOLATILITY OF CAPITAL AND THE STATIONARY DENSITY OF η_t

Volatility Paradox

- Decreased exogenous risk can actually lead to MORE endogenous risk !! (Great moderation?)
- Overcomes the Kocherlakota critique (effect of expected price appreciations in the future: if recovery is certain in a not so distant future, then price change is low).
- Advantage of having a non log-linearized model: non-linear dynamics, amplification.

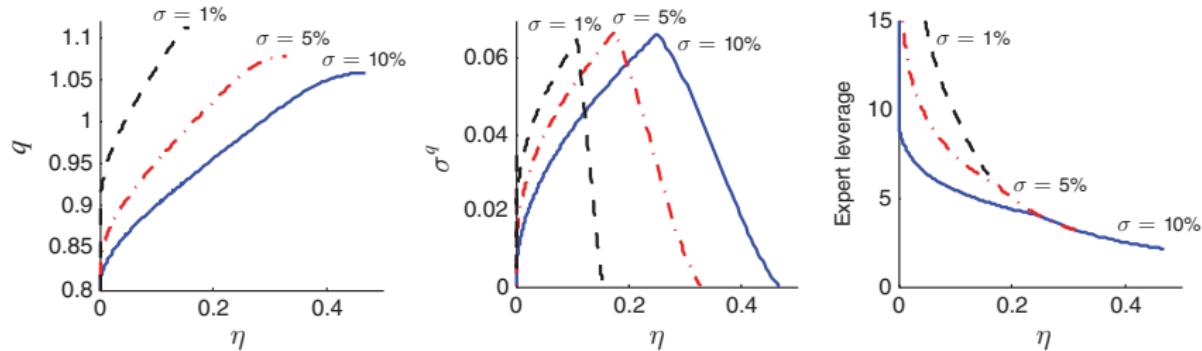


FIGURE 6. EQUILIBRIUM FOR THREE LEVELS OF EXOGENOUS RISK, $\sigma = 10$ PERCENT, 5 PERCENT, AND 1 PERCENT

Technological Illiquidity

- How bad are households? More interestingly: how severe is market illiquidity (or how worse are second-best uses of the capital? - cf. Shleifer and Vishny (1997))

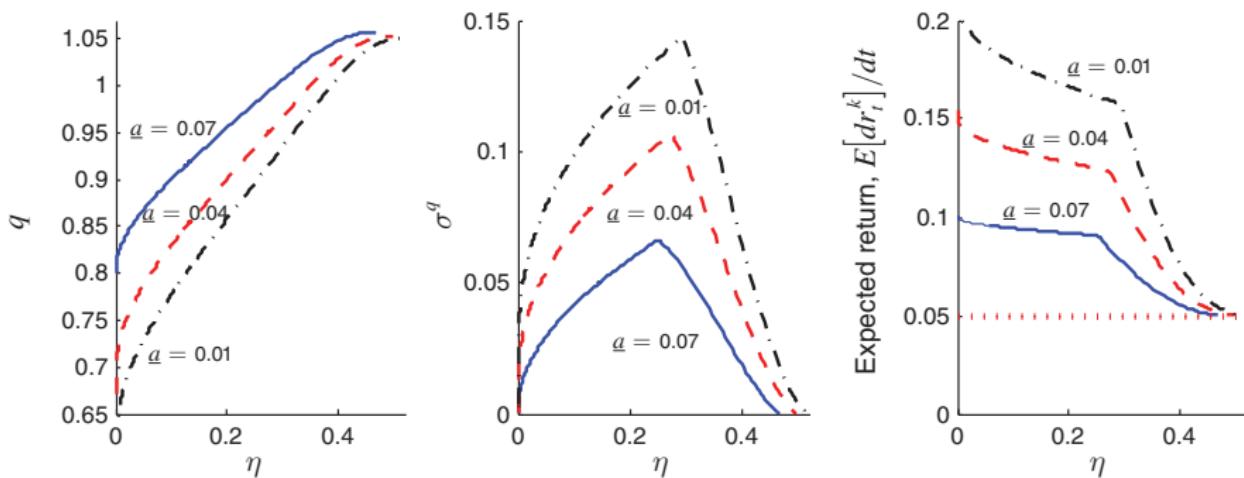
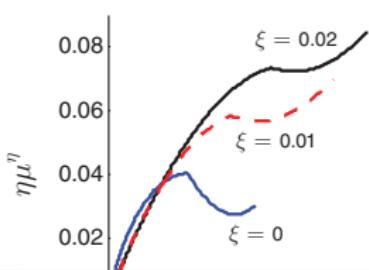
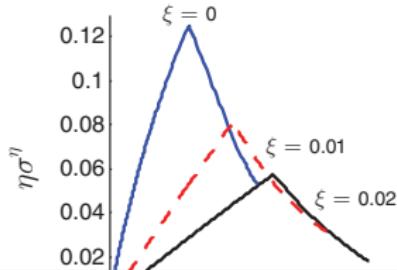
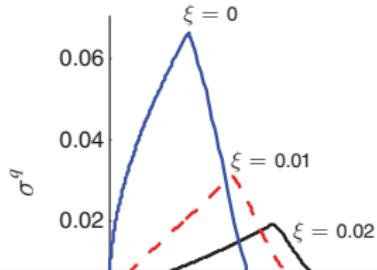
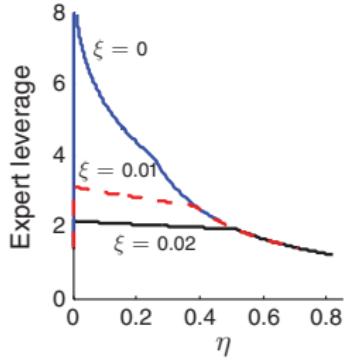
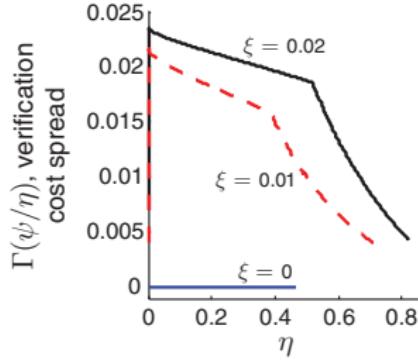
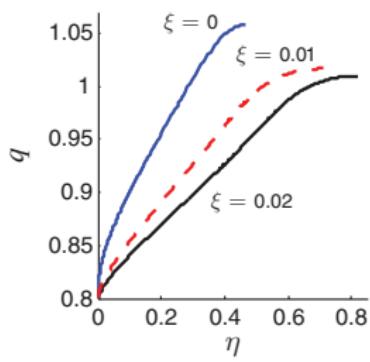


FIGURE 7. ENDOGENOUS RISK AND RISK PREMIA FOR $\underline{\alpha} = 0.07, 0.04, 0.01$

Financial Frictions (in the form of CSV) are good

- How bad are households? More interestingly: how severe is market illiquidity (or how worse are second-best uses of the capital? - cf. Shleifer and Vishny (1997))



Policies

- In the last part of the paper, Brunnermeier-Sannikov cautiously investigate the potential impact of several policy interventions:
 - Controlling Consumption (that is, dividend payouts !)
 - Open-Market Operations
 - Tail risk insurance

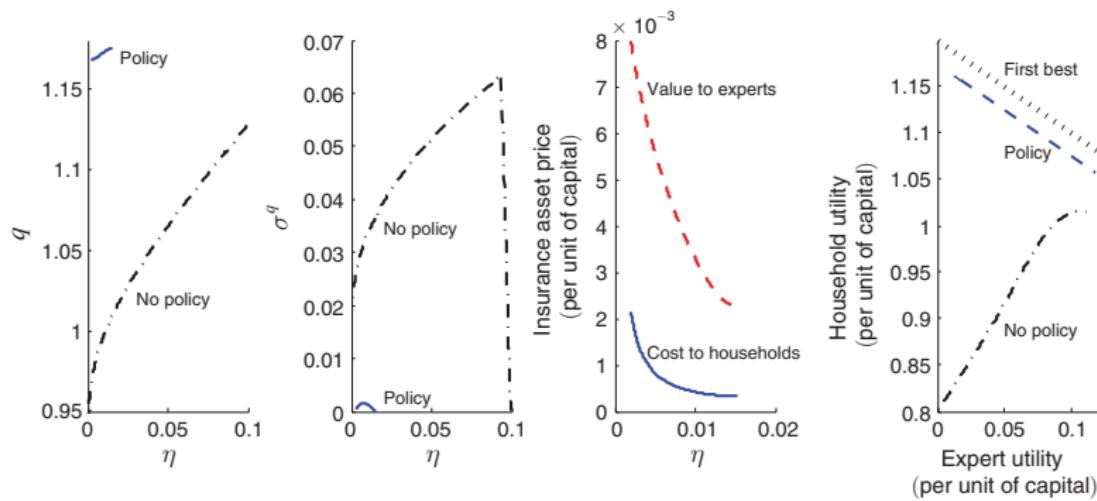


FIGURE 9. EQUILIBRIUM WITH AND WITHOUT INSURANCE

Policies

- Even if agents are risk neutral they behave as if they were risk averse.
- One of the previous comparative statics allows to think about the effect of more risk sharing (securitization, options?...) Which one is that?
- Key assumption maintained throughout: aggregate risk cannot be hedged, but stays in the hands of entrepreneurs. Alternative: one cannot observe if the project fails because of the entrepreneur or because of the recession hitting everyone.
- Why were banks, taking Mortgage-Backed Securities on their Balance Sheets, paying dividends?

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Abstract

We show that the interest rate on Federal funds is extremely informative about future movements of real macroeconomic variables. Then we argue that the reason for this forecasting success is that the **funds rate sensitively records shocks to the supply of bank reserves**; that is, the funds rate is a good indicator of monetary policy actions. Finally, using innovations to the funds rate as a measure of changes in policy, we present evidence consistent with the view that **monetary policy works at least in part through "credit" (i.e., bank loans) as well as through "money" (i.e., bank deposit)**.

Results

TABLE 1—MARGINAL SIGNIFICANCE LEVELS OF MONETARY INDICATORS FOR FORECASTING ALTERNATIVE MEASURES OF ECONOMIC ACTIVITY: SIX-VARIABLE PREDICTION EQUATIONS

| Forecasted variable | M1 | M2 | BILL | BOND | FUNDS |
|---|-------|-------|--------|--------|--------|
| <i>A. Sample Period 1959:7–1989:12:</i> | | | | | |
| Industrial production | 0.92 | 0.10 | 0.071 | 0.26 | 0.017 |
| Capacity utilization | 0.74 | 0.22 | 0.16 | 0.40 | 0.031 |
| Employment | 0.45 | 0.27 | 0.0040 | 0.085 | 0.0004 |
| Unemployment rate | 0.96 | 0.37 | 0.0005 | 0.024 | 0.0001 |
| Housing starts | 0.50 | 0.32 | 0.52 | 0.014 | 0.22 |
| Personal income | 0.38 | 0.24 | 0.35 | 0.59 | 0.049 |
| Retail sales | 0.64 | 0.036 | 0.33 | 0.74 | 0.014 |
| Consumption | 0.96 | 0.11 | 0.12 | 0.46 | 0.0052 |
| Durable-goods orders | 0.87 | 0.22 | 0.28 | 0.19 | 0.039 |
| <i>B. Sample Period 1959:7–1979:12:</i> | | | | | |
| Industrial production | 0.99 | 0.084 | 0.0092 | 0.61 | 0.0001 |
| Capacity utilization | 0.96 | 0.40 | 0.025 | 0.18 | 0.0003 |
| Employment | 0.57 | 0.41 | 0.0005 | 0.15 | 0.0004 |
| Unemployment rate | 0.56 | 0.88 | 0.0006 | 0.13 | 0.0000 |
| Housing starts | 0.34 | 0.17 | 0.73 | 0.72 | 0.11 |
| Personal income | 0.43 | 0.095 | 0.20 | 0.91 | 0.037 |
| Retail sales | 0.96 | 0.86 | 0.27 | 0.050 | 0.061 |
| Consumption | 0.79 | 0.017 | 0.010 | 0.050 | 0.0000 |
| Durable-goods orders | 0.080 | 0.030 | 0.014 | 0.0071 | 0.0002 |

Notes: For each forecasted variable, the entries across each row are the marginal significance levels for omitting six lags of the monetary-policy variable indicated in the column heading from an unrestricted ordinary-least-squares (OLS) prediction equation that also included a constant, six lags of the forecasted variable, and six lags of the CPI. Data are monthly. M1, M2, industrial production, employment, and housing starts are in log levels. Personal income, retail sales, and consumption are deflated and in log levels. The data are from the DRI database; see the Data Appendix for details. FUNDS is the Federal funds rate; BILL is the three-month Treasury bill rate; BOND is

Results

- Fed Funds Rate is far and away the best predictive variable among the five considered.
- Superior to M1, M2, the Treasury bill rate.
- The Federal Reserve reduced its reliance on the Federal funds rate as an intermediate target in October 1979. Therefore, predictive power of the funds rate should have been even stronger in a subsample that ends in September 1979. This is what is found.
- Problems with Granger-causality tests to assess predictive power?
- A stylized example will illustrate the potential problem. Suppose, say, that M1 were truly an exogenous policy variable which moved the Treasury bill rate (BILL), which in turn moved the real economy. Then M1 might be insignificant in a regression that includes BILL, even though it is the genuine driving force.

Results

TABLE 2—VARIANCE DECOMPOSITIONS OF FORECASTED VARIABLES

| Forecasted variable | Own lags | CPI | M1 | M2 | BILL | BOND | FUNDS |
|---|----------|------|------|-----|------|------|-------|
| <i>A. Sample Period 1959:7–1989:12:</i> | | | | | | | |
| Industrial production | 36.6 | 3.1 | 15.4 | 8.7 | 8.0 | 0.8 | 27.4 |
| Personal income | 39.7 | 1.3 | 21.0 | 3.5 | 9.5 | 1.7 | 23.3 |
| Employment | 38.9 | 7.0 | 10.5 | 0.6 | 9.8 | 2.7 | 30.6 |
| Unemployment rate | 31.9 | 7.2 | 10.5 | 0.6 | 9.9 | 1.9 | 37.9 |
| Housing starts | 28.8 | 1.4 | 3.9 | 1.8 | 38.6 | 14.3 | 11.2 |
| Personal income | 48.2 | 4.3 | 20.8 | 0.1 | 6.9 | 3.3 | 16.3 |
| Retail sales | 32.4 | 15.5 | 5.1 | 4.4 | 27.4 | 1.1 | 14.1 |
| Consumption | 18.2 | 13.1 | 16.0 | 2.2 | 28.4 | 5.3 | 16.8 |
| Durable-goods orders | 41.3 | 6.8 | 14.7 | 5.5 | 10.3 | 2.6 | 18.8 |
| <i>B. Sample Period 1959:7–1979:9:</i> | | | | | | | |
| Industrial production | 36.3 | 2.7 | 11.8 | 6.5 | 11.5 | 3.3 | 27.8 |
| Capacity utilization | 39.9 | 2.4 | 12.4 | 4.5 | 10.8 | 5.6 | 24.3 |
| Employment | 41.4 | 1.8 | 5.8 | 0.2 | 10.4 | 3.2 | 37.9 |
| Unemployment rate | 44.9 | 1.3 | 4.9 | 1.3 | 11.6 | 2.2 | 33.8 |
| Housing starts | 45.2 | 9.9 | 8.3 | 6.3 | 11.8 | 9.6 | 9.0 |
| Personal income | 34.5 | 17.7 | 7.0 | 0.5 | 11.9 | 14.9 | 13.4 |
| Retail sales | 49.2 | 6.0 | 9.9 | 2.7 | 16.7 | 4.1 | 11.2 |
| Consumption | 18.9 | 21.1 | 13.2 | 3.3 | 11.7 | 16.4 | 15.5 |
| Durable-goods orders | 41.9 | 1.2 | 16.9 | 5.8 | 7.9 | 7.4 | 18.9 |

Notes: Entries are the percentages of the variance of the forecasted variable accounted for by variation in the column variable at a 24-month horizon. Estimates are based on vector autoregressions with six monthly lags of each variable. The ordering of the variables in the variance decomposition is the same as the ordering (left to right) of the columns. M1, M2, industrial production, employment, and housing starts are in log levels. Personal income, retail sales, and consumption are deflated and in log levels. The data are from the DRI database; see the Data Appendix for details. FUNDS is the Federal funds rate; BILL is the three-month Treasury bill rate; BOND

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TABLE 2—VARIANCE DECOMPOSITIONS OF FORECASTED VARIABLES

| Forecasted variable | Own lags | CPI | M1 | M2 | BILL | BOND | FUNDS |
|---|----------|------|------|-----|------|------|-------|
| <i>A. Sample Period 1959:7–1989:12:</i> | | | | | | | |
| Industrial production | 36.6 | 3.1 | 15.4 | 8.7 | 8.0 | 0.8 | 27.4 |
| Personal income | 39.7 | 1.3 | 21.0 | 3.5 | 9.5 | 1.7 | 23.3 |
| Employment | 38.9 | 7.0 | 10.5 | 0.6 | 9.8 | 2.7 | 30.6 |
| Unemployment rate | 31.9 | 7.2 | 10.5 | 0.6 | 9.9 | 1.9 | 37.9 |
| Housing starts | 28.8 | 1.4 | 3.9 | 1.8 | 38.6 | 14.3 | 11.2 |
| Personal income | 48.2 | 4.3 | 20.8 | 0.1 | 6.9 | 3.3 | 16.3 |
| Retail sales | 32.4 | 15.5 | 5.1 | 4.4 | 27.4 | 1.1 | 14.1 |
| Consumption | 18.2 | 13.1 | 16.0 | 2.2 | 28.4 | 5.3 | 16.8 |
| Durable-goods orders | 41.3 | 6.8 | 14.7 | 5.5 | 10.3 | 2.6 | 18.8 |
| <i>B. Sample Period 1959:7–1979:9:</i> | | | | | | | |
| Industrial production | 36.3 | 2.7 | 11.8 | 6.5 | 11.5 | 3.3 | 27.8 |
| Capacity utilization | 39.9 | 2.4 | 12.4 | 4.5 | 10.8 | 5.6 | 24.3 |
| Employment | 41.4 | 1.8 | 5.8 | 0.2 | 10.4 | 3.2 | 37.9 |
| Unemployment rate | 44.9 | 1.3 | 4.9 | 1.3 | 11.6 | 2.2 | 33.8 |
| Housing starts | 45.2 | 9.9 | 8.3 | 6.3 | 11.8 | 9.6 | 9.0 |
| Personal income | 34.5 | 17.7 | 7.0 | 0.5 | 11.9 | 14.9 | 13.4 |
| Retail sales | 49.2 | 6.0 | 9.9 | 2.7 | 16.7 | 4.1 | 11.2 |
| Consumption | 18.9 | 21.1 | 13.2 | 3.3 | 11.7 | 16.4 | 15.5 |
| Durable-goods orders | 41.9 | 1.2 | 16.9 | 5.8 | 7.9 | 7.4 | 18.9 |

Notes: Entries are the percentages of the variance of the forecasted variable accounted for by variation in the column variable at a 24-month horizon. Estimates are based on vector autoregressions with six monthly lags of each variable. The ordering of the variables in the variance decomposition is the same as the ordering (left to right) of the columns. M1, M2, industrial production, employment, and housing starts are in log levels. Personal income, retail sales, and consumption are deflated and in log levels. The data are from the DRI database; see the Data Appendix for details. FUNDS is the Federal funds rate; BILL is the three-month Treasury bill rate; BOND

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TABLE 3—MARGINAL SIGNIFICANCE LEVELS OF MONETARY INDICATORS FOR FORECASTING ALTERNATIVE MEASURES OF ECONOMIC ACTIVITY: SIX-VARIABLE PREDICTION EQUATIONS (SAMPLE PERIOD 1961:7–1989:12)

| Forecasted variable | M1 | M2 | CPBILL | TERM | FUNDS |
|-----------------------|------|------|--------|------|-------|
| Industrial production | 0.72 | 0.86 | 0.0049 | 0.55 | 0.86 |
| Capacity utilization | 0.50 | 0.71 | 0.0008 | 0.64 | 0.85 |
| Employment | 0.79 | 0.82 | 0.032 | 0.55 | 0.63 |
| Unemployment rate | 0.47 | 0.54 | 0.049 | 0.53 | 0.28 |
| Housing starts | 0.56 | 0.23 | 0.21 | 0.38 | 0.55 |
| Personal income | 0.40 | 0.29 | 0.020 | 0.37 | 0.76 |
| Retail sales | 0.59 | 0.16 | 0.48 | 0.96 | 0.41 |
| Consumption | 0.99 | 0.53 | 0.021 | 0.78 | 0.41 |
| Durable-goods orders | 0.60 | 0.52 | 0.021 | 0.96 | 0.39 |

Notes: See notes to Table 1. CPBILL is the difference between the six-month commercial paper rate and the six-month Treasury bill rate. TERM is the difference between the ten-year and one-year government bond rates.

Results

TABLE 4—VARIANCE DECOMPOSITIONS OF FORECASTED VARIABLES

| Forecasted variable | M1 | M2 | CPBILL | TERM | FUNDS | OWN | CPI |
|-----------------------|------|------|--------|------|-------|------|-----|
| Industrial production | 13.5 | 19.6 | 10.7 | 11.3 | 6.6 | 34.3 | 4.0 |
| Capacity utilization | 17.0 | 8.7 | 14.2 | 7.1 | 18.7 | 32.5 | 1.7 |
| Employment | 16.1 | 8.6 | 13.1 | 8.0 | 11.6 | 37.3 | 5.3 |
| Unemployment rate | 6.8 | 0.9 | 14.1 | 7.9 | 18.5 | 45.0 | 6.8 |
| Housing starts | 13.5 | 3.8 | 1.3 | 47.4 | 2.7 | 30.5 | 0.8 |
| Personal income | 18.7 | 0.1 | 4.1 | 9.7 | 1.4 | 64.3 | 1.6 |
| Retail sales | 8.4 | 2.7 | 4.1 | 33.5 | 5.7 | 38.1 | 7.4 |
| Consumption | 24.9 | 1.4 | 2.5 | 36.9 | 5.6 | 22.5 | 6.2 |
| Durable-goods orders | 11.9 | 8.2 | 11.5 | 6.4 | 12.5 | 43.3 | 6.3 |

| Forecasted variable | M1 | M2 | FUNDS | TERM | CPBILL | OWN | CPI |
|-----------------------|------|------|-------|------|--------|------|-----|
| Industrial production | 13.5 | 19.6 | 21.8 | 0.8 | 5.9 | 34.3 | 4.0 |
| Capacity utilization | 17.0 | 8.7 | 30.3 | 0.9 | 8.9 | 32.5 | 1.7 |
| Employment | 16.1 | 8.6 | 26.7 | 0.1 | 6.0 | 37.3 | 5.3 |
| Unemployment rate | 6.8 | 0.9 | 32.9 | 0.9 | 6.6 | 45.0 | 6.8 |
| Housing starts | 13.5 | 3.8 | 26.5 | 22.6 | 2.3 | 30.5 | 0.8 |
| Personal income | 18.7 | 0.1 | 11.0 | 2.6 | 1.6 | 64.3 | 1.6 |
| Retail sales | 8.4 | 2.7 | 30.6 | 9.8 | 3.0 | 38.1 | 7.4 |
| Consumption | 24.9 | 1.4 | 33.3 | 10.9 | 0.8 | 22.5 | 6.2 |
| Durable-good orders | 11.9 | 8.2 | 22.6 | 0.7 | 7.1 | 43.3 | 6.3 |

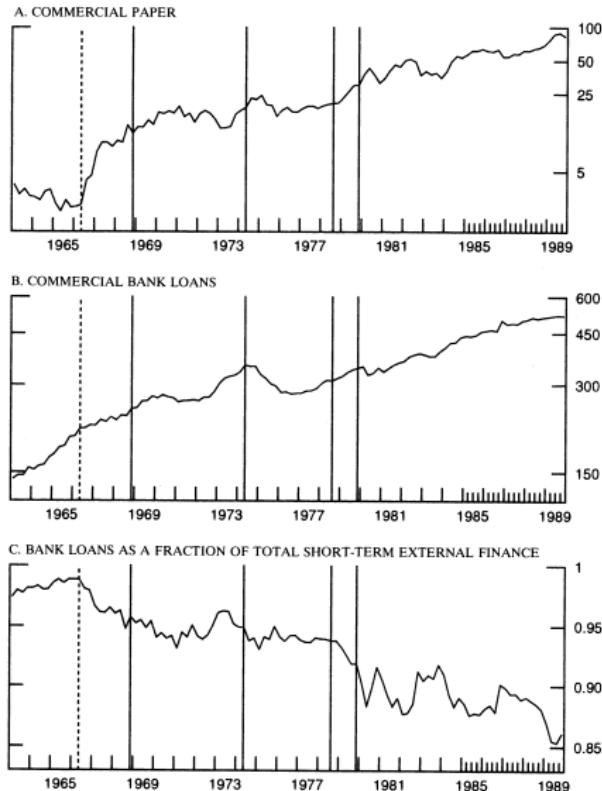
Notes: See notes to Table 2. CPBILL is the difference between the six-month commercial paper rate and the six-month Treasury bill rate. TERM is the difference

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Abstract

In this paper, we use the relative moments in **bank loans and commercial paper** to provide evidence on the existence of a **loan-supply channel** of monetary-policy transmission. We find that tighter monetary policy leads to a shift in firms' mix of external financing: **commercial paper issuance rises while bank loans fall**. This suggests that contractionary policy can indeed reduce loan supply. Furthermore, such shifts in loan supply seem to affect investment, even controlling for interest rates and output.

Results



Notes: Solid vertical lines mark Romer dates; the dotted line represents the 1966

Results

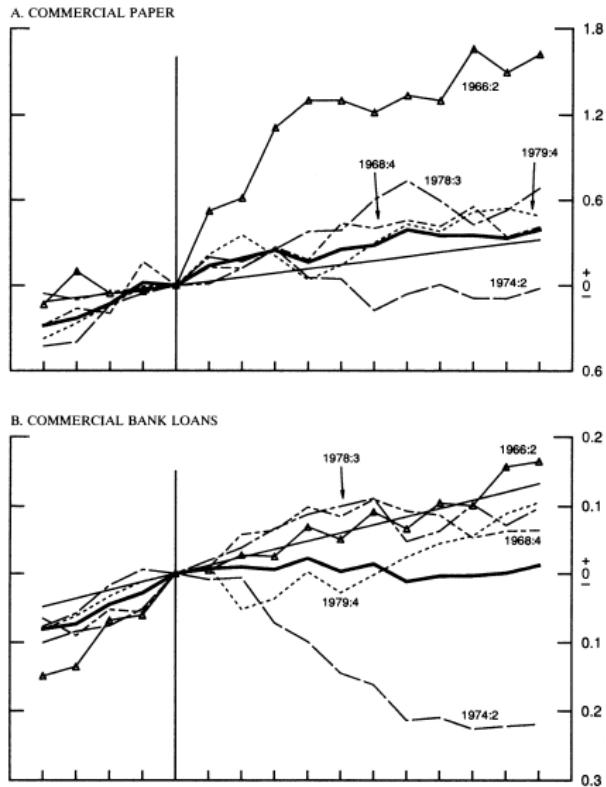


FIGURE 2. CHANGES IN SHORT-TERM EXTERNAL FINANCE AROUND ROMER DATES

Notes: All series are shown as log deviations from their values as of the Romer dates. Ticks along the x-axis mark quarters. Averages across Romer dates, excluding the

Results

C. BANK LOANS AS A FRACTION OF TOTAL SHORT-TERM EXTERNAL FINANCE

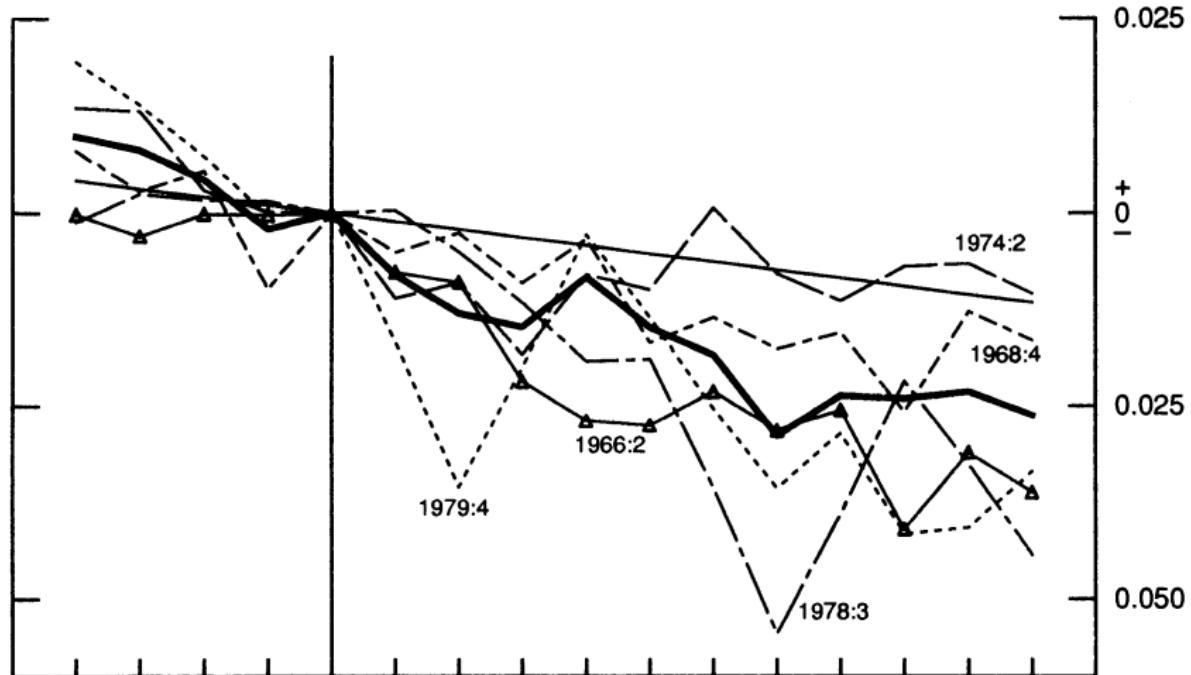


FIGURE 2. (*Continued*)

Results

C. BANK LOANS AS A FRACTION OF TOTAL SHORT-TERM EXTERNAL FINANCE

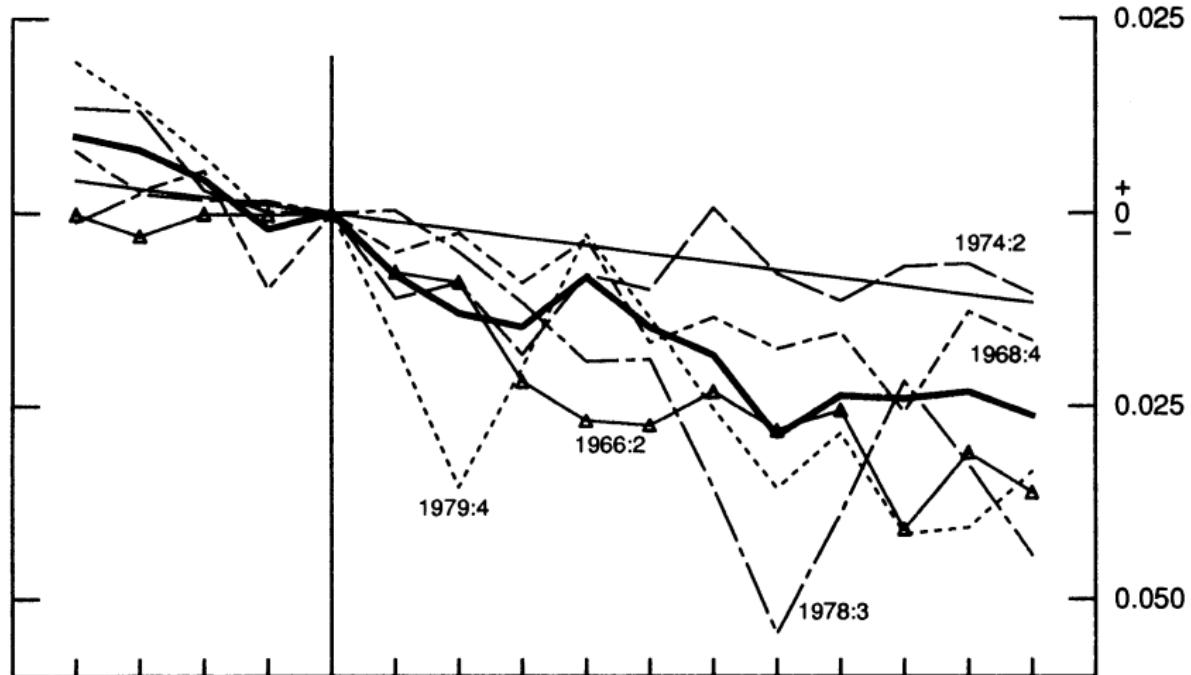


FIGURE 2. (*Continued*)

Results

TABLE 1—CAUSALITY TESTS BETWEEN FINANCING VARIABLES AND INDICATORS
OF THE STANCE OF MONETARY POLICY

| Indicator | Mix | | Log real paper | | Log real loans | | Prime–CP spread | |
|---|-----------|-----------|----------------|-----------|----------------|-----------|-----------------|-----------|
| | Exclusion | Summation | Exclusion | Summation | Exclusion | Summation | Exclusion | Summation |
| A. Romer Date Indicators: | | | | | | | | |
| Romer dates (bivariate) | 0.09 | −2.10 | 0.84 | 0.61 | 0.17 | −2.16 | 0.0002 | 2.17 |
| Romer dates plus 1966 (bivariate) | 0.08 | −2.55 | 0.13 | 1.99 | 0.07 | −1.99 | 0.002 | 2.27 |
| Romer dates (multivariate) | 0.02 | −2.91 | 0.57 | 1.63 | 0.45 | −1.02 | 0.0009 | 2.35 |
| Romer dates plus 1966 (multivariate) | 0.05 | −3.02 | 0.07 | 2.96 | 0.12 | −1.18 | 0.02 | 1.98 |
| B. Interest Rate Indicators: | | | | | | | | |
| Funds rate (bivariate) | 0.003 | −3.06 | 0.06 | 2.23 | 0.24 | −1.46 | 0.001 | 4.10 |
| Spread: 10-year government bond–funds (bivariate) | 0.03 | 1.92 | 0.14 | −1.10 | 0.55 | 1.61 | 0.003 | −1.48 |
| Funds rate (multivariate) | 0.007 | −1.92 | 0.20 | 1.35 | 0.58 | −0.15 | 0.002 | 2.44 |
| Spread: 10-year government bond–funds (multivariate) | 0.04 | 2.36 | 0.10 | −2.73 | 0.99 | −0.48 | 0.028 | −1.10 |

Notes: In each case, the variable at the top of the column is regressed against eight lags of itself and eight lags of the variable in the row. In the multivariate cases, eight lags of GNP growth are added to the regression. The following variables have been differenced so that they enter the regressions in stationary form: mix, log real paper, log real loans, prime–CP spread, and funds rate. Entries in the “exclusion” columns report the marginal significance levels on tests that variables shown in rows do not help forecast the variable at the top of the column. Entries in the “summation” columns report the *t* statistic for the test that the sum of the coefficients on the eight lags of the variable shown in the row is zero.

Results

TABLE 2—TESTS FOR EXPLANATORY POWER OF MIX AND PRIME–CP SPREAD
IN STRUCTURAL INVENTORY AND INVESTMENT EQUATIONS

| Category | Mix | | | Prime–CP spread | | |
|------------------------------|-------------|--------------|----------|-----------------|--------------|----------|
| | Accelerator | Neoclassical | <i>Q</i> | Accelerator | Neoclassical | <i>Q</i> |
| Nondurable inventories | 0.173 | 0.009 | — | 0.022 | 0.001 | — |
| Durable inventories | 0.002 | 0.049 | — | 0.500 | 0.302 | — |
| Producer's durable equipment | 10^{-6} | 0.003 | 0.026 | 10^{-7} | 0.003 | 0.027 |
| Nonresidential structures | 0.460 | 0.391 | 0.175 | 0.537 | 0.011 | 0.037 |

Notes: The number in each cell is the significance level in an *F* test that tests whether a distributed lag of either the mix or the prime–CP spread enters the inventory and investment equations described in the text. “Nondurable inventories” are inventories held by manufacturers, wholesalers, and retailers of nondurable goods; “durable inventories” are inventories held by manufacturers and wholesalers of durable goods.

Interpretation

- An unconditional correlation between the mix and real activity could arise if monetary policy moved the mix around but influenced the real economy solely through its effect on security-market interest rate.
- In the case of fixed investment, there are several well-known empirical models. We examine three: the "accelerator," the "neoclassical," and the securities-value (or "Q") models.
- The first, which we label the "accelerator" model, contains only the terms pertaining to **expected sales**.
- The second, labeled "neo-classical" in what follows, includes both the sales and interest-expense proxies.

- 1 Deterministic Q-theory
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- 5 Results, Comparative Statics
- 6 Bernanke and Blinder (1992)
- 7 Kashyap et al. (1993)
- 8 Kashyap and Stein (2000)**
- 9 Krishnamurthy and Vissing-Jorgensen (2011)
- 10 Gilchrist and Zakrajšek (2012)
- 11 Jiménez et al. (2014)
- 12 Chodorow-Reich (2014)
- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Abstract

We study the monetary-transmission mechanism with a data set that includes **quarterly observations of every insured U.S. commercial bank from 1976 to 1993**. We find that the impact of monetary policy on lending is **stronger for banks with less liquid balance sheets**—i.e., banks with **lower ratios of securities to assets**. Moreover, this pattern is largely attributable to the **smaller banks**, those in the bottom 95 percent of the size distribution. Our results support the existence of a “bank lending channel” of monetary transmission, though they do not allow us to make precise statements about its quantitative importance.

Summary Statistics

TABLE 1—BALANCE SHEETS FOR BANKS OF DIFFERENT SIZES

| | Below 75th percentile | Between 75th and 90th percentile | Between 90th and 95th percentile | Between 95th and 98th percentile | Between 98th and 99th percentile | Above 99th percentile |
|---|-----------------------------|---|---|---|---|-----------------------------|
| Panel A: Composition of Bank Balance Sheets as of 1976 Q1 | | | | | | |
| Number of banks | 10,784 | 2,157 | 719 | 431 | 144 | 144 |
| Mean assets (1993 \$ millions) | 32.82 | 119.14 | 247.73 | 556.61 | 1,341.45 | 10,763.44 |
| Median assets (1993 \$ millions) | 28.43 | 112.63 | 239.00 | 508.06 | 1,228.66 | 3,964.55 |
| Fraction of total system assets | 0.13 | 0.09 | 0.06 | 0.09 | 0.07 | 0.56 |
| <i>Fraction of total assets in size category</i> | | | | | | |
| Cash | 0.09 | 0.09 | 0.10 | 0.12 | 0.13 | 0.22 |
| Securities | 0.34 | 0.33 | 0.32 | 0.29 | 0.27 | 0.15 |
| Federal funds lent | 0.05 | 0.04 | 0.04 | 0.05 | 0.04 | 0.03 |
| Total domestic loans | 0.52 | 0.53 | 0.53 | 0.53 | 0.54 | 0.41 |
| Real estate loans | 0.17 | 0.19 | 0.20 | 0.18 | 0.17 | 0.09 |
| C & I loans | 0.10 | 0.13 | 0.15 | 0.16 | 0.17 | 0.17 |
| Loans to individuals | 0.15 | 0.16 | 0.15 | 0.15 | 0.14 | 0.06 |
| Total deposits | 0.90 | 0.90 | 0.89 | 0.87 | 0.84 | 0.81 |
| Demand deposits | 0.31 | 0.30 | 0.30 | 0.31 | 0.33 | 0.25 |
| Time and savings deposits | 0.59 | 0.60 | 0.59 | 0.55 | 0.51 | 0.33 |
| Time deposits > \$100K | 0.07 | 0.10 | 0.12 | 0.14 | 0.14 | 0.16 |
| Federal funds borrowed | 0.00 | 0.01 | 0.02 | 0.04 | 0.07 | 0.08 |
| Subordinated debt | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Other liabilities | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.06 |
| Equity | 0.08 | 0.08 | 0.07 | 0.07 | 0.07 | 0.05 |

Summary Statistics

Panel B: Composition of Bank Balance Sheets as of 1993 Q2

| | Below 75th percentile | Between 75th and 90th percentile | Between 90th and 95th percentile | Between 95th and 98th percentile | Between 98th and 99th percentile | Above 99th percentile |
|--|-----------------------------|---|---|---|---|-----------------------------|
| Number of banks | 8,404 | 1,681 | 560 | 336 | 112 | 113 |
| Mean assets (1993 \$ millions) | 44.42 | 165.81 | 380.14 | 1,072.57 | 3,366.01 | 17,413.41 |
| Median assets (1993 \$ millions) | 38.59 | 155.73 | 362.75 | 920.78 | 3,246.33 | 9,297.70 |
| Fraction of total system assets | 0.10 | 0.08 | 0.06 | 0.10 | 0.11 | 0.55 |
| <i>Fraction of total assets in size category</i> | | | | | | |
| Cash | 0.05 | 0.05 | 0.05 | 0.07 | 0.07 | 0.09 |
| Securities | 0.34 | 0.32 | 0.29 | 0.27 | 0.25 | 0.22 |
| Federal funds lent | 0.04 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 |
| Total loans | 0.53 | 0.56 | 0.60 | 0.59 | 0.60 | 0.59 |
| Real estate loans | 0.30 | 0.33 | 0.34 | 0.30 | 0.25 | 0.21 |
| C & I loans | 0.09 | 0.10 | 0.11 | 0.12 | 0.13 | 0.18 |
| Loans to individuals | 0.09 | 0.10 | 0.12 | 0.14 | 0.17 | 0.10 |
| Total deposits | 0.88 | 0.87 | 0.85 | 0.79 | 0.76 | 0.69 |
| Transaction deposits | 0.26 | 0.26 | 0.25 | 0.24 | 0.26 | 0.19 |
| Large deposits | 0.17 | 0.21 | 0.22 | 0.25 | 0.24 | 0.21 |
| Brokered deposits | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.01 |
| Federal funds borrowed | 0.01 | 0.02 | 0.04 | 0.06 | 0.10 | 0.09 |
| Subordinated debt | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Other liabilities | 0.01 | 0.02 | 0.03 | 0.05 | 0.06 | 0.13 |
| Equity | 0.10 | 0.09 | 0.08 | 0.09 | 0.08 | 0.07 |

Summary Statistics

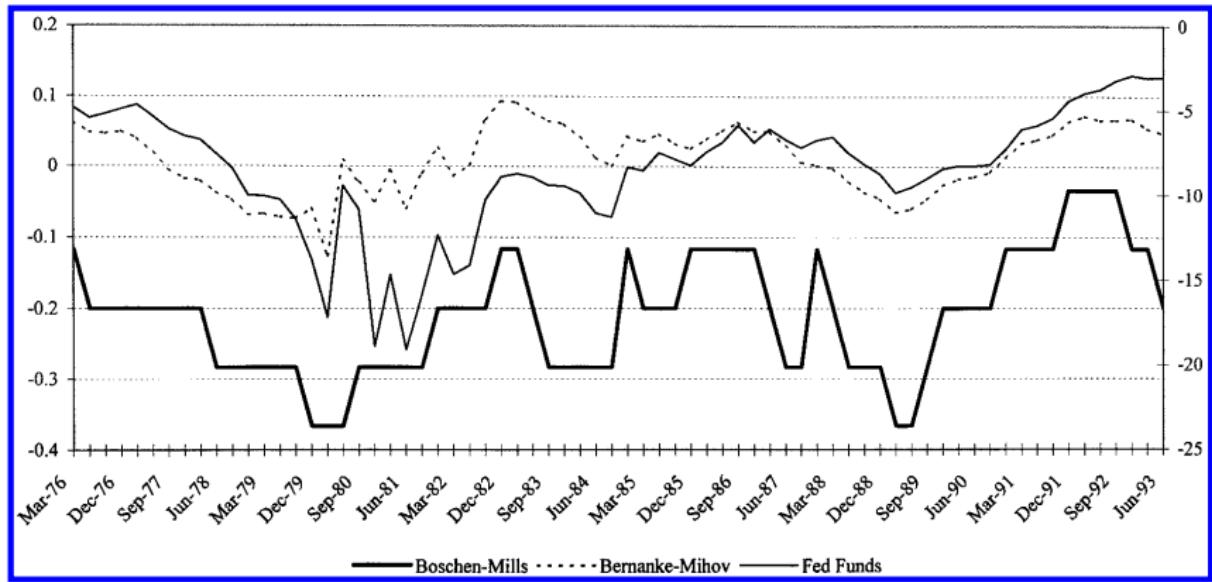


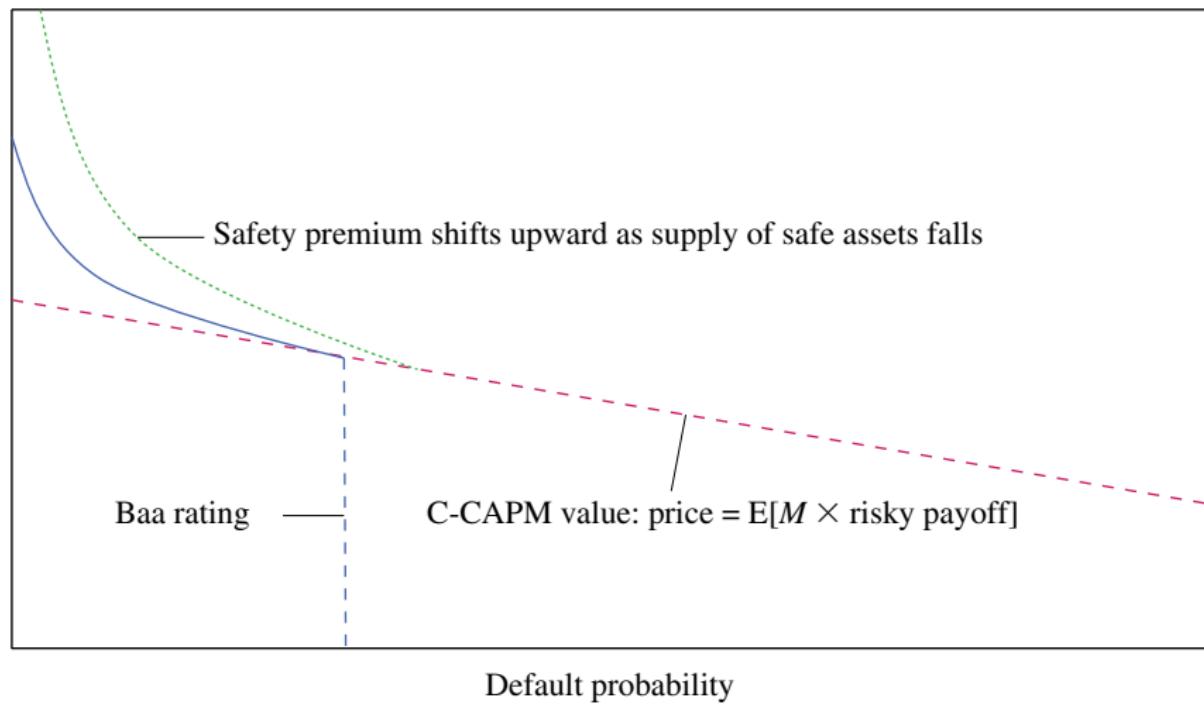
FIGURE 1. MEASURES OF MONETARY POLICY

- 1 Deterministic Q-theory
- 2 Models with Financial Frictions
- 3 Importance of “Fire Sales”
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- 14 Giroud and Mueller (2017)

Theory

Figure 1. The Safety Premium on Bonds with Near-Zero Default Risk

Price

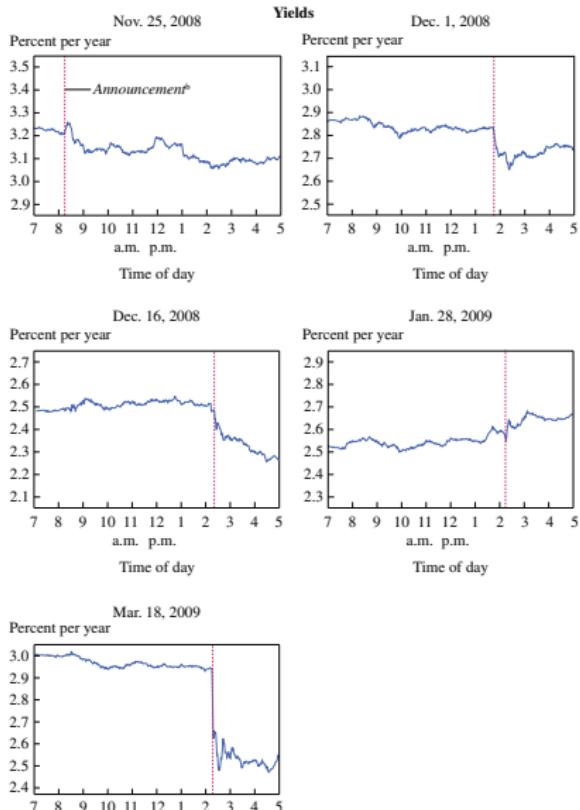


Summary

- QE1. in 10-year equivalents, the Federal Reserve had purchased \$169 billion of Treasuries, \$59 billion of agency debt, and \$573 billion of agency MBSs by February 1, 2010. The Treasury purchases were complete at \$300 billion, whereas \$164 billion of up to \$200 billion of agency securities had been purchased.
- QE2. purchase \$600 billion of Treasuries and roll over the maturing MBSs in its portfolio into long-term Treasuries

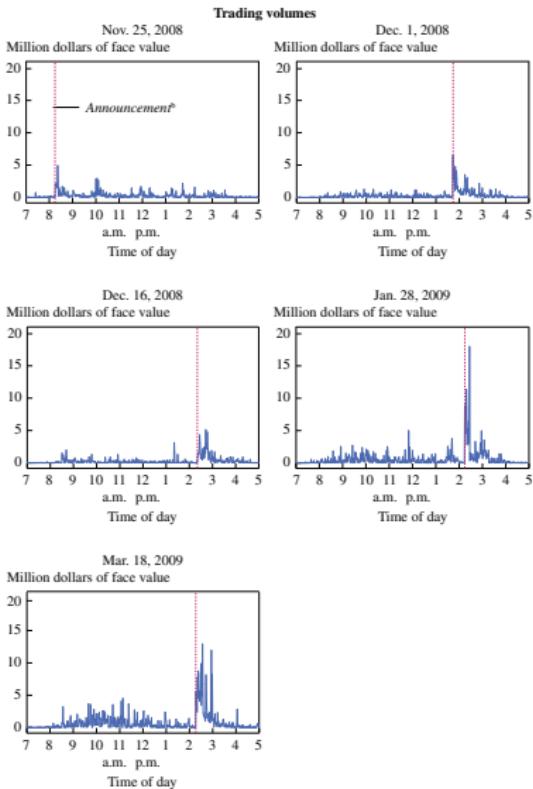
Results

Figure 2. Intraday Yields and Trading Volumes on QE1 Event Days^a



Results

Figure 2. Intraday Yields and Trading Volumes on QE1 Event Days^a (Continued)



Source: BG Cantor data.

^a Yields and trading volumes are minute-by-minute averages and total volume by minute, respectively.

Results

Table 1. Changes in Treasury, Agency, and Agency MBS Yields around QE1 Event Dates^a

Basis points

| Date | Event | Treasury yields (constant maturity) | | | | | Agency (Fannie Mae) yields | | | | Agency MBS yields ^b | |
|--------------------------------------|----------------------|-------------------------------------|---------|--------|--------|--------|----------------------------|---------|---------|---------|--------------------------------|---------|
| | | 30-year | 10-year | 5-year | 3-year | 1-year | 30-year | 10-year | 5-year | 3-year | 30-year | 15-year |
| Nov. 25, 2008 | Initial announcement | -24 | -36 | -23 | -15 | -2 | -57 | -76 | -57 | -42 | -72 | -88 |
| Dec. 1, 2008 | Bernanke speech | -27 | -25 | -28 | -15 | -13 | -52 | -67 | -50 | -33 | -14 | 12 |
| Dec. 16, 2008 | FOMC statement | -32 | -33 | -15 | -4 | -5 | -37 | -39 | -26 | -25 | -26 | -16 |
| Jan. 28, 2009 | FOMC statement | 31 | 28 | 28 | 19 | 4 | 33 | 28 | 27 | 14 | 31 | 20 |
| Mar. 18, 2009 | FOMC statement | -21 | -41 | -36 | -24 | -9 | -31 | -45 | -44 | -35 | -27 | -16 |
| Sum of above five dates ^c | | -73* | -107** | -74 | -39 | -25** | -144** | -200*** | -150*** | -123*** | -107* | -88 |

Sources: FRED, Federal Reserve Bank of St. Louis; Bloomberg.

a. All changes are over 2 days, from the day before to the day after the event. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

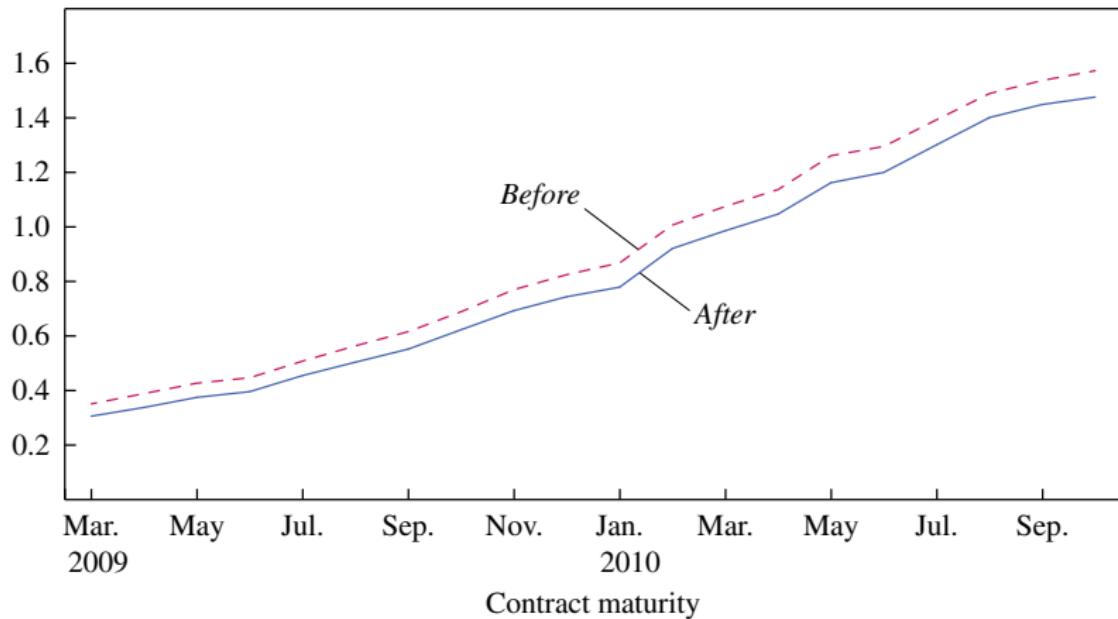
b. Averages across current-coupon Ginnie Mae, Fannie Mae, and Freddie Mac MBSs.

c. May differ from the sum of the values reported for individual dates because of rounding.

Results

Figure 3. Yield Curves Calculated from Federal Funds Futures before and after QE1 Event Days

Percent per year



Source: Bloomberg data.

a. Yields are computed the day before each QE1 event date and again the day after. All the before-event

Results

Table 2. Changes in Federal Funds Futures Yields around QE1 and QE2 Event Dates^a
Basis points

| Date ^b | <i>Federal funds futures, contract maturity</i> | | | |
|------------------------|---|------------------|-------------------|-------------------|
| | <i>3rd month</i> | <i>6th month</i> | <i>12th month</i> | <i>24th month</i> |
| <i>QE1^c</i> | -6 | -5 | -8 | -16 |
| Nov. 25, 2008 | -6 | -3 | -7 | -20 |
| Dec. 1, 2008 | -13 | -15 | -10 | -11 |
| Dec. 16, 2008 | -1 | -1 | -1 | 19 |
| Jan. 28, 2009 | -2 | -4 | -8 | -11 |
| Mar. 18, 2009 | -28* | -27 | -33** | -40 |
| Sum ^d | | | | |
| <i>QE2</i> | | | | |
| Aug. 10, 2010 | | | | |
| One-day change | 0 | 0 | -2 | -3 |
| Two-day change | 0 | 0 | -3 | -8 |
| Sep. 21, 2010 | | | | |
| One-day change | 0 | -1 | -3 | -8 |
| Two-day change | 0 | -1 | -3 | -8 |
| Sum ^d | | | | |
| One-day changes | 0*** | -1 | -4*** | -11*** |
| Two-day changes | 0*** | -1 | -5*** | -16*** |

Source: Authors' calculations using Bloomberg data.

a. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. See table 1 for descriptions of events on QE1 dates; QE2 dates are those of FOMC statements regarding QE2.

c. All changes in yields for QE1 are 2-day changes, from the day before to the day after the event.

d. Because our significance tests are based on comparing changes on QE announcement days with changes on other days, changes on QE announcement days of zero can be statistically significant. For the 3-month federal funds futures, changes on non-QE days were on average slightly negative. Values may

Results

Table 3. Changes in Corporate Yields, Unadjusted and Adjusted by Credit Default Swap Rates, around QE1 Event Dates^a
Basis points

| Date ^b | Corporate yields | | | | | | | | | | | |
|-------------------|------------------|-------|-------|-------|-------|-----|-------------------|-------|-------|-------|--------|---------|
| | Long-term | | | | | | Intermediate-term | | | | | |
| | Aaa | Aa | A | Baa | Ba | B | Aaa | Aa | A | Baa | Ba | B |
| Nov. 25, 2008 | -28 | -18 | -23 | -19 | -4 | 4 | -17 | -15 | -18 | -18 | 1 | -47 |
| Dec. 1, 2008 | -24 | -24 | -21 | -17 | -13 | 28 | -21 | -15 | -18 | -8 | -5 | 6 |
| Dec. 16, 2008 | -43 | -37 | -45 | -39 | 1 | -11 | -19 | -21 | -24 | -27 | -28 | -42 |
| Jan. 28, 2009 | 34 | 17 | 17 | 14 | -16 | -25 | 12 | 8 | 7 | 3 | -32 | -25 |
| Mar. 18, 2009 | -16 | -21 | -21 | -20 | -28 | -39 | -43 | -50 | -39 | -26 | -18 | -22 |
| Sum ^c | -77 | -83** | -93** | -81** | -60** | -43 | -88** | -93** | -92** | -76** | -82*** | -130*** |

| | Credit default swap rates ^d | | | | | | | | | | | |
|------------------|--|-----|-----|------|------|----------|-----------------|-----|-----|-------|------|--------|
| | 10-year maturity | | | | | | 5-year maturity | | | | | |
| | -1 | 10 | -17 | -13 | -31 | -798 | -1 | -6 | -20 | -18 | -32 | -573 |
| Nov. 25, 2008 | -1 | 10 | -17 | -13 | -31 | -798 | -1 | -6 | -20 | -18 | -32 | -573 |
| Dec. 1, 2008 | 1 | 0 | 9 | 11 | 21 | 1 | 1 | 3 | 13 | 7 | 28 | 33 |
| Dec. 16, 2008 | -2 | -8 | -18 | -17 | -23 | -308 | -2 | -15 | -20 | -21 | -40 | -172 |
| Jan. 28, 2009 | -3 | -15 | -6 | -13 | -26 | -231 | -3 | -7 | -9 | -11 | -27 | -255 |
| Mar. 18, 2009 | -2 | -1 | 0 | -7 | -18 | -18 | -2 | 8 | 2 | -8 | -27 | -25 |
| Sum ^c | -7*** | -14 | -32 | -40* | -78* | -1,354** | -6*** | -17 | -33 | -51** | -98* | -991** |

(continued)

Results

Table 3. Changes in Corporate Yields, Unadjusted and Adjusted by Credit Default Swap Rates, around QE1 Event Dates^a (Continued)
 Basis points

| Date ^b | Adjusted corporate yields ^c | | | | | | | | | | | |
|-------------------|--|-----|-----|-----|-----|---------|-------------------|-----|-----|-----|-----|-------|
| | Long-term | | | | | | Intermediate-term | | | | | |
| | Aaa | Aa | A | Baa | Ba | B | Aaa | Aa | A | Baa | Ba | B |
| Nov. 25, 2008 | -27 | -28 | -6 | -6 | 27 | 802 | -16 | -9 | 2 | 0 | 33 | 526 |
| Dec. 1, 2008 | -25 | -24 | -30 | -28 | -34 | 27 | -22 | -18 | -31 | -15 | -33 | -27 |
| Dec. 16, 2008 | -41 | -29 | -27 | -22 | 24 | 297 | -17 | -6 | -4 | -6 | 12 | 130 |
| Jan. 28, 2009 | 37 | 32 | 23 | 27 | 10 | 206 | 15 | 15 | 16 | 14 | -5 | 230 |
| Mar. 18, 2009 | -14 | -20 | -21 | -13 | -10 | -21 | -41 | -58 | -41 | -18 | 9 | 3 |
| Sum ^d | -70 | -69 | -61 | -41 | 18 | 1,311** | -82* | -76 | -59 | -25 | 16 | 861** |

Sources: Authors' calculations using data from Barclays, Credit Market Analysis (CMA), the Mergent Fixed Investment Securities Database (FISD), and the Trade Reporting and Compliance Engine (TRACE) of the Financial Industry Regulatory Authority.

a. All changes are over 2 days, from the day before to the day after the event. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. See table 1 for descriptions of the events on these dates.

c. May differ from the sum of the values reported for individual dates because of rounding.

d. Constructed using CMA data and ratings from FISD; changes are value-weighted averages using information on issue sizes from FISD and prices from TRACE.

e. Change in the unadjusted corporate yield minus the change in the corresponding CDS rate.

Results

Table 4. Changes in Inflation Swap Rates, TIPS Yields, and Implied Interest Rate Volatility around QE1 Event Dates^a

Basis points

| Date ^b | Inflation swap rates | | | | TIPS real yield (constant maturity) | | | Implied interest rate volatility ^c |
|-------------------|----------------------|---------|--------|--------|-------------------------------------|---------|------------------|---|
| | 30-year | 10-year | 5-year | 1-year | 20-year | 10-year | 5-year | |
| Nov. 25, 2008 | 1 | -6 | -28 | 48 | -22 | -43 | 5 | 1 |
| Dec. 1, 2008 | 15 | 27 | 12 | -40 | -38 | -34 | -52 ^d | -7 |
| Dec. 16, 2008 | 4 | 37 | 35 | -17 | -45 | -57 | -83 | -20 |
| Jan. 28, 2009 | 14 | 15 | -6 | 5 | 15 | 6 | 13 | 0 |
| Mar. 18, 2009 | 2 | 22 | 24 | 45 | -45 | -59 | -43 | -11 |
| Sum ^e | 35** | 96** | 38 | 41 | -135*** | -187*** | -160** | -38*** |

Sources: FRED, Federal Reserve Bank of St. Louis; Bloomberg.

a. All changes are over 2 days, from the day before to the day after the event. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. See table 1 for descriptions of the events on these dates.

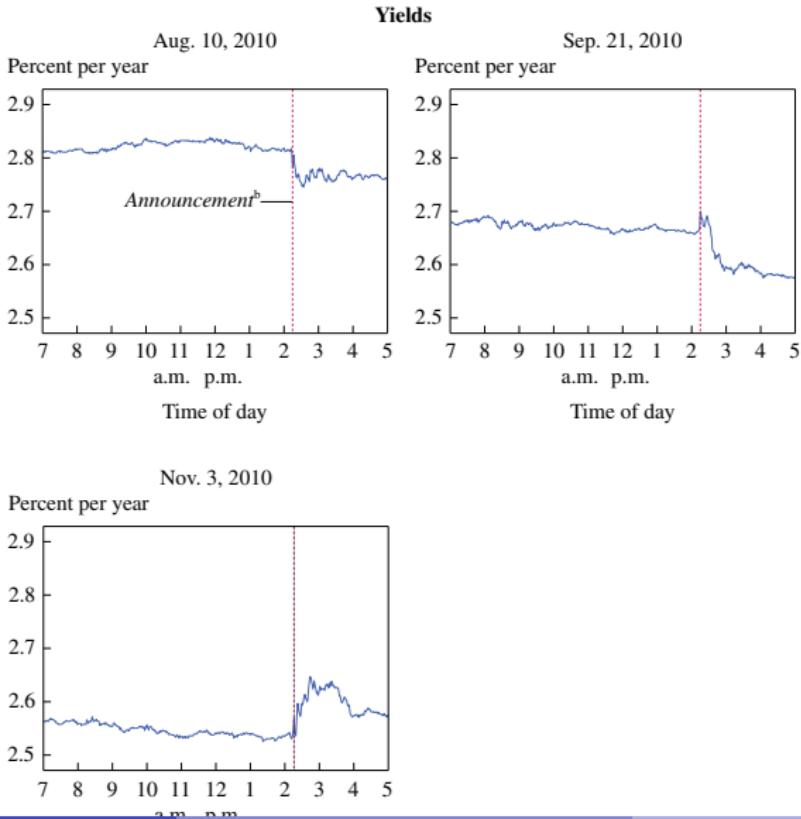
c. Volatility implied from swaptions as measured using the Barclays implied volatility index.

d. The constant-maturity TIPS data from FRED indicate that the 5-year TIPS fell by 244 bp around this event. We think this is a data error. Using data from FRED on the 5-year and 10-year underlying TIPS with remaining maturities near 5 years around QE1 (the 5-year TIPS maturing April 15, 2013, and the 10-year TIPS maturing January 15, 2014), we found yield changes of -58 bp and -46 bp, respectively. The value reported in the table is the average of these changes.

e. May differ from the sum of the values reported for individual dates because of rounding.

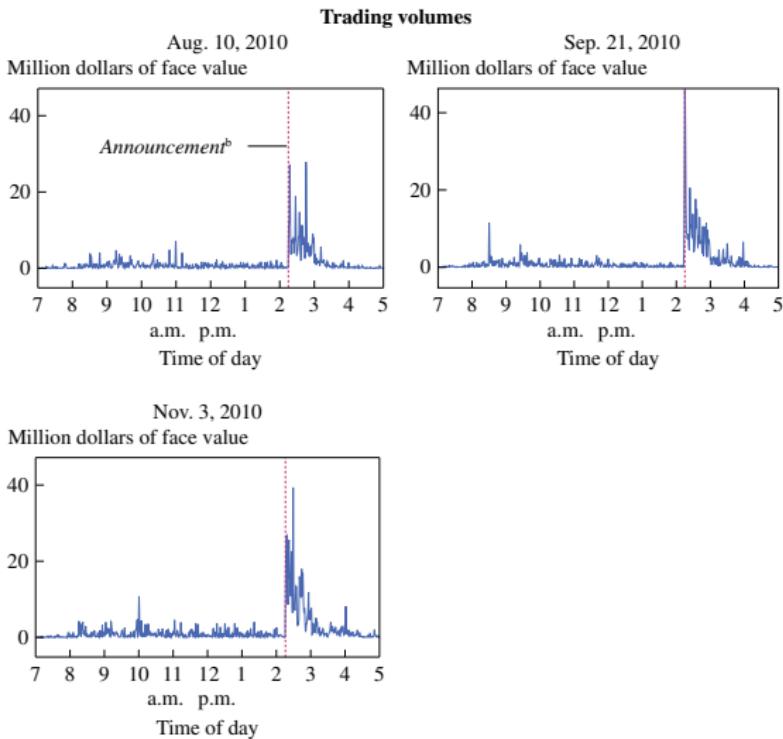
Results

Figure 4. Intraday Yields and Trading Volumes on QE2 Event Days^a



Results

Figure 4. Intraday Yields and Trading Volumes on QE2 Event Days^a (Continued)



Source: BG Cantor data.

a. Yields and trading volumes are minute-by-minute averages and total volume by minute, respectively, for the on-the-run 10-year bond on the indicated dates.

Results

Table 5. Changes in Treasury, Agency, and Agency MBS Yields around QE2 Event Dates^a

Basis points

| Date | Treasury yields (constant maturity) | | | | | Agency (Fannie Mae) yields | | | | Agency MBS yields ^b | |
|---|-------------------------------------|---------|--------|--------|--------|----------------------------|---------|--------|--------|--------------------------------|---------|
| | 30-year | 10-year | 5-year | 3-year | 1-year | 30-year | 10-year | 5-year | 3-year | 30-year | 15-year |
| Aug. 10, 2010 | | | | | | | | | | | |
| One-day change | -1 | -7 | -8 | -3 | -1 | -2 | -7 | -8 | -4 | -1 | -4 |
| Two-day change | -8 | -14 | -10 | -3 | -1 | -8 | -13 | -9 | -7 | -4 | -8 |
| Sep. 21, 2010 | | | | | | | | | | | |
| One-day change | -8 | -11 | -9 | -5 | 0 | -8 | -11 | -9 | -6 | -8 | -8 |
| Two-day change | -13 | -16 | -10 | -5 | -1 | -14 | -16 | -10 | -6 | -4 | -5 |
| Nov. 3, 2010 | | | | | | | | | | | |
| One-day change | 16 | 4 | -4 | -2 | 0 | 13 | 5 | -5 | -3 | -4 | -4 |
| Two-day change | 11 | -10 | -11 | -6 | -1 | 4 | -10 | -14 | -8 | -10 | -9 |
| Sum of Aug. 10 and Sep. 21 ^c | | | | | | | | | | | |
| One-day change | -9* | -18*** | -17*** | -8*** | -1 | -9** | -17*** | -17*** | -10*** | -9* | -12*** |
| Two-day change | -21*** | -30*** | -20*** | -8*** | -2 | -22*** | -29*** | -20*** | -13*** | -8 | -13** |

Sources: FRED, Federal Reserve Bank of St. Louis; Bloomberg.

a. Dates are those of FOMC statements regarding QE2. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. Averages across current-coupon Ginnie Mae, Fannie Mae, and Freddie Mac MBSs.

c. May differ from the sum of the values reported for individual dates because of rounding.

Results

Table 6. Changes in Corporate Yields, Unadjusted and Adjusted by Credit Default Swap Rates, around QE2 Event Dates^a

Basis points

| Date | Corporate yields | | | | | | | | | | | |
|---|------------------|------|--------|-------|--------|-----|-------------------|-------|-------|--------|-------|-----|
| | Long-term | | | | | | Intermediate-term | | | | | |
| | Aaa | Aa | A | Baa | Ba | B | Aaa | Aa | A | Baa | Ba | B |
| Aug. 10, 2010 | | | | | | | | | | | | |
| One-day change | 0 | 3 | 1 | 1 | -3 | -9 | -4 | -2 | -2 | -3 | 0 | 6 |
| Two-day change | -10 | -5 | -7 | -7 | -3 | -5 | -8 | -5 | -6 | -6 | 9 | 23 |
| Sep. 21, 2010 | | | | | | | | | | | | |
| One-day change | -9 | -9 | -9 | -8 | -7 | 2 | -9 | -9 | -10 | -10 | -4 | -3 |
| Two-day change | -13 | -12 | -13 | -11 | -15 | 1 | -10 | -8 | -10 | -11 | -3 | 2 |
| Nov. 3, 2010 | | | | | | | | | | | | |
| One-day change | 10 | 11 | 12 | 9 | 28 | -1 | -2 | -2 | -1 | -1 | -1 | -5 |
| Two-day change | 5 | 2 | 4 | -1 | 22 | -10 | -10 | -11 | -13 | -14 | -12 | -18 |
| Sum of Aug. 10 and Sep. 21 ^b | | | | | | | | | | | | |
| One-day change | -9 | -6 | -8 | -7 | -10*** | -7 | -13*** | -11** | -12** | -13** | -4 | 3** |
| Two-day change | -23*** | -17* | -20*** | -18** | -18*** | -4 | -18*** | -13** | -16** | -17*** | 6 | 25 |
| Credit default swap rates ^c | | | | | | | | | | | | |
| | 10-year maturity | | | | | | 5-year maturity | | | | | |
| Aug. 10, 2010 | | | | | | | | | | | | |
| One-day change | -1 | 5 | 2 | 2 | 4 | 4 | 1 | 5 | 3 | 4 | 5 | 9 |
| Two-day change | 0 | 10 | 7 | 7 | 16 | 23 | 1 | 15 | 7 | 9 | 20 | 26 |
| Sep. 21, 2010 | | | | | | | | | | | | |
| One-day change | 2 | -3 | 0 | 0 | 2 | 4 | -1 | -1 | 0 | 0 | 4 | 4 |
| Two-day change | 3 | 0 | 2 | 2 | 9 | 8 | 1 | 3 | 3 | 4 | 11 | 12 |
| Sum of Aug. 10 and Sep. 21 ^b | | | | | | | | | | | | |
| One-day change | 2 | 2 | 2 | 2 | 6 | 8 | 0 | 4 | 3 | 4 | 9 | 13 |
| Two-day change | 3 | 10 | 10** | 8* | 25*** | 31 | 2* | 18* | 10** | 13*** | 31*** | 38 |

(continued)

Results

Table 6. Changes in Corporate Yields, Unadjusted and Adjusted by Credit Default Swap Rates, around QE2 Event Dates^a (*Continued*)

Basis points

| Date | Adjusted corporate yields ^d | | | | | | | | | | | |
|---|--|--------|--------|--------|--------|-----|-------------------|--------|--------|--------|--------|-----|
| | Long-term | | | | | | Intermediate-term | | | | | |
| | Aaa | Aa | A | Baa | Ba | B | Aaa | Aa | A | Baa | Ba | B |
| Aug. 10, 2010 | | | | | | | | | | | | |
| One-day change | 1 | -2 | -1 | -1 | -7 | -13 | -5 | -7 | -5 | -7 | -5 | -3 |
| Two-day change | -10 | -15 | -14 | -14 | -19 | -28 | -9 | -20 | -13 | -15 | -11 | -3 |
| Sep. 21, 2010 | | | | | | | | | | | | |
| One-day change | -11 | -6 | -9 | -8 | -9 | -2 | -8 | -8 | -10 | -10 | -8 | -7 |
| Two-day change | -16 | -12 | -15 | -13 | -24 | -7 | -11 | -11 | -13 | -15 | -14 | -10 |
| Sum of Aug. 10 and Sep. 21 ^b | | | | | | | | | | | | |
| One-day change | -11 | -8** | -10* | -9 | -16*** | -15 | -13*** | -15*** | -15*** | -17*** | -13*** | -10 |
| Two-day change | -26*** | -27*** | -30*** | -26*** | -43*** | -35 | -20*** | -31*** | -26*** | -30*** | -25*** | -13 |

Sources: Authors' calculations using data from Barclays, Credit Market Analysis (CMA), the Mergent Fixed Investment Securities Database (FISD), and the Trade Reporting and Compliance Engine (TRACE) of the Financial Industry Regulatory Authority.

a. Dates are those of FOMC statements regarding QE2. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. May differ from the sum of the values reported for individual dates because of rounding.

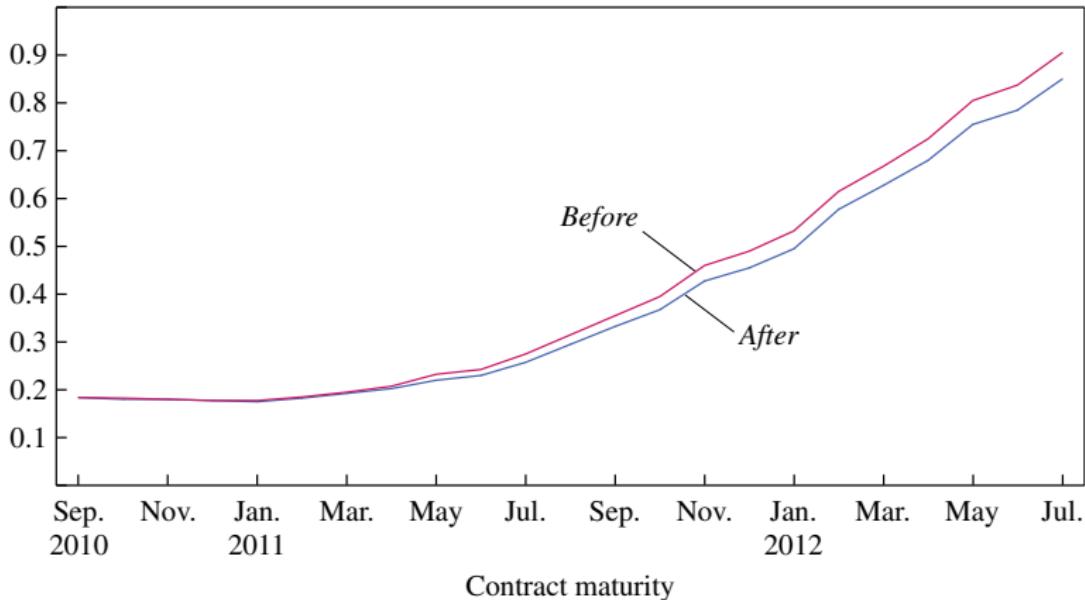
c. Constructed using CMA data and ratings from FISD; changes are value-weighted averages using information on issue sizes from FISD and prices from TRACE. Data for the November 3 event are unavailable.

d. Change in the unadjusted corporate yield minus the change in the corresponding CDS rate.

Results

Figure 5. Yield Curves Calculated from Federal Funds Futures before and after QE2 Event Days^a

Percent per year



Source: Bloomberg data.

a. Yields are computed the day before each QE2 event date and again the day after. All the before-event yields are then averaged across events, and likewise for the after-event yields.

Results

Table 7. Changes in Inflation Swap Rates, TIPS Yields, and Implied Interest Rate Volatility around QE2 Event Dates^a
 Basis points

| Date | <i>Inflation swaps</i> | | | | <i>TIPS real yield (constant maturity)</i> | | | <i>Implied interest rate volatility^b</i> |
|---|------------------------|---------|--------|--------|--|---------|--------|---|
| | 30-year | 10-year | 5-year | 1-year | 20-year | 10-year | 5-year | |
| Aug. 10, 2010 | | | | | | | | |
| One-day change | 5 | -1 | -3 | 0 | -7 | -9 | -8 | -2 |
| Two-day change | -2 | 0 | -3 | -4 | -5 | -9 | -5 | -3 |
| Sep. 21, 2010 | | | | | | | | |
| One-day change | 6 | 6 | 6 | -1 | -13 | -16 | -14 | -1 |
| Two-day change | 6 | 4 | 7 | 9 | -18 | -20 | -18 | -2 |
| Nov. 3, 2010 | | | | | | | | |
| One-day change | 6 | -3 | 2 | 1 | 8 | 1 | -6 | -2 |
| Two-day change | 1 | -11 | 4 | 14 | 12 | -5 | -14 | -3 |
| Sum of Aug. 10 and Sep. 21 ^c | | | | | | | | |
| One-day change | 11*** | 5 | 3 | -1 | -20*** | -25*** | -22*** | -3*** |
| Two-day change | 4 | 4 | 4 | 5 | -23*** | -29*** | -23*** | -5*** |

Sources: FRED, Federal Reserve Bank of St. Louis; Bloomberg.

a. Dates are those of FOMC statements regarding QE2. Asterisks denote statistical significance at the ***1 percent, **5 percent, and *10 percent level.

b. Volatility implied from swaptions as measured using the Barclays implied volatility index.

c. May differ from the sum of the values reported for individual dates because of rounding.

- 1 Deterministic Q-theory
- 2 Models with Financial Frictions
- 3 Importance of “Fire Sales”
- 4 A very simplified Brunnermeier-Sannikov economy
- 5 Results, Comparative Statics
- 6 Bernanke and Blinder (1992)
- 7 Kashyap et al. (1993)
- 8 Kashyap and Stein (2000)
- 9 Krishnamurthy and Vissing-Jorgensen (2011)
- 10 Gilchrist and Zakrajšek (2012)
- 11 Jiménez et al. (2014)
- 12 Chodorow-Reich (2014)
- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Summary Statistics

TABLE 1—SUMMARY STATISTICS OF CORPORATE BOND CHARACTERISTICS

| Variable | Mean | SD | Min | P50 | Max |
|---|-------|-------|------|-------|-------|
| Number of bonds per firm/month | 2.91 | 3.64 | 1.00 | 2.00 | 74.0 |
| Market value of issue (\$mil.) ^a | 322.9 | 326.6 | 1.22 | 238.6 | 5,628 |
| Maturity at issue (years) | 13.0 | 9.3 | 1.0 | 10.0 | 50.0 |
| Term to maturity (years) | 11.3 | 8.5 | 1.0 | 8.1 | 30.0 |
| Duration (years) | 6.47 | 3.20 | 0.91 | 6.06 | 16.0 |
| Callable (pct.) | 67.2 | 47.0 | — | — | — |
| Credit rating (S&P) | — | — | D | BBB1 | AAA |
| Coupon rate (pct.) | 7.34 | 1.99 | 1.80 | 7.00 | 17.5 |
| Nominal effective yield (pct.) | 7.68 | 3.24 | 0.54 | 7.16 | 44.3 |
| Credit spread (basis points) | 204 | 281 | 5 | 118 | 3,499 |

Notes: Sample period: 1973:1–2010:9; Observations = 346,126; Number of bonds = 5,982; Number of firms = 1,112. Sample statistics are based on trimmed data (see text for details).

^a Market value of the outstanding issue deflated by the CPI (2000 = 100).

Results

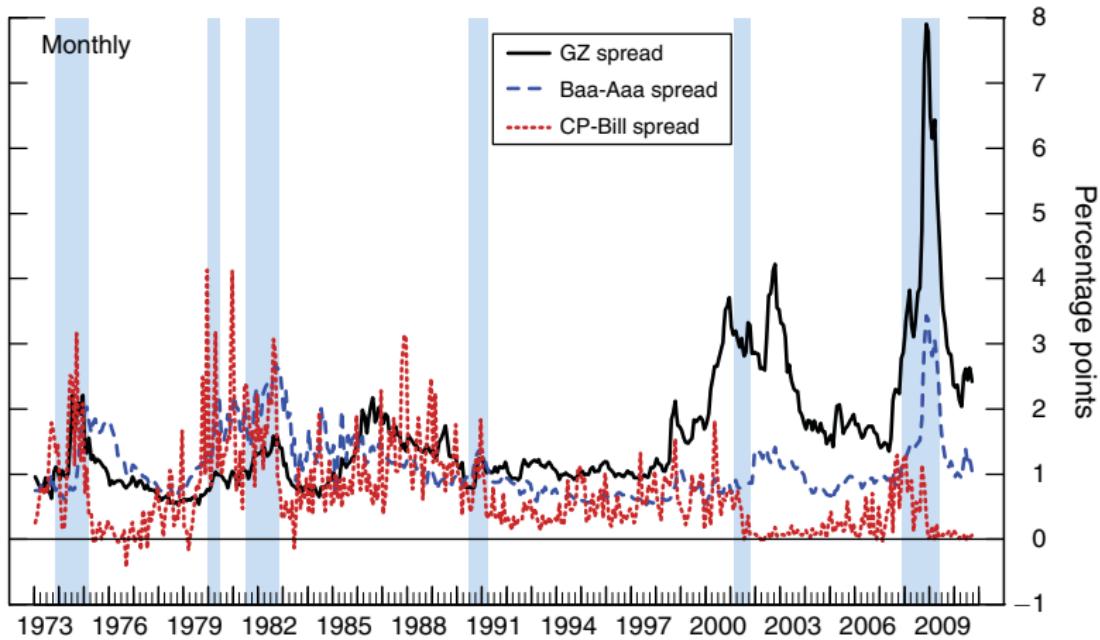


FIGURE 1. SELECTED CORPORATE CREDIT SPREADS

Notes: Sample period: 1973:1–2010:9. The figure depicts the following credit spreads: GZ spread = the average credit spread on senior unsecured bonds issued by nonfinancial firms in our sample (the solid line); Baa-

Results

TABLE 2—FINANCIAL INDICATORS AND MONTHLY MEASURES OF ECONOMIC ACTIVITY

| Financial indicator | Forecast horizon: 3 months | | | | Forecast horizon: 12 months | | | |
|---------------------------------------|----------------------------|------------------|------------------|------------------|-----------------------------|------------------|------------------|------------------|
| <i>Panel A. Payroll employment</i> | | | | | | | | |
| Term spread | -0.096 [2.12] | -0.102 [2.27] | -0.110 [2.44] | -0.110 [2.42] | -0.252 [4.94] | -0.255 [5.05] | -0.241 [4.93] | -0.277 [5.53] |
| Real FFR | -0.058 [1.18] | 0.050 [0.78] | -0.038 [0.75] | -0.113 [2.23] | -0.116 [2.10] | -0.064 [0.96] | -0.129 [2.45] | -0.204 [3.84] |
| CP-bill spread | — | -0.165 [3.80] | — | — | — | -0.080 [2.29] | — | — |
| Baa–Aaa spread | — | — | -0.075 [2.05] | — | — | — | 0.054 [1.15] | — |
| GZ spread | — | — | — | -0.322 [8.50] | — | — | — | -0.497 [13.4] |
| Adjusted R^2 | 0.622 | 0.639 | 0.625 | 0.685 | 0.422 | 0.424 | 0.422 | 0.579 |
| <i>Panel B. Unemployment rate</i> | | | | | | | | |
| Term spread | 0.164 [7.71] | 0.179 [8.42] | 0.215 [10.2] | 0.199 [9.37] | 0.375 [46.7] | 0.386 [48.4] | 0.394 [50.6] | 0.419 [51.8] |
| Real FFR | 0.029 [1.24] | -0.152 [5.22] | -0.024 [1.06] | 0.107 [4.50] | 0.037 [4.60] | -0.089 [9.72] | 0.019 [2.45] | 0.131 [16.4] |
| CP-bill spread | — | 0.268 [13.8] | — | — | — | 0.191 [36.0] | — | — |
| Baa–Aaa spread | — | — | 0.198 [10.4] | — | — | — | 0.074 [11.2] | — |
| GZ spread | — | — | — | 0.351 [19.5] | — | — | — | 0.453 [83.0] |
| Adjusted R^2 | 0.335 | 0.378 | 0.362 | 0.425 | 0.270 | 0.292 | 0.273 | 0.417 |
| <i>Panel C. Industrial production</i> | | | | | | | | |
| Term spread | -0.182 [2.54] | -0.202 [2.83] | -0.239 [3.43] | -0.224 [3.15] | -0.358 [4.03] | -0.371 [4.91] | -0.357 [4.06] | -0.400 [4.59] |
| Real FFR | -0.035 [0.44] | 0.183 [1.86] | 0.016 [0.20] | -0.126 [1.62] | -0.094 [0.98] | 0.052 [0.48] | -0.095 [1.02] | -0.175 [1.90] |
| CP-bill spread | — | -0.332 [4.75] | — | — | — | -0.226 [3.67] | — | — |
| Baa–Aaa spread | — | — | -0.211 [3.08] | — | — | — | 0.004 [0.05] | — |
| GZ spread | — | — | — | -0.386 [5.28] | — | — | — | -0.412 [5.11] |
| Adjusted R^2 | 0.251 | 0.319 | 0.283 | 0.360 | 0.227 | 0.258 | 0.225 | 0.346 |

Notes: Sample period: 1973:1–2010:9. Dependent variable is $\nabla^h Y_{t+h}$, where Y_t denotes an indicator of economic activity in month t and h is the forecast horizon. In addition to the specified financial indicator in month t , each specification also includes a constant and p lags of ∇Y_{t-1} (not reported), where p is determined by the AIC. Entries in the table denote the standardized estimates of the OLS coefficients associated with each financial indicator.

Results

TABLE 3—FINANCIAL INDICATORS AND REAL GDP

| Financial indicator | Forecast horizon: 1 quarter | | | | Forecast horizon: 4 quarters | | | |
|---------------------|-----------------------------|------------------|------------------|------------------|------------------------------|------------------|------------------|------------------|
| Term spread | −0.198 [1.77] | −0.217 [1.92] | −0.250 [2.07] | −0.247 [2.26] | −0.398 [2.79] | −0.406 [2.81] | −0.413 [2.70] | −0.460 [3.22] |
| Real FFR | −0.016 [0.12] | 0.175 [1.12] | 0.020 [0.15] | −0.123 [0.95] | −0.036 [0.24] | 0.042 [0.22] | −0.026 [0.17] | −0.131 [0.87] |
| CP–bill spread | — [2.16] | −0.254 — | — — | — — | — [0.82] | −0.105 — | — — | — — |
| Baa–Aaa spread | — — | — — | −0.229 [1.95] | — — | — — | — — | −0.066 [0.52] | — — |
| GZ spread | — — | — — | — — | −0.437 [4.96] | — — | — — | — — | −0.482 [5.74] |
| Adjusted R^2 | 0.170 | 0.197 | 0.209 | 0.313 | 0.215 | 0.215 | 0.213 | 0.369 |

Notes: Sample period: 1973:I–2010:III. Dependent variable is $\nabla^h Y_{t+h}$, where Y_t denotes the real GDP in quarter t and h is the forecast horizon. In addition to the specified financial indicator in quarter t , each specification also includes a constant and p lags of ∇Y_{t-1} (not reported), where p is determined by the AIC. Entries in the table denote the standardized estimates of the OLS coefficients associated with each financial indicator; absolute asymptotic t -statistics reported in brackets are computed according to Hodrick (1992) (see text for details).

Results

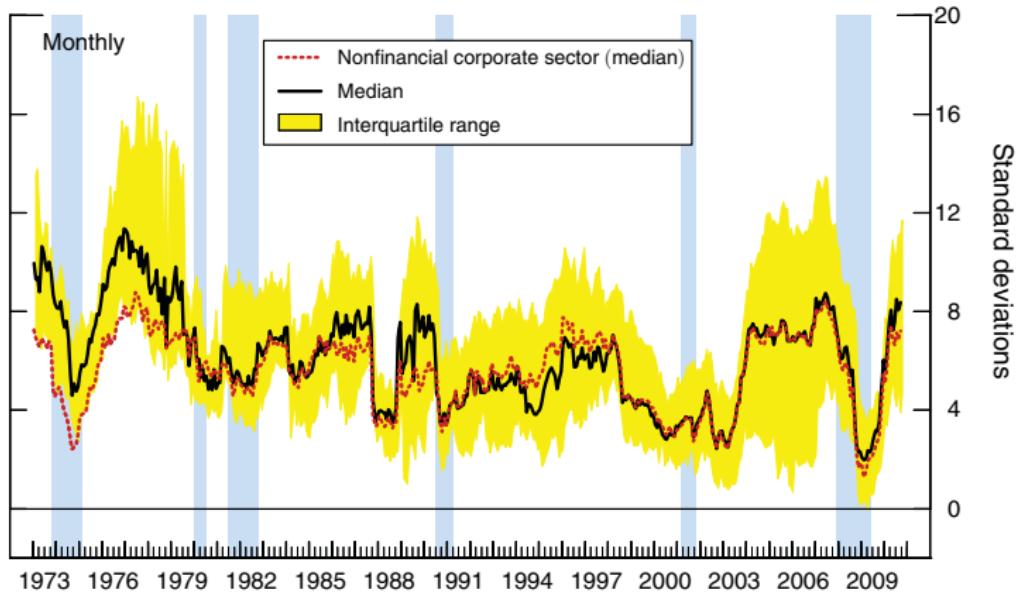


FIGURE 2. DISTANCE TO DEFAULT

Notes: Sample period: 1973:1–2010:9. The solid line depicts the (weighted) median DD of the firms in our sample, and the shaded band depicts the corresponding (weighted) interquartile range. The dotted line depicts the (weighted) median DD in the US nonfinancial corporate sector; all percentiles are weighted by the firm's outstanding liabilities. The shaded vertical bars represent the NBER-dated recessions.

Results

TABLE 4—CREDIT SPREADS AND THE DISTANCE TO DEFAULT

| Explanatory variable | Est. | Standard error | Est. | Standard error |
|-------------------------------------|-------|----------------|--------|----------------|
| $-DD_{it}$ | 0.075 | 0.005 | 0.093 | 0.005 |
| $\ln(DUR_{it}[k])$ | 0.106 | 0.018 | 0.201 | 0.019 |
| $\ln(PAR_{it}[k])$ | 0.171 | 0.018 | 0.121 | 0.022 |
| $\ln(CPN_i[k])$ | 0.439 | 0.074 | 0.031 | 0.062 |
| $\ln(AGE_{it}[k])$ | 0.047 | 0.008 | 0.135 | 0.010 |
| $CALL_i[k]$ | 0.262 | 0.029 | -0.427 | 0.210 |
| $-DD_{it} \times CALL_i[k]$ | — | — | -0.030 | 0.004 |
| $\ln(DUR_{it}[k]) \times CALL_i[k]$ | — | — | -0.120 | 0.023 |
| $\ln(PAR_{it}[k]) \times CALL_i[k]$ | — | — | -0.122 | 0.024 |
| $\ln(CPN_i[k]) \times CALL_i[k]$ | — | — | 0.915 | 0.078 |
| $\ln(AGE_{it}[k]) \times CALL_i[k]$ | — | — | -0.132 | 0.013 |
| $LEV_t \times CALL_i[k]$ | — | — | -0.385 | 0.027 |
| $SLP_t \times CALL_i[k]$ | — | — | -0.088 | 0.017 |
| $CRV_t \times CALL_i[k]$ | — | — | -0.041 | 0.019 |
| $VOL_t \times CALL_i[k]$ | — | — | 0.134 | 0.021 |
| Adjusted R^2 | 0.649 | | 0.700 | |
| Industry effects ^a | 0.000 | | 0.000 | |
| Credit rating effects ^b | 0.000 | | 0.000 | |

Notes: Sample period: 1973:1–2010:9. Obs. = 346,126; Number of bonds/firms = 5,982/1,112. Dependent variable is $\ln(S_{it}[k])$, the log of the credit spread on bond k (issued by firm i) in month t . The Treasury term structure is represented by the following three factors: LEV_t = level; SLP_t = slope; and CRV_t = curvature; VOL_t = (annualized) realized monthly volatility of the daily ten-year Treasury yield. Asymptotic standard errors are clustered in both the firm (i) and time (t) dimensions, according to Cameron, Gelbach, and Miller (2011).

^a p -value of the exclusion test of industry fixed effects.

Results

TABLE 5—SELECTED MARGINAL EFFECTS BY TYPE OF BOND

| Explanatory variable | Noncallable | | Callable | | Mean ^a | STD ^b |
|---------------------------------|-------------|----------------|----------|----------------|-------------------|------------------|
| | Est. | Standard error | Est. | Standard error | | |
| Distance to default: $-DD_{it}$ | 0.190 | 0.010 | 0.129 | 0.008 | 6.610 | 3.946 |
| Term structure: LEV_t | — | — | -0.783 | 0.055 | 0.000 | 1.000 |
| Term structure: SLP_t | — | — | -0.179 | 0.034 | 0.000 | 1.000 |
| Term structure: CRV_t | — | — | -0.082 | 0.038 | 0.000 | 1.000 |
| Term structure: VOL_t (%) | — | — | 0.273 | 0.043 | 1.862 | 1.239 |

Notes: The table contains the estimates of the marginal effect of a one-unit change in the specified variable on the level of credit spreads (in percentage points) for noncallable and callable bonds based on the parameter estimates reported in Table 4. All marginal effects are evaluated at sample means; by construction, the level, slope, and curvature factors are standardized to have mean equal to zero and standard deviation equal to one. Asymptotic standard errors are computed according to the delta method.

^a Sample mean of the specified variable.

^b Sample standard deviation of the specified variable.

Results

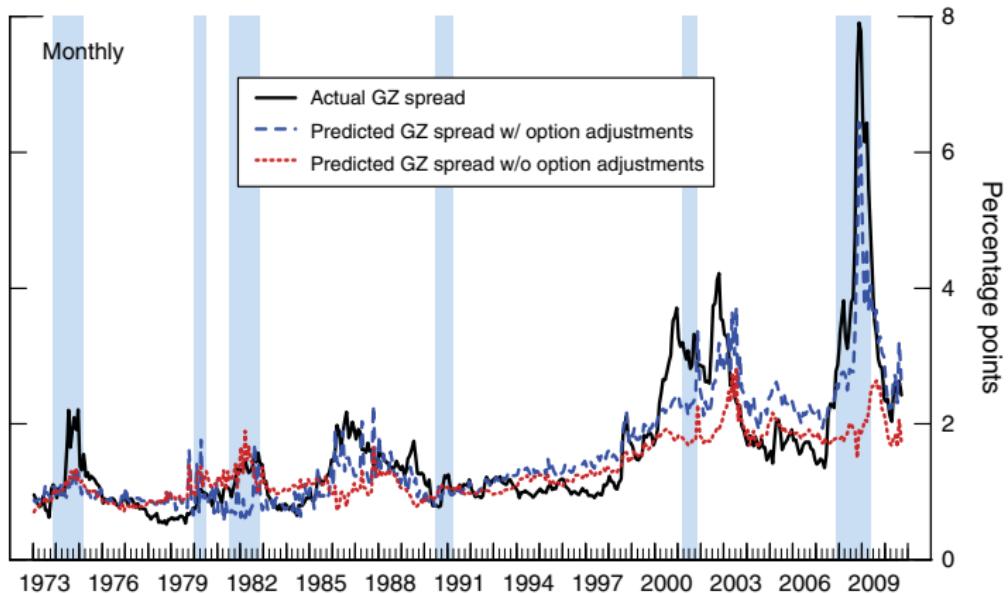


FIGURE 3. ACTUAL AND PREDICTED CREDIT SPREADS

Notes: Sample period: 1973:1–2010:9. The solid line depicts the actual GZ credit spread. The dashed line depicts the predicted GZ credit spread based on the specification that includes the term structure option-adjustment terms; the dotted line depicts the predicted GZ credit spread based on the specification that excludes the term structure option-adjustment terms (see text for details). The shaded vertical bars represent the NBER-dated recessions.

Results

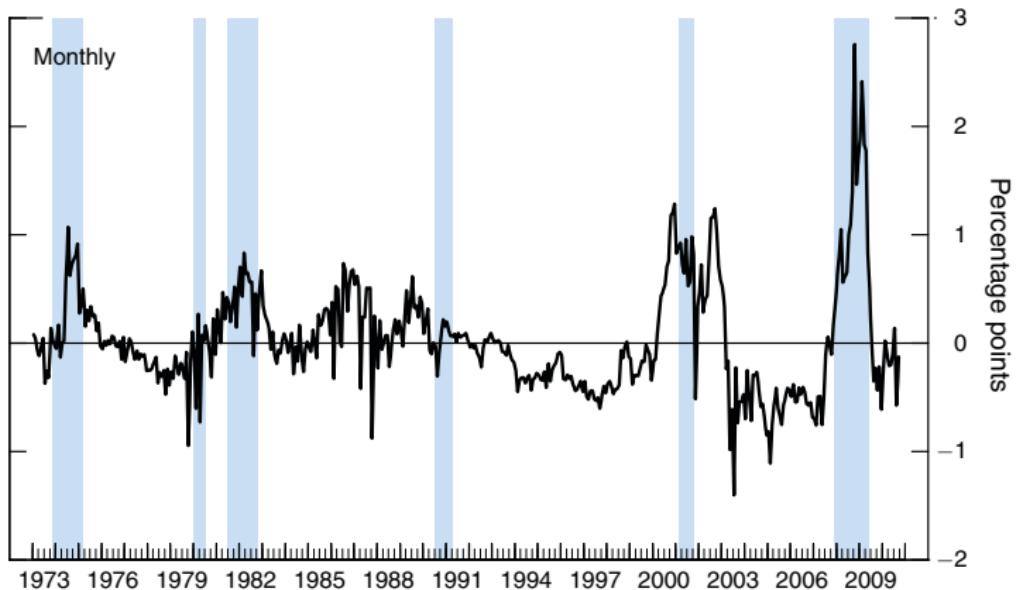


FIGURE 4. THE EXCESS BOND PREMIUM

Notes: Sample period: 1973:1–2010:9. The figure depicts the estimated (option-adjusted) excess bond premium. The shaded vertical bars represent the NBER-dated recessions.

Results

TABLE 6—THE EXCESS BOND PREMIUM AND MONTHLY MEASURES OF ECONOMIC ACTIVITY

| Financial indicator | Forecast horizon: 3 months | | | Forecast horizon: 12 months | | |
|----------------------------------|----------------------------|-----------------|------------------|-----------------------------|-----------------|------------------|
| | EMP | UER | IPM | EMP | UER | IPM |
| Term spread | -0.122 [2.67] | 0.221 [10.3] | -0.256 [3.60] | -0.291 [5.78] | 0.440 [55.4] | -0.435 [4.99] |
| Real FFR | -0.044 [0.87] | 0.007 [0.30] | -0.018 [0.23] | -0.112 [2.06] | 0.022 [2.70] | -0.079 [0.81] |
| Predicted GZ spread ^a | -0.202 [5.65] | 0.134 [8.41] | -0.186 [3.62] | -0.355 [9.63] | 0.213 [38.5] | -0.283 [4.18] |
| Excess bond premium | -0.259 [8.52] | 0.331 [20.9] | -0.386 [5.87] | -0.369 [14.5] | 0.414 [91.6] | -0.388 [5.42] |
| Adjusted R^2 | 0.687 | 0.430 | 0.381 | 0.588 | 0.433 | 0.384 |

Notes: Sample period: 1973:1–2010:9. Dependent variable is $\nabla^h Y_{t+h}$, where Y_t denotes an indicator of economic activity in month t and h is the forecast horizon; EMP = private nonfarm payroll employment; UER = civilian unemployment rate; and IPM = index of manufacturing industrial production. In addition to the specified financial indicators in month t , each specification also includes a constant and p lags of ∇Y_{t-1} (not reported), where p is determined by the AIC. Entries in the table denote the standardized estimates of the OLS coefficients associated with each financial indicator; absolute asymptotic t -statistics reported in brackets are computed according to Hodrick (1992) (see text for details).

^a Excludes the effect of option adjustment on callable bonds.

Results

TABLE 7—THE EXCESS BOND PREMIUM, REAL GDP, AND ITS MAIN COMPONENTS

| Financial indicator | GDP | C-NDS | C-D | I-RES | I-ES | I-HT | I-NRS | INV |
|---|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| <i>Panel A. 1973:I–2010:III (Forecast horizon: Four quarters)</i> | | | | | | | | |
| Term spread | -0.478 [3.33] | -0.452 [3.89] | -0.551 [2.55] | -0.564 [5.23] | -0.398 [3.16] | -0.098 [0.83] | 0.317 [2.73] | -0.123 [1.43] |
| Real FFR | -0.036 [0.24] | 0.106 [0.99] | 0.106 [0.58] | -0.003 [0.03] | -0.086 [0.82] | -0.092 [0.67] | -0.111 [0.87] | 0.014 [0.15] |
| Predicted GZ spread ^a | -0.258 [2.56] | -0.209 [2.39] | 0.014 [0.11] | -0.159 [2.10] | -0.221 [2.48] | -0.426 [4.43] | -0.186 [2.07] | -0.287 [4.11] |
| Excess bond premium | -0.364 [5.36] | -0.260 [4.36] | -0.127 [1.00] | -0.018 [0.29] | -0.558 [5.87] | -0.374 [4.42] | -0.587 [5.77] | -0.656 [9.39] |
| Adjusted R^2 | 0.365 | 0.349 | 0.224 | 0.419 | 0.481 | 0.432 | 0.557 | 0.580 |
| <i>Panel B. 1985:I–2010:III (Forecast horizon: Four quarters)</i> | | | | | | | | |
| Term spread | -0.509 [4.09] | -0.362 [4.07] | -0.456 [2.00] | -0.596 [6.52] | -0.340 [2.75] | -0.071 [0.60] | 0.392 [2.46] | -0.321 [4.08] |
| Real FFR | 0.424 [2.67] | 0.181 [1.53] | 0.395 [1.49] | 0.331 [2.96] | 0.032 [0.18] | -0.130 [0.90] | 0.000 [0.00] | 0.301 [2.47] |
| Predicted GZ spread ^a | -0.023 [0.20] | -0.093 [0.82] | 0.194 [0.99] | 0.045 [0.47] | -0.088 [0.63] | -0.294 [2.11] | -0.061 [0.49] | -0.047 [0.46] |
| Excess bond premium | -0.501 [6.80] | -0.362 [5.02] | -0.260 [1.51] | -0.035 [0.50] | -0.650 [5.41] | -0.382 [3.39] | -0.613 [4.76] | -0.701 [8.20] |
| Adjusted R^2 | 0.357 | 0.508 | 0.101 | 0.484 | 0.448 | 0.405 | 0.624 | 0.635 |

Notes: Dependent variable is $\nabla^4 Y_{t+4}$, where Y_t denotes real GDP or one of its components in quarter t ; C-NDS = PCE on nondurable goods & services; C-D = PCE on durable goods; I-RES = residential investment; I-ES = business fixed investment in E&S (excluding high tech); I-HT = business fixed investment in high-tech equipment; I-NRS = business fixed investment in structures; INV = business inventories. In addition to the specified financial indicators in quarter t , each specification also includes a constant and p lags of ∇Y_{t-1} (not reported), where p is determined by the AIC. Entries in the table denote the standardized estimates of the OLS coefficients associated with each financial indicator; absolute asymptotic t -statistics reported in brackets are computed according to Hodrick (1992) (see text for details).

Results

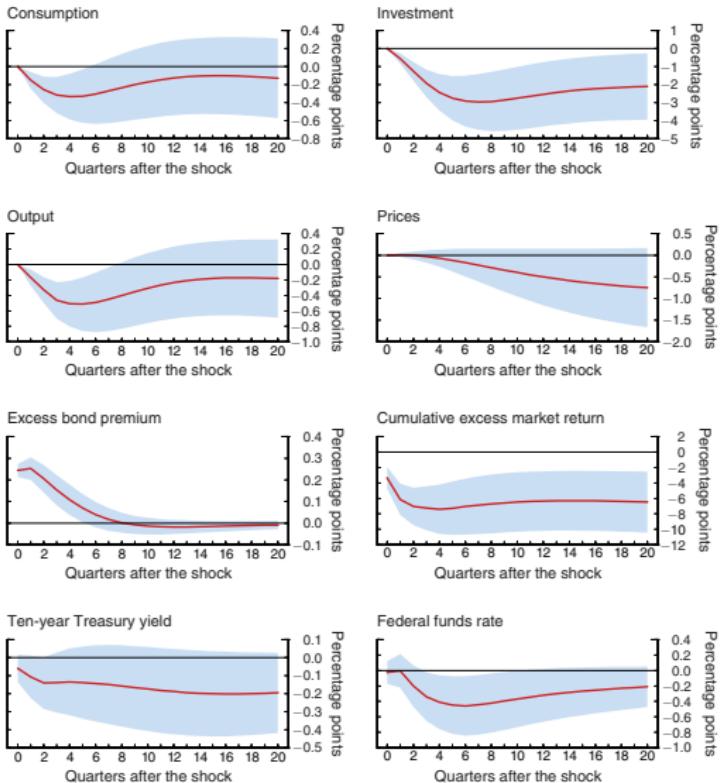


FIGURE 5. MACROECONOMIC IMPLICATIONS OF A FINANCIAL SHOCK

Notes: The figure depicts the impulse responses to a one-standard-deviation orthogonalized shock to the excess bond premium (see text for details). The responses of consumption, investment, and output growth and that of

Results

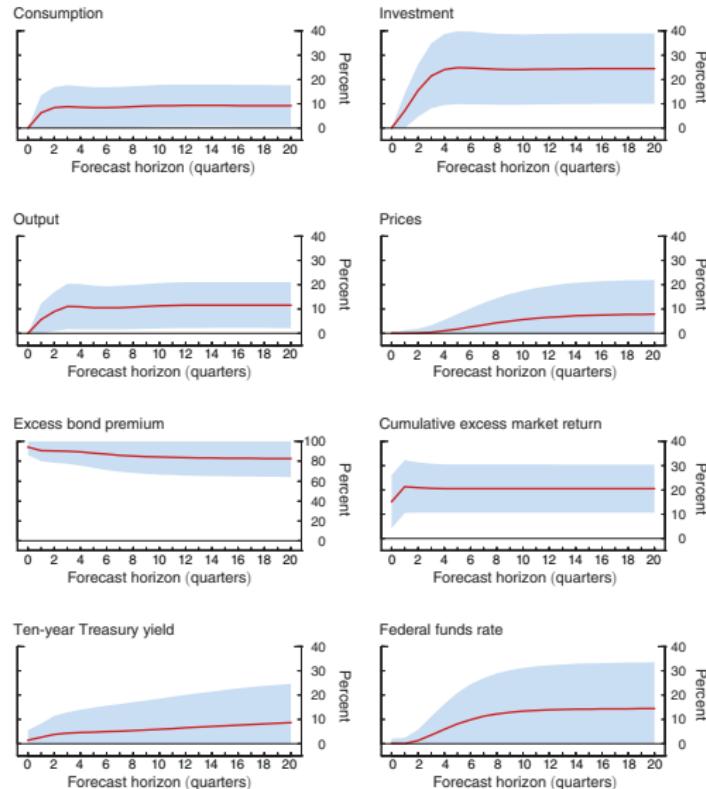
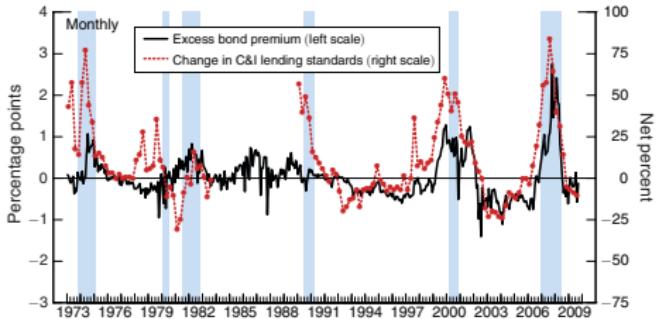


FIGURE 6. FORECAST ERROR VARIANCE DECOMPOSITION OF A FINANCIAL SHOCK

Notes: The figure depicts the forecast error variance decomposition from a one-standard-deviation orthogonalized shock to the excess bond premium (see text for details). The forecast error variance decomposition of consumption

Results

Panel A. Changes in bank lending standards and the excess bond premium



Panel B. Financial sector profitability and the excess bond premium

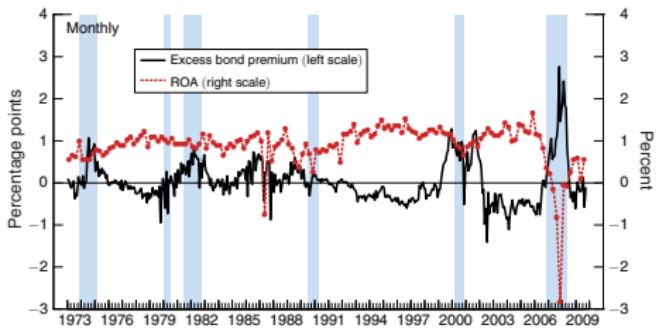


FIGURE 7. THE EXCESS BOND PREMIUM AND FINANCIAL MARKET CONDITIONS

Notes: Sample period: 1973:1–2010:9. The solid line in both panels depicts the estimated (option-adjusted) excess bond premium. The overlayed dots in panel A depict the net percent of SLOOS respondents that reported tightening their credit standards on C&I loans over the past three months. (There was no survey conducted during the 1984–89

Results

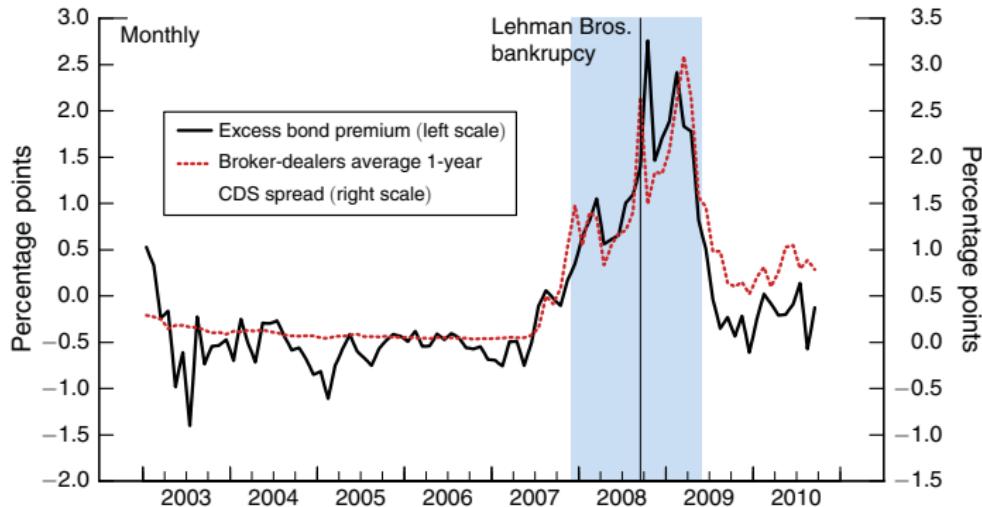


FIGURE 8. THE EXCESS BOND PREMIUM AND FINANCIAL INTERMEDIARY CDS SPREADS

Notes: Sample period: 2003:1–2010:9. The solid line depicts the estimated excess bond premium. The overlayed dotted line depicts the average one-year CDS spread of broker-dealers. The shaded vertical bar represents the 2007–09 NBER-dated recession.

Results

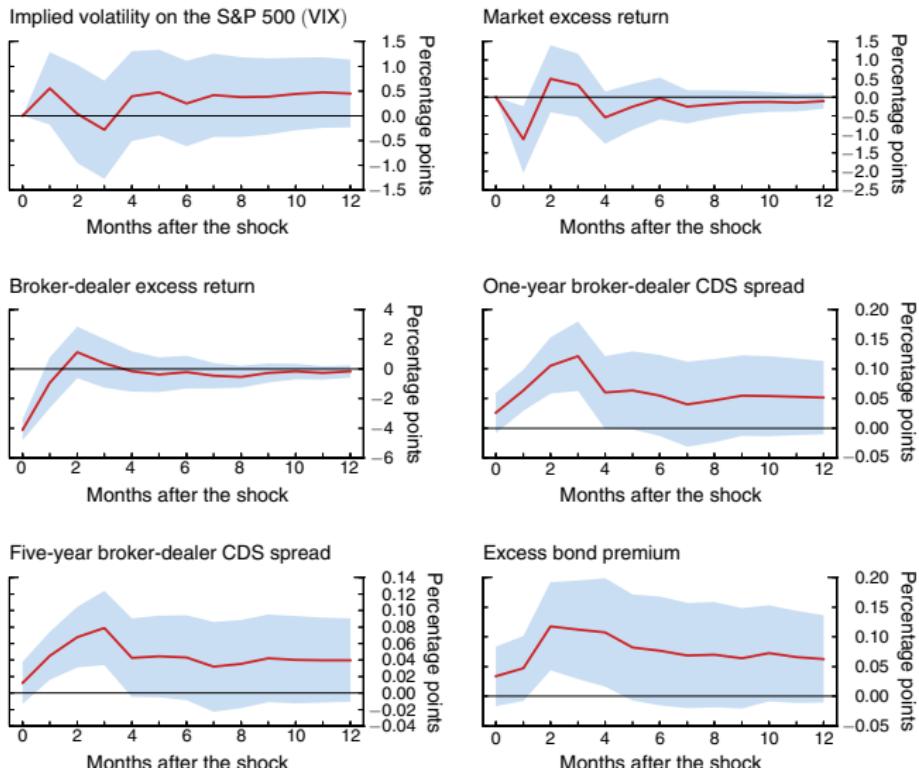


FIGURE 9. IMPLICATIONS OF A SHOCK TO THE PROFITABILITY OF FINANCIAL INTERMEDIARIES

Notes: The figure depicts the impulse responses to a one-standard-deviation orthogonalized shock to the average

- 1 Deterministic Q-theory
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- 5 Results, Comparative Statics
- 6 Bernanke and Blinder (1992)
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- 12 Chodorow-Reich (2014)
- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Abstract

Hazardous times for monetary policy: what do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?

We identify the effects of monetary policy on credit risk-taking with an exhaustive credit register of **loan applications and contracts**. We separate the changes in the composition of the supply of credit from the concurrent changes in the volume of supply and quality, and the volume of demand. We employ a **two-stage model** that analyzes the granting of **loan applications in the first stage** and **loan outcomes for the applications granted in the second stage**, and that controls for both observed and unobserved, time-varying, **firm and bank heterogeneity** through **time*firm** and **time*bank** fixed effects. We find that a **lower overnight interest rate induces lowly capitalized banks to grant more loan applications to ex ante risky firms and to commit larger loan volumes with fewer collateral requirements to these firms, yet with a higher ex post likelihood of default**. A lower long-term interest rate and other relevant macroeconomic variables have no such effects.

Identification

- Risk-taking channel implies that expansionary monetary policy spurs banks into risky lending. However, this testable prediction can also be consistent with demand channels, in particular, with the firm balance sheet and the **interest rate channel of monetary policy** (Bernanke and Gertler (1995)). Therefore, to suppress concurrent changes in the quality (along balance-sheet strength, as risky firms may have improved their net worth, investment opportunities, and collateral values) and volume of the firm demand for credit, we **saturate our benchmark specifications with time*firm fixed effects**.
- Identification comes from comparing changes in lending in the same month by different banks (with respect to their capital-to-asset ratios) to the same firm.
- With observed and unobserved time-varying bank heterogeneity accounted for, **identification resides in comparing changes in lending during the same month by the same bank to firms that differ in credit risk**.

Summary Statistics

TABLE I

SUMMARY STATISTICS OF ALL VARIABLES USED IN THE ESTIMATIONS ON THE SAMPLE SELECTION MODEL USING LOAN APPLICATIONS^a

| Variable Name | Mean | Minimum | Q1 | Median | Q3 | Maximum | Standard Deviation |
|---|-------|---------|-------|--------|-------|---------|--------------------|
| <i>Dependent Variables</i> | | | | | | | |
| I(GRANTING OF LOAN APPLICATIONS _{tbi}) | 0.36 | 0 | 0 | 0 | 1 | 1 | 0.48 |
| COMMITTED AMOUNT OF GRANTED LOANS _{tbi} | 287 | 2 | 30 | 69 | 180 | 77,704 | 1315 |
| LN(CREDIT AMOUNT _{tbi}) | 4.41 | 0.69 | 3.40 | 4.23 | 5.19 | 11.26 | 1.32 |
| I(FUTURE DEFAULT _{tbi}) | 0.35 | 0 | 0 | 0 | 1 | 1 | 0.48 |
| I(WITHOUT COLLATERAL _{tbi}) | 0.89 | 0 | 1 | 1 | 1 | 1 | 0.31 |
| <i>Independent Variables</i> | | | | | | | |
| <i>Firm Credit Risk Variables</i> | | | | | | | |
| <i>Firm Credit Risk Variable With 4 Years Horizon</i> | | | | | | | |
| I(FIRM RISK _{tj}) | 0.03 | 0 | 0 | 0 | 0 | 1 | 0.17 |
| <i>Firm Credit Risk Variables With Other Horizons</i> | | | | | | | |
| I(FIRM RISK 5 YEARS _{tj}) | 0.03 | 0 | 0 | 0 | 0 | 1 | 0.17 |
| I(FIRM RISK 3 YEARS _{tj}) | 0.03 | 0 | 0 | 0 | 0 | 1 | 0.16 |
| I(FIRM RISK 2 YEARS _{tj}) | 0.02 | 0 | 0 | 0 | 0 | 1 | 0.14 |
| I(FIRM RISK 1 YEAR _{tj}) | 0.02 | 0 | 0 | 0 | 0 | 1 | 0.12 |
| <i>Macro Variables</i> | | | | | | | |
| ΔOVERNIGHT RATE _{t-1} | 0.26 | -1.52 | -0.08 | 0.23 | 0.74 | 1.48 | 0.71 |
| ΔGDP _{t-1} | 3.19 | -0.27 | 3.00 | 3.46 | 3.83 | 3.98 | 0.88 |
| ΔCPI _{t-1} | 3.41 | 2.14 | 2.67 | 3.47 | 4.03 | 5.27 | 0.80 |
| <i>Bank Variables</i> | | | | | | | |
| <i>Bank Risk-Taking Variable</i> | | | | | | | |
| BANK CAPITAL _{t-1b} | 5.51 | 3.18 | 4.20 | 4.94 | 6.09 | 63.10 | 1.96 |
| LN(BANK CAPITAL _{t-1b}) | 1.66 | 1.16 | 1.44 | 1.60 | 1.81 | 4.14 | 0.30 |
| <i>Bank Controls</i> | | | | | | | |
| LN(TOTAL ASSET _{t-1b}) | 17.33 | 9.94 | 16.34 | 17.37 | 18.50 | 19.91 | 1.45 |
| LIQUIDITY RATIO _{t-1b} | 14.96 | 0.03 | 9.59 | 13.94 | 18.87 | 91.21 | 7.52 |
| ROA _{t-1b} | 0.98 | -8.93 | 0.68 | 0.92 | 1.17 | 10.84 | 0.53 |
| NPL RATIO _{t-1b} | 0.90 | 0.00 | 0.36 | 0.62 | 1.03 | 16.08 | 0.89 |
| I(COMMERCIAL BANK _b) | 0.39 | 0 | 0 | 0 | 1 | 1 | 0.49 |
| I(SAVINGS BANK _b) | 0.54 | 0 | 0 | 1 | 1 | 1 | 0.50 |

^aThis table reports summary statistics for the sample with 241,052 observations from the 2002:02–2008:12 period. To improve the readability of the estimated coefficients, we divide the ΔOVERNIGHT RATE by 100 in all subsequent estimations.

Main results

TABLE II
MAIN RESULTS^a

| | (1) | (2) | (3) | (4) | (5) | (6) | | | | | | |
|--|------------------------|---------------------|--------------------|--------------------|--------------------|-------------------|--|--|--|--|--|--|
| | BENCHMARK TIME*BANK FE | | | | | | | | | | | |
| FIRST STEP | | | | | | | | | | | | |
| <i>Dependent Variable: I(GRANTING OF LOAN APPLICATIONS_{tbi})</i> | | | | | | | | | | | | |
| I(FIRM RISK _{ti}) | -0.04*** (0.01) | -0.04*** (0.01) | -0.04*** (0.01) | -0.06*** (0.02) | | | | | | | | |
| ΔOVERNIGHT RATE _{t-1} * I(FIRM RISK _{ti}) | | -2.65** (1.22) | -2.62* (1.53) | 1.26 (2.37) | | | | | | | | |
| ΔOVERNIGHT RATE _{t-1} * I(FIRM RISK _{ti}) * LN(BANK CAPITAL _{t-1b}) | | | | 6.97* (4.12) | 9.89** (4.72) | 9.73* (5.59) | | | | | | |
| <i>Impact of 1 pp Decrease in Overnight Rate on Granting to Risky Firms</i> | | | | | | | | | | | | |
| – By the Mean Bank | | | | | | | | | | | | |
| – By Lowly versus Highly Capitalized Bank (1 St. Dev. Difference) | | | | | | | | | | | | |
| <i>SECOND STEP</i> | | | | | | | | | | | | |
| <i>Dependent Variable: LN(CREDIT AMOUNT_{tbi})</i> | | | | | | | | | | | | |
| I(FIRM RISK _{ti}) | -0.23*** (0.08) | -0.17** (0.08) | -0.15 (0.10) | -0.30 (0.24) | | | | | | | | |
| ΔOVERNIGHT RATE _{t-1} * I(FIRM RISK _{ti}) | | -27.39*** (9.93) | -25.68* (13.14) | -62.59* (37.51) | | | | | | | | |
| ΔOVERNIGHT RATE _{t-1} * I(FIRM RISK _{ti}) * LN(BANK CAPITAL _{t-1b}) | | | | 59.56** (25.41) | 58.94** (24.96) | 53.49+ (32.62) | | | | | | |
| <i>Impact of 1 pp Decrease in Overnight Rate on Credit to Risky Firms</i> | | | | | | | | | | | | |
| – By the Mean Bank | | | | | | | | | | | | |
| – By Lowly versus Highly Capitalized Bank (1 St. Dev. Difference) | | | | | | | | | | | | |
| <i>Total Impact of 1 pp Decrease in Overnight Rate on Credit to Risky Firms</i> | | | | | | | | | | | | |
| – By the Mean Bank | | | | | | | | | | | | |
| – By Lowly versus Highly Capitalized Bank (1 St. Dev. Difference) | | | | | | | | | | | | |

(Continues)

Main results

TABLE II—Continued

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|-----|-----|-----|-----|-----------|--------------|
| | | | | | BENCHMARK | TIME+BANK FE |
| (Year–Month) Fixed Effects | Yes | Yes | Yes | Yes | — | — |
| Firm Fixed Effects | No | No | No | Yes | — | — |
| Bank Fixed Effects | No | No | Yes | Yes | Yes | — |
| [(Year–Month)*Firm] Fixed Effects | No | No | No | No | Yes | Yes |
| [(Year–Month)*Bank] Fixed Effects | No | No | No | No | No | Yes |
| Bank Controls | Yes | Yes | Yes | Yes | Yes | — |
| $\{\Delta GDP_{t-1}, \Delta CPI_{t-1}\} * I(\text{FIRM RISK}_{it}) * \text{LN}(\text{BANK CAPITAL}_{t-1b})$ | No | No | No | Yes | Yes | Yes |
| $\{\text{OVERNIGHT RATE}_{t-1} * I(\text{FIRM RISK}_{it}) * \{\text{Bank Controls}_{t-1b}\}$ | No | No | No | Yes | Yes | Yes |

^aThis table reports estimates from type-2 Tobit sample selection models, which explain the probability that a loan application is approved by a bank and the loan is granted to a firm that is new to the bank (extensive margin of new lending) and the committed amount of granted loans by the bank to a firm given its loan application was successful (intensive margin of new lending). The estimates of the first step in this table come from linear probability models using ordinary least squares and 241,052 observations from the 2002:02–2008:12 period. The estimates of the second step come from the second stage of a two-step estimation procedure for panel data sample selection models outlined by Kyriazidou (1997) using kernel least squares. It uses 38,334 observations. The dependent variables are $I(\text{GRANTING OF LOAN APPLICATIONS}_{ith})$, which equals 1 if the loan application made in month t to bank b by firm i is successful and the loan is granted in t to $t+3$, and equals 0 otherwise; and $\text{LN}(\text{CREDIT AMOUNT}_{ith})$, which following a successful application filed in month t to bank b by firm i is the logarithm of the committed loan amount granted by bank b to firm i in t to $t+3$. The definition of the independent variables can be found in the Appendix (FIRM RISK is based on a 4-year credit history). Where possible, a constant is included but its coefficient is left unreported. When firm fixed effects are not included, firm observables are included; see the main text. Where possible, all macro, bank, and firm variables in triple interactions are included in levels and in double interactions but their coefficients are left unreported. Fixed effects are either included ("Yes"), not included ("No"), or spanned by another set of effects ("—"). For each variable the first row lists the coefficient, the second row lists the robust standard error that is corrected for multiclustering at the year-month, bank and firm level; the corresponding significance levels are adjacent to the coefficient in the second column. The single-stage/total impact is calculated as the percent change in the mean granting probability or/times the credit amount following a one percentage point decrease in the overnight interest rate and lending to firms with doubtful loans in the previous four years by a mean bank or by a lowly versus highly capitalized bank that differ by one standard deviation in capitalization. ⁺The coefficient has a p -value that equals 10.1 percent.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Main results

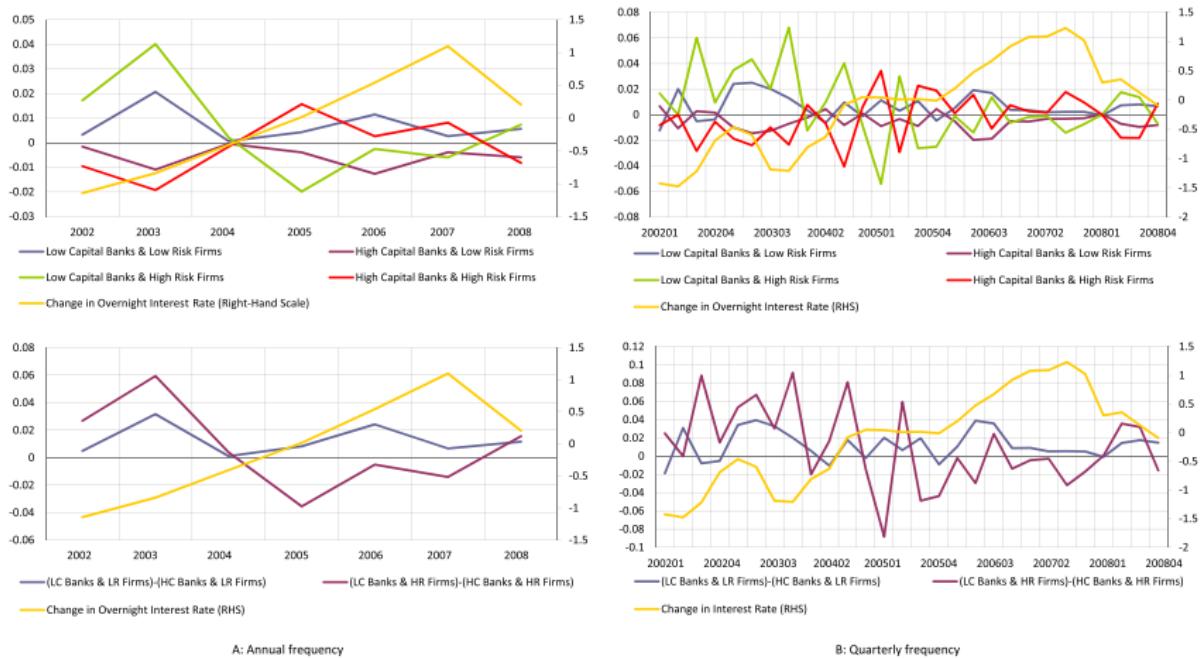


FIGURE 1.—The probability a loan application is granted (left-hand scale) by a bank with low versus high capital (by median) to an otherwise average firm with non-performing loans outstanding in the previous 4 years (HR) versus a firm without (LR), and the change in the overnight interest rate (right-hand scale).

Main results



FIGURE 2.—The logarithm of the committed amount of granted loans (left-hand scale) by a bank with low versus high capital (by median) to an otherwise average firm with non-performing loans outstanding in the previous 4 years (HR) versus a firm without (LR), and the change in the overnight interest rate (right-hand scale).

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- 12 Chodorow-Reich (2014)
- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Abstract

The employment effects of credit market disruptions: firm-level evidence from the 2008–9 financial crisis

This article investigates the effect of bank lending frictions on employment outcomes. I construct a new data set that combines information on **banking relationships and employment at 2,000 nonfinancial firms during the 2008–9 crisis**. The article first verifies empirically the importance of banking relationships, which imply a cost to **borrowers who switch lenders**. I then use the dispersion in lender health following the Lehman crisis as a source of **exogenous variation in the availability of credit to borrowers**. I find that credit matters. Firms that had precrisis relationships with less healthy lenders had a lower likelihood of obtaining a loan following the Lehman bankruptcy, paid a higher interest rate if they did borrow, and reduced **employment by more compared to precrisis clients of healthier lenders**. Consistent with frictions deriving from asymmetric information, the effects vary by firm type. Lender health has an economically and statistically significant effect on employment at small and medium firms, but the data cannot reject the hypothesis of no effect at the largest or

Results

TABLE I
BANKING RELATIONSHIP REGRESSIONS

| | (1) Lender chosen as lead | (2) | (3) | (4) Lender chosen as participant |
|---|---------------------------------|---------------------|---------------------|--|
| Explanatory variables | | | | |
| Previous lead | 0.71** (0.011) | 0.67** (0.012) | 0.022** (0.0040) | -0.023** (0.0045) |
| Previous participant | 0.029** (0.0014) | 0.020** (0.0015) | 0.50** (0.011) | 0.46** (0.011) |
| Previous lead × Public (Unrated) | -0.052** (0.016) | -0.043* (0.017) | | |
| Previous lead × Public (Rated) | -0.058** (0.014) | -0.086** (0.016) | | |
| Previous participant × Public (Unrated) | | 0.039* (0.018) | 0.033+ (0.018) | |
| Previous participant × Public (Rated) | | 0.012 (0.014) | -0.038* (0.015) | |
| Lender FE | Yes | Yes | Yes | Yes |
| 2-digit SIC × lender FE | No | Yes | No | Yes |
| State × lender FE | No | Yes | No | Yes |
| Year × lender FE | No | Yes | No | Yes |
| Public/private × lender FE | No | Yes | No | Yes |
| All in drawn quartile × lender FE | No | Yes | No | Yes |
| Sales quartile × lender FE | No | Yes | No | Yes |
| R^2 | 0.480 | 0.504 | 0.285 | 0.334 |
| Borrower clusters | 3,253 | 3,253 | 3,253 | 3,253 |
| Observations | 349,008 | 349,008 | 349,008 | 349,008 |

Notes. The dependent variable is an indicator for whether the lender serves in the role indicated in the table header. For each loan in which the borrower has previous accessed the syndicated market, the data set contains one observation for each potential lender, where a potential lender is a lender active in the syndicated loan market in that year. The variables Previous lead and Previous participant equal 1 if the lender served as the lead or as a participant on the borrower's previous loan, respectively. The sample covers 2001 to June 2009 and excludes loans to borrowers in finance, insurance, or real estate, and for which the purpose of the loan is not working capital or general corporate purposes. Estimation is via OLS.

Results

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BANKING RELATIONSHIP REGRESSIONS

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| Previous participant | 0.029** (0.0014) | 0.020** (0.0015) | 0.50** (0.011) | 0.46** (0.011) |
| Previous lead × Public (Unrated) | -0.052** (0.016) | -0.043* (0.017) | | |
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| Lender FE | Yes | Yes | Yes | Yes |
| 2-digit SIC × lender FE | No | Yes | No | Yes |
| State × lender FE | No | Yes | No | Yes |
| Year × lender FE | No | Yes | No | Yes |
| Public/private × lender FE | No | Yes | No | Yes |
| All in drawn quartile × lender FE | No | Yes | No | Yes |
| Sales quartile × lender FE | No | Yes | No | Yes |
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Results

TABLE II
SAMPLE SUMMARY STATISTICS

| | N | Mean | Std. Dev. | p10 | p50 | p90 |
|---|-------|-------|-----------|-------|-------|-------|
| Panel A: Firm variables | | | | | | |
| Loan size (millions of 2005 dollars) | | | | | | |
| All lenders | 4,791 | 287 | 530 | 23 | 119 | 693 |
| Top 43 lenders | 4,391 | 302 | 542 | 26 | 129 | 720 |
| Merged Dealscan-LDB | 2,040 | 305 | 544 | 27 | 131 | 703 |
| Sales at close (millions of 2005 dollars) | | | | | | |
| All lenders | 3,954 | 1,836 | 4,059 | 53 | 433 | 4,661 |
| Top 43 lenders | 3,623 | 1,928 | 4,149 | 60 | 478 | 4,869 |
| Merged Dealscan-LDB | 1,721 | 2,024 | 4,310 | 68 | 551 | 4,813 |
| Employment growth rate, 2008:3–2009:3 | 2,040 | -0.09 | 0.23 | -0.29 | -0.06 | 0.08 |
| 2008 employment level | 2,040 | 2,985 | 9,993 | 77 | 620 | 6,128 |
| Panel B: Bank variables | | | | | | |
| % Δ number of loans | 43 | -52.4 | 29.3 | -87.4 | -58.8 | -7.5 |
| Lehman co-syndication exposure (%) | 42 | 1.15 | 1.20 | 0.34 | 0.72 | 1.91 |
| ABX exposure | 40 | 1.16 | 0.46 | 0.71 | 1.07 | 1.77 |
| 2007–8 trading revenue/assets (%) | 42 | -0.08 | 0.62 | -0.72 | 0.01 | 0.39 |
| 2007–8 real estate net charge-offs/assets (%) | 21 | 0.24 | 0.23 | 0.04 | 0.18 | 0.49 |
| 2007 deposits/assets (%) | 43 | 42.2 | 25.4 | 3.0 | 47.4 | 68.2 |

Notes. The sample includes non-FIRE U.S. borrowers that obtained a loan for working capital or corporate purposes and with valid state, industry, and public/private status identifiers, excluding the top 1% by sales. Statistics for loan size and borrower sales correspond to information as of the last loan obtained by each borrower prior to September 2008. Rows indicated by Top 43 lenders include only borrowers whose last precrisis loan included one of the most active 43 lenders as a lead arranger. Rows indicated by merged Dealscan-LDB and the employment statistics include only borrowers matched to the LDB. The variable % Δ loans equals the change in the annualized number of loans made by the bank between the periods October 2005 to June 2007 and October 2008 to June 2009. The variable Lehman co-syndication exposure equals the fraction of the bank's syndication portfolio where Lehman Brothers had a lead role in the loan deal. The variable ABX exposure equals the loading of the bank's stock return on the ABX AAA 2006-H1 index between October 2007 and December 2007.

Results



FIGURE I
Stress in the Interbank Lending Market

Source: Federal Reserve Board of Governors (H.15 Release).

Results

TABLE III
DETERMINANTS OF BANK LENDING

| | (1) | (2) | (3) |
|---|-------------------------------------|-------------------|--------------------------------|
| | Change in lending during the crisis | | |
| Explanatory variables | | | |
| Lehman cosyndication exposure | −0.14** (0.049) | | |
| ABX exposure | | −0.11* (0.041) | |
| 2007–8 trading revenue/assets | | | 0.046 (0.040) |
| Real estate charge-offs flag | | | 0.012 (0.050) |
| 2007–8 real estate net charge-offs/assets | | | −0.092 ⁺ (0.051) |
| 2007 Bank Deposits/Assets | | | 0.19** (0.059) |
| Joint test <i>p</i> -value | 0.008 | 0.013 | 0.002 |
| <i>R</i> ² | 0.16 | 0.15 | 0.35 |
| Observations | 42 | 40 | 42 |

Notes. The dependent variable is the change in the annualized number of loans made by the bank between the periods October 2005 to June 2007 and October 2008 to June 2009, with each loan scaled by the importance of the lender in the loan syndicate as described in Section IV.C of the text. Observations weighted by number of precrisis borrowers. The explanatory variables have been normalized to have unit

Results

TABLE IV
BALANCING OF COVARIATES IN THE SAMPLE

| | Quantile of lender health | | | | Memo: std. dev. |
|---|---------------------------|---------|---------|---------|--------------------|
| | 1 | 2 | 3 | 4 | |
| Mean employment change in Borrower's industry, 2008:3–2009:3 | -0.086 | -0.081 | -0.085 | -0.089 | 0.083 |
| Borrower's county, 2008:3–2009:3 | -0.056 | -0.056 | -0.056 | -0.056 | 0.009 |
| Share with bond market access | 0.455 | 0.540 | 0.458 | 0.236 | 0.494 |
| Share private, no bond market access | 0.418 | 0.331 | 0.363 | 0.525 | 0.492 |
| Share public, no bond market access | 0.127 | 0.129 | 0.179 | 0.239 | 0.374 |
| Mean all in drawn spread | 266 | 155 | 156 | 199 | 133 |
| Median sales at close (\$2005 billions) | 0.366 | 0.837 | 0.701 | 0.285 | 4.146 |
| Mean year of last precrisis loan | 2005.83 | 2005.98 | 2006.03 | 2006.05 | 1.50 |
| Share with loan due during crisis | 0.193 | 0.188 | 0.183 | 0.205 | 0.394 |

Notes. The table splits the sample into four quantiles based on the change in the annualized number of loans made by the borrower's last precrisis syndicate between the periods October 2005 to June 2007 and October 2008 to June 2009. Employment change by borrower industry computed at the four-digit SIC level using six-digit NAICS employment levels from the Quarterly Census of Wages and Employment and a SIC-NAICS concordance table available from the BLS. Employment change by borrower county computed by averaging the employment change in all counties in which a firm operates establishments using establishment employment shares as weights. The last column reports the standard deviation of the variable summarized in each row.

Results

TABLE VI
THE EFFECT OF BANK HEALTH ON THE LIKELIHOOD OF OBTAINING A LOAN

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|--|------------------|--|-----------------|------------------|------------------|
| | Firm obtains a new loan or positive modification | | | | | |
| | Probit | | $\Delta\tilde{L}_{i,s}$ instrumented using | | | |
| | | | Bank | | | |
| | | | Lehman exposure | ABX exposure | statement items | All |
| Explanatory variables | | | | | | |
| % Δ loans to other firms ($\Delta\tilde{L}_{i,s}$) | 2.19** (0.79) | 2.00** (0.53) | 3.65** (1.28) | 2.33* (1.12) | 2.28** (0.64) | 2.32** (0.63) |
| 2-digit SIC, state, loan year FE | No | Yes | Yes | Yes | Yes | Yes |
| Bond access/public/private FE | No | Yes | Yes | Yes | Yes | Yes |
| Additional Dealscan controls | No | Yes | Yes | Yes | Yes | Yes |
| First stage <i>F</i> -statistic | | | 14.0 | 8.2 | 18.2 | 19.8 |
| <i>J</i> -statistic <i>p</i> -value | | | . | . | . | 0.206 |
| <i>E[borrow]</i> | 0.134 | 0.134 | 0.134 | 0.134 | 0.134 | 0.134 |
| <i>E[borrow]:</i> $\Delta\tilde{L}_{p_{30}} - \Delta\tilde{L}_{p_{10}}$ | 0.052 | 0.048 | 0.087 | 0.055 | 0.054 | 0.055 |
| Lead lender 1 clusters | 43 | 43 | 43 | 40 | 43 | 40 |
| Lead lender 2 clusters | 43 | 43 | 43 | 40 | 43 | 40 |
| Observations | 4,391 | 4,391 | 4,391 | 4,354 | 4,391 | 4,354 |

Notes. The dependent variable is an indicator for whether the borrower signed a new loan or received a favorable modification to an existing loan between October 2008 and June 2009. The variable $\Delta\tilde{L}_{i,s}$ equals the change in the annualized number of loans made by the bank between the periods October 2005 to June 2007 and October 2008 to June 2009, and has been normalized to have unit variance. The variable Lehman cosyndication exposure equals the fraction of the bank's syndication portfolio where Lehman Brothers had a lead role in the loan deal. The variable ABX exposure equals the loading of the bank's stock return on the ABX AAA 2006-H1 index between October 2007 and December 2007. The balance sheet and income statement items include the ratio of deposits to assets at the end of 2007, the ratio of trading revenue over 2007–8 to assets, the ratio of net real estate charge-offs over 2007–8 to assets, and an indicator for reporting real estate charge-offs. The last column includes all of the instruments. For each firm, the bank-level measures are averaged over the members of the firm's last precrisis loan syndicate, with weights given according to each bank's role. In columns (1) and (2) estimation is via probit, and the table reports marginal coefficients. In columns (3)–(6) $\Delta\tilde{L}_{i,s}$ is instrumented using the variable indicated in the column heading and estimation is via two-stage least squares. Borrower-level covariates are as of the last precrisis loan taken by each borrower. Additional Dealscan controls: multiple lead lenders indicator, loan due during crisis indicator, credit line indicator, log sales at close, all in drawn spread, credit line * all in drawn. Standard errors in parentheses and two-way clustered on the lead lenders in the

Results

TABLE VII
THE EFFECT OF BANK HEALTH ON INTEREST RATE SPREADS

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|--------------------------------|---------|---|-----------------|----------------------------|---------|
| | Change in interest rate spread | | | | | |
| | OLS | | $\Delta \tilde{L}_{i,s}$ instrumented using | | | |
| | | | Lehman exposure | ABX exposure | Bank statement items | All |
| Explanatory variables | | | | | | |
| % Δ loans to other firms ($\Delta \tilde{L}_{i,s}$) | -14.6** | -12.2** | -23.1* | -20.0 | -17.2* | -17.6** |
| | (5.26) | (4.15) | (11.2) | (13.3) | (7.63) | (6.68) |
| 1-digit SIC, loan year FE | No | Yes | Yes | Yes | Yes | Yes |
| Bond access/public/private FE | No | Yes | Yes | Yes | Yes | Yes |
| Additional Dealscan controls | No | Yes | Yes | Yes | Yes | Yes |
| First stage <i>F</i> -statistic | | | 60.5 | 7.8 | 14.3 | 14.5 |
| <i>J</i> -statistic <i>p</i> -value | | | | | | 0.967 |
| $E[\Delta \text{Spread}]$ | 130.6 | 130.6 | 130.6 | 130.7 | 130.6 | 130.7 |
| $E[\text{Spread} : \Delta \tilde{L}_{p90} - \Delta \tilde{L}_{p10}]$ | -39.7 | -33.0 | -62.8 | -54.3 | -46.6 | -47.7 |
| Lead lender 1 clusters | 34 | 34 | 34 | 32 | 34 | 32 |
| Lead lender 2 clusters | 30 | 30 | 30 | 28 | 30 | 28 |
| Observations | 350 | 350 | 350 | 346 | 350 | 346 |

Notes. The dependent variable is the interest spread, in basis points, charged to a firm on a loan starting between October 2008 and June 2009, less the interest spread charged to the same firm on its last loan of the same type (credit line or term loan) obtained prior to September 15, 2008. The regressions exclude loan pairs with an increase of >400 basis points. See the text for further details of the sample construction. The variable $\Delta \tilde{L}_{i,s}$ equals the change in the annualized number of loans made by the bank between the periods October 2005 to June 2007 and October 2008 to June 2009 and has been normalized to have unit variance. The variable Lehman cosyndication exposure equals the fraction of the bank's syndication portfolio where Lehman Brothers had a lead role in the loan deal. The variable ABX exposure equals the loading of the bank's stock return on the ABX AAA 2006-H1 index between October 2007 and December 2007. The balance sheet and income statement items include the ratio of deposits to assets at the end of 2007, the ratio of trading revenue over 2007–8 to assets, the ratio of net real estate charge-offs over 2007–8 to assets, and an indicator for reporting real estate charge-offs. For each firm, the bank-level measures are averaged over the members of the firm's last precrisis loan syndicate, with weights given according to each bank's role. Additional Dealscan controls: multiple lead lenders indicator, loan due during crisis indicator, credit line indicator, log sales at close, all in drawn spread, credit line * all in drawn. Standard errors in parentheses and two-way clustered on the lead

Results

TABLE VIII
BOND MARKET ACCESS AND EMPLOYMENT

| | (1) | (2) |
|------------------------------|--------------------------------------|-------------------|
| | Employment growth rate 2008:3–2009:3 | |
| Explanatory variables | | |
| No bond market access | -2.65** (0.98) | -3.15** (1.10) |
| 2-digit SIC and state FE | No | Yes |
| Firm size bin FE | No | Yes |
| Firm age bin FE | No | Yes |
| Lagged employment growth | No | Yes |
| County employment growth | No | Yes |
| R^2 | 0.003 | 0.172 |
| Observations | 2,040 | 2,040 |

Notes. The dependent variable is the symmetric growth rate g_j^y of employment. Firms that do not have access to the bond market do not have a credit rating from either Moody's or Standard and Poors, and have never issued public debt. Firms divided into size bin classes of 1–250, 250–999, and 1,000+, and age bins for birth in the 2000s, 1990s, or earlier. Eicker-White standard errors in parentheses. +, *, and ** indicate significance at the 0.1, 0.05, and 0.01, levels respectively.

Results

TABLE IX
THE EFFECT OF LENDER CREDIT SUPPLY ON EMPLOYMENT

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|--------------------------------------|-----------------|--------------|--|--------------------|---------|
| | Employment growth rate 2008:3–2009:3 | | | | | |
| | OLS | | | $\Delta\tilde{L}_{i,s}$ instrumented using | | |
| | | Lehman exposure | ABX exposure | Bank statement items | Bank statement All | |
| Explanatory variables | | | | | | |
| % Δ loans to other firms ($\Delta\tilde{L}_{i,s}$) | 1.17* | 1.67** | 2.49* | 3.17* | 2.13* | 2.38** |
| | (0.58) | (0.61) | (1.00) | (1.35) | (0.88) | (0.77) |
| Lagged employment growth | 0.0033 | 0.0039 | 0.0045 | 0.0036 | 0.0039 | |
| | (0.019) | (0.019) | (0.019) | (0.019) | (0.019) | (0.019) |
| Emp. change in firm's county | 0.89* | 0.85+ | 0.86+ | 0.87+ | 0.89+ | |
| | (0.43) | (0.46) | (0.48) | (0.45) | (0.46) | |
| 2-digit SIC, state, loan year FE | No | Yes | Yes | Yes | Yes | Yes |
| Firm size bin FE | No | Yes | Yes | Yes | Yes | Yes |
| Firm age bin FE | No | Yes | Yes | Yes | Yes | Yes |
| Bond access/public/private FE | No | Yes | Yes | Yes | Yes | Yes |
| Additional Dealscan controls | No | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 15.5 | 8.5 | 18.5 | 23.1 | |
| J-statistic p-value | | | | | | 0.190 |
| $E[g_j^y]$ | -0.092 | -0.092 | -0.092 | -0.093 | -0.092 | -0.093 |
| $E[g_j^y; \Delta\tilde{L}_{p_{10}} - \Delta\tilde{L}_{p_{10}}]$ | 0.027 | 0.039 | 0.058 | 0.074 | 0.050 | 0.055 |
| Lead lender 1 clusters | 43 | 43 | 43 | 40 | 43 | 40 |
| Lead lender 2 clusters | 43 | 43 | 43 | 40 | 43 | 40 |
| Observations | 2,040 | 2,040 | 2,040 | 2,015 | 2,040 | 2,015 |

Notes. The dependent variable is the symmetric growth rate g_j^y of employment. The variable $\Delta\tilde{L}_{i,s}$ equals the change in the annualized number of loans made by the bank between the periods October 2005 to June 2007 and October 2008 to June 2009 and has been normalized to have unit variance. The variable Lehman co-syndication exposure equals the fraction of the bank's syndication portfolio where Lehman Brothers had a lead role in the loan deal. The variable ABX exposure equals the loading of the bank's stock return on the ABX AAA 2006-H1 index between October 2007 and December 2007. The balance sheet and income statement items include the ratio of deposits to assets at the end of 2007, the ratio of trading revenue over 2007–8 to assets, the ratio of net real estate charge-offs over 2007–8 to assets, and an indicator for report real estate charge-offs. For each firm, the bank-level measures are averaged over the members of the firm's last precrisis loan syndicate, with weights given according to each bank's role. In columns (1) and (2) estimation is via OLS. In columns (3)–(6) $\Delta\tilde{L}_{i,s}$ is instrumented using the variable indicated in the column heading. Borrower-level covariates are as of the last precrisis loan taken by each borrower. Firms divided into size bin classes of 1–250, 250–999, and 1,000+, and age bins for birth in the 2000s, 1990s, or earlier. Additional Dealscan controls: multiple lead lenders indicator, loan due during crisis indicator, credit line indicator, log sales at close all in drawn spread credit line * all in drawn

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- 9 Krishnamurthy and Vissing-Jorgensen (2011)
- 10 Gilchrist and Zakrajšek (2012)
- 11 Jiménez et al. (2014)
- 12 Chodorow-Reich (2014)
- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Abstract

We provide evidence on the transmission of monetary policy shocks in a setting with both economic and financial variables. We first show that shocks identified using high frequency surprises around policy announcements as external instruments produce responses in output and inflation that are typical in monetary VAR analysis. We also find, however, that the resulting “modest” movements in short rates lead to “large” movements in credit costs, which are due mainly to the reaction of both term premia and credit spreads. Finally, we show that forward guidance is important to the overall strength of policy transmission.

Results

TABLE 1—YIELD EFFECTS OF MONETARY POLICY SHOCKS (*Daily*, 1991–2012)

| Indicator and instruments | 2 year (1) | 5 year (2) | 10 year (3) | 30 year (4) | 5 × 5 forw (5) | Baa ⁺ (6) | Mortg. ⁺ (7) |
|---------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------------|----------------------------|
| FF, FF1 | 0.367*** (3.467) | 0.233** (2.241) | 0.0980 (1.053) | 0.00637 (0.103) | -0.0369 (-0.388) | 0.139 (1.475) | 0.170 (1.445) |
| 1 YR, FF1 | 0.739*** (8.493) | 0.469*** (3.094) | 0.197 (1.173) | 0.0128 (0.103) | -0.0744 (-0.379) | 0.280 (1.544) | 0.343 (1.416) |
| 1 YR, FF4 | 0.880*** (15.81) | 0.683*** (8.201) | 0.375*** (4.410) | 0.145* (1.694) | 0.0668 (0.614) | 0.333** (2.176) | 0.427** (2.239) |
| 2 YR, FF4 | | 0.778*** (11.80) | 0.432*** (5.306) | 0.169* (1.839) | 0.0848 (0.702) | 0.355** (1.986) | 0.483** (2.141) |
| 2 YR, GSS | | 0.878*** (18.70) | 0.575*** (11.84) | 0.234*** (4.139) | 0.271*** (3.601) | 0.231* (1.844) | 0.350** (2.049) |

Note: Robust z -statistics in parentheses; QE dates and crisis period are excluded, 188 observations.

⁺Two-week cumulative changes

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

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- 13 Gertler and Karadi (2015)
- 14 Giroud and Mueller (2017)

Overview

This article argues that firms' balance sheets were instrumental in the transmission of **consumer demand shocks** during the Great Recession. Using **micro-level data from the U.S. Census Bureau**, we find that **establishments of more highly levered firms experienced significantly larger employment losses** in response to declines in local consumer demand. These results are not driven by firms being less productive, having expanded too much prior to the Great Recession, or being generally more sensitive to fluctuations in either aggregate employment or house prices. Likewise, at the **county level**, we find that counties with more highly levered firms experienced significantly larger declines in employment in response to **local consumer demand shocks**. Accordingly, firms' balance sheets also matter for aggregate employment. Our results suggest a **possible role for employment policies that target firms directly besides conventional stimulus**.

Summary Statistics

TABLE I
SUMMARY STATISTICS

| | Mean | Std. dev. | Correlation with Leverage ₀₆ | <i>p</i> -value of correlation |
|--|--------|-----------|---|--------------------------------|
| Panel A: Establishment level (N = 284,800) | | | | |
| Employees ₀₆ | 39 | 63 | -0.028 | .283 |
| ΔLog(Emp) _{07–09} | -8.2 | 24.2 | -0.047** | .020 |
| ΔLog(HP) _{06–09} | -14.5 | 16.1 | 0.005 | .718 |
| Housing supply elasticity | 1.799 | 0.927 | 0.011 | .345 |
| Census regions | | | | |
| Northeast | 0.17 | 0.38 | 0.004 | .801 |
| Midwest | 0.21 | 0.41 | -0.006 | .610 |
| South | 0.38 | 0.49 | 0.002 | .894 |
| West | 0.24 | 0.42 | -0.000 | .978 |
| Industry sectors | | | | |
| Tradable | 0.03 | 0.18 | 0.001 | .954 |
| Nontradable | 0.44 | 0.5 | -0.146** | .014 |
| Other | 0.53 | 0.5 | 0.145** | .013 |
| Panel B: Firm level 2006 (N = 2,800) | | | | |
| Establishments ₀₆ | 101 | 451 | -0.015 | .495 |
| Employees ₀₆ | 4,005 | 16,384 | -0.008 | .191 |
| Assets ₀₆ | 3,040 | 18,515 | -0.003 | .655 |
| ROA ₀₆ | 0.045 | 0.177 | -0.073*** | .003 |
| NPM ₀₆ | 0.024 | 0.28 | -0.041** | .032 |
| TFP ₀₆ | -0.002 | 0.599 | -0.083*** | .004 |
| Leverage ₀₆ | 0.227 | 0.253 | 1.000*** | .000 |
| WW ₀₆ | -0.251 | 0.135 | 0.189*** | .000 |
| KZ ₀₆ | -4.067 | 44.295 | 0.259*** | .000 |

Summary Statistics

TABLE I
(CONTINUED)

| | Mean | Std. dev. | Correlation with Leverage ₀₆ | p-value of correlation |
|--|--------|-----------|--|---------------------------|
| Panel C: Firm level 2002–2006 (N = 2,800) | | | | |
| ΔEstablishments _{02–06} | 4.4 | 10.2 | 0.089*** | .000 |
| ΔLog(Emp) _{02–06} | 0.052 | 0.093 | 0.048*** | .009 |
| ΔLog(Assets) _{02–06} | 0.110 | 0.133 | 0.087*** | .000 |
| ΔROA _{02–06} | 0.022 | 0.127 | -0.061*** | .003 |
| ΔNPM _{02–06} | 0.020 | 0.225 | -0.032** | .015 |
| ΔTFP _{02–06} | -0.001 | 0.569 | -0.017 | .649 |
| ΔLeverage _{02–06} | -0.023 | 0.153 | 0.379*** | .000 |
| ΔWW _{02–06} | -0.006 | 0.08 | 0.085*** | .000 |
| ΔKZ _{02–06} | -0.370 | 49.633 | 0.188*** | .000 |
| Panel D: 10th and 90th percentiles of ΔLog(HP) _{06–09} and leverage ₀₆ | | | | |
| | 10th | 90th | | |
| ΔLog(HP) _{06–09} | -0.402 | 0.035 | | |
| Leverage ₀₆ | 0.000 | 0.568 | | |

Notes. Panel A provides summary statistics at the establishment level. Leverage₀₆ is the ratio of the sum of debt in current liabilities and long-term debt to total assets associated with the establishment's parent firm in 2006. ΔLog(Emp)_{07–09} is the percentage change in establishment-level employment from 2007 to 2009. ΔLog(HP)_{06–09} is the percentage change in house prices in the establishment's zip code or county (if the zip code information is missing) from 2006 to 2009. Housing Supply Elasticity is described in [Saiz \(2010\)](#). Tradable and nontradable industries are described in [Mian and Sufi \(2014a\)](#). "Other" industries are those that are neither tradable nor nontradable. Panels B and C provide summary statistics at the firm level. Assets is the book value of total assets. ROA (return on assets) is the ratio of operating income before depreciation to total assets. NPM (net profit margin) is the ratio of operating income before depreciation to sales. TFP (total factor productivity) is the residual from a regression of log(sales) on log(employees) and log(PP&E) across all Compustat firms in the same two-digit SIC industry. WW is the financial constraints index of [Whited and Wu \(2006\)](#). KZ is the financial constraints index of [Kaplan and Zingales \(1997\)](#). Panel D shows the 10th and 90th percentiles of Δ Log(HP)_{06–09} and Leverage₀₆, respectively, used in counterfactual analyses in [Section IIIA](#). **, and *** denotes significance at the 5%, and 1% levels, respectively.

Results

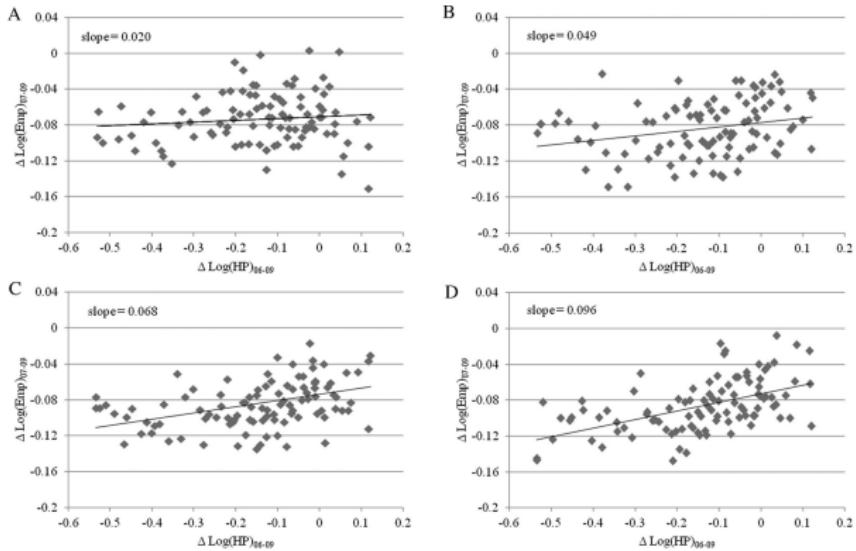


FIGURE I
Firm Leverage, House Prices, and Employment at the Establishment Level

The figure plots the percentage change in establishment-level employment between 2007 and 2009, $\Delta \text{Log}(\text{Emp})_{07-09}$, against the percentage change in house prices in the establishment's zip code or county between 2006 and 2009, $\Delta \text{Log}(\text{HP})_{06-09}$, for different quartiles of firm leverage. For each percentile of $\Delta \text{Log}(\text{HP})_{06-09}$, the scatterplot depicts the mean values of $\Delta \text{Log}(\text{HP})_{06-09}$ and $\Delta \text{Log}(\text{Emp})_{07-09}$, respectively.

Results

TABLE II
FIRM LEVERAGE, CONSUMER DEMAND, AND EMPLOYMENT

| | (1) | (2) | (3) | $\Delta \text{Log}(\text{Emp})_{07-09}$ | (4) | (5) | (6) | (7) |
|--|---------------------|---------------------|---------------------|---|--------------------|--------------------|--------------------|---------|
| $\Delta \text{Log}(\text{HP})_{06-09}$ | 0.066*** (0.019) | 0.029 (0.022) | 0.029 (0.019) | | 0.027 (0.019) | | | |
| $\Delta \text{Log}(\text{HP})_{06-09} \times \text{Leverage}_{06}$ | | 0.111*** (0.039) | 0.114*** (0.040) | 0.113*** (0.038) | 0.084** (0.035) | 0.076** (0.031) | 0.075** (0.038) | |
| Leverage ₀₆ | | -0.028** (0.014) | -0.032** (0.015) | -0.020** (0.009) | | | | |
| Industry fixed effects | No | No | Yes | Yes | Yes | Yes | Yes | — |
| Firm fixed effects | No | No | No | No | Yes | Yes | Yes | Yes |
| Zip code fixed effects | No | No | No | Yes | No | Yes | — | |
| Zip code \times industry fixed effects | No | No | No | No | No | No | Yes | |
| R-squared | 0.00 | 0.00 | 0.04 | 0.13 | 0.17 | 0.25 | 0.31 | |
| Observations | 284,800 | 284,800 | 284,800 | 284,800 | 284,800 | 284,800 | 284,800 | 284,800 |

Notes. The dependent variable, $\Delta \text{Log}(\text{Emp})_{07-09}$, is the percentage change in establishment-level employment from 2007 to 2009. $\Delta \text{Log}(\text{HP})_{06-09}$ is the percentage change in house prices in the establishment's zip code or county (if the zip code information is missing) from 2006 to 2009. Leverage₀₆ is the ratio of the sum of debt in current liabilities and long-term debt to total assets associated with the establishment's parent firm in 2006. Industry fixed effects are based on four-digit NAICS codes. All regressions are weighted by establishment size. Standard errors (in parentheses) are clustered at both the state and firm level. **, and *** denote significance at the 5%, and 1% levels, respectively.

Results

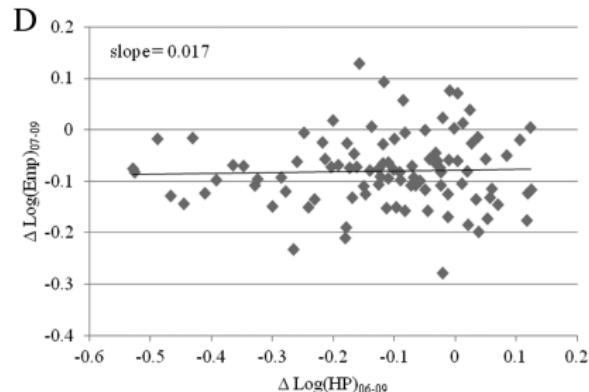
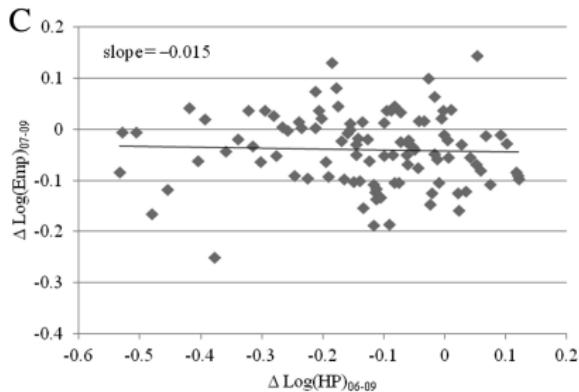
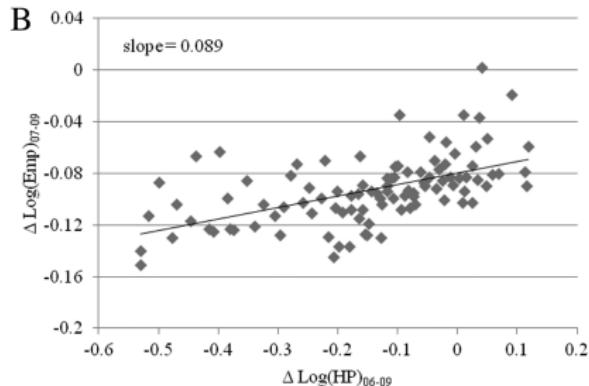
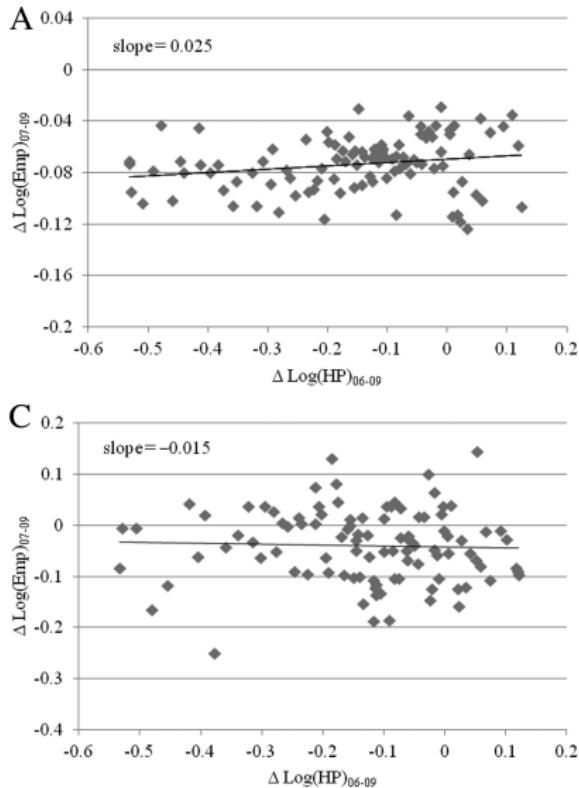


FIGURE II

Results

TABLE IV
TRADABLE AND NONTRADABLE INDUSTRIES

| | $\Delta \text{Log}(\text{Emp})_{07-09}$ | | | |
|---|---|------------------|---------------------|-------------------|
| | (1) Nontradable | (2) Tradable | (3) Nontradable | (4) Tradable |
| $\Delta \text{Log}(\text{HP})_{06-09}$ | 0.074** (0.035) | 0.009 (0.019) | 0.029 (0.019) | -0.015 (0.043) |
| $\Delta \text{Log}(\text{HP})_{06-09} \times$ Leverage ₀₆ | | | 0.131*** (0.034) | 0.037 (0.120) |
| Leverage ₀₆ | | | -0.038** (0.015) | -0.026 (0.020) |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| R-squared | 0.04 | 0.03 | 0.04 | 0.03 |
| Observations | 124,100 | 9,900 | 124,100 | 9,900 |

Notes. This table presents variants of the regressions in [Table II](#) in which the sample is restricted to tradable and nontradable industries, respectively. Tradable and nontradable industries are described in [Mian and Sufi \(2014a\)](#). All regressions are weighted by establishment size. Standard errors (in parentheses) are clustered at both the state and firm level. **, and *** denote significance at the 5%, and 1% levels, respectively.

Results

TABLE V
FIRM-LEVEL ANALYSIS

| | External finance | | | Employment and investment | | |
|---|---------------------------|---------------------------|-------------------------|---------------------------|-------------------------|------------------------|
| | $\Delta ST\ debt_{07-09}$ | $\Delta LT\ debt_{07-09}$ | $\Delta Equity_{07-09}$ | $\Delta Log(Emp)_{07-09}$ | Est. Closure $_{07-09}$ | $\Delta CAPEX_{07-09}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\Delta Log(HP)_{06-09}$ | -0.025** (0.011) | -0.040** (0.019) | 0.005 (0.037) | 0.020 (0.033) | -0.008 (0.015) | 0.002 (0.005) |
| $\Delta Log(HP)_{06-09} \times Leverage_{06}$ | 0.035** (0.014) | 0.059** (0.021) | -0.011 (0.047) | 0.122*** (0.040) | -0.046** (0.019) | 0.014** (0.007) |
| Leverage ₀₆ | -0.011* (0.006) | -0.019* (0.011) | 0.009 (0.021) | -0.024** (0.010) | 0.018** (0.008) | -0.005* (0.003) |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.09 | 0.08 | 0.03 | 0.11 | 0.11 | 0.14 |
| Observations | 2,800 | 2,800 | 2,800 | 2,800 | 2,800 | 2,800 |

Notes. This table presents firm-level variants of the regressions in Table II. Short-term (ST) debt is the ratio of debt in current liabilities divided by total assets. Long-term (LT) debt is the ratio of long-term debt divided by total assets. Equity is the ratio of the book value of equity divided by total assets. Establishment (Est.) closure is the number of establishments closed between 2007 and 2009 divided by the number of establishments in 2007. CAPEX is the ratio of capital expenditures to property, plant and equipment (PP&E). $\Delta Log(HP)_{06-09}$ is aggregated at the firm level by computing the employment-weighted average value of $\Delta Log(HP)_{06-09}$ across all of the firm's establishments. Industry fixed effects are based on four-digit NAICS codes. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

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