Whatever It Takes? The Impact of Conditional Policy Promises

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Policy announcement $\rightarrow$ market infers **state-contingent plan**

This paper: measuring perception of the state-contingent response at announcement

Asset Purchases

Fed announces purchases $\rightarrow$ asset price responds

- QE during 2008 crisis, corporate bond purchases during the COVID-19 crash

View 1: headline number taken at face value

- Compare to price response

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View 2: (implicit) promise: Fed will do more if conditions worsen

- Price response driven by potential policy expansions (e.g, "policy put")
  - Distort asset price dynamics
  - Weak response to subsequent announcements
  - Distort inference of policy effectiveness

Why Promises Matter

Intense debate

- Useful tool: promise to do more if situation worsens stabilizes prices today (e.g. Draghi)
- Criticism: moral hazard, excessive risk taking $\rightarrow$ distortions
- Promises often ignored in analyzing policy effects (hard to measure)

Relevant in many other contexts

- Bank bailouts, yield curve or exchange rate control, expansionary fiscal policy, ...
- Explicit or implicit, voluntary or involuntary

What we do

Measure the state-contingent nature of announced policy

1. **Simple framework to understand and quantify impact of policy promises**
   - Response contaminated by past and future promises
   - Option prices reveal state-contingent policy impact
2. **In-depth evidence from 2020 corporate bond purchases**
   - Promises explain half of price recovery
   - Long-term distortions: "too little" tail risk in corporate bond markets since then
3. **Role for promises in many announcements**
   - U.S. quantitative easing, Bank of Japan asset purchases, bank equity injections during the 2008, ECB purchases, FOMC ...

Corp bond purchases, March 23rd 2020

Fed announces purchase of IG corp bonds $\rightarrow$ prices $\uparrow$ 7-14%, $\approx$ \$0.5-1 trillion in value, ultimately purchase $\approx$ \$15 billion. Huge multiplier or implicit promise?

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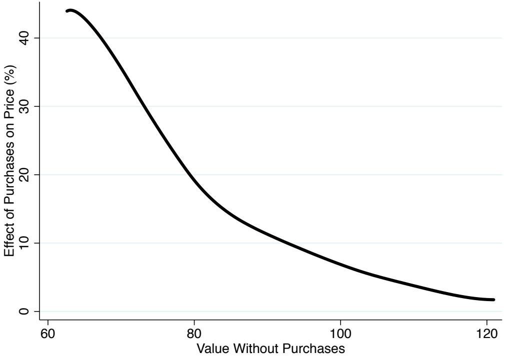

30x larger price support in bad states (e.g. purchase 30x realized)

(Some) Related Literature

Asset purchase announcements

- QE: Krishnamurthy Vissing-Jorgensen (2011), Gagnon et al (2018), Bernanke (2020)...
- Weakening announcement effects: Hesse Hofman Weber (2018), Meaning and Zhu (2011)
- Corp bonds: Haddad Moreira Muir (2021), Boyarchenko Kovner Shachar (2021), ...

(Implicit) policy promises: e.g., "Fed put" Cieslak Vissing-Jorgensen (2021), forward guidance (Nakamura McKay Steinsson 2016), ...

Information from option prices: Kelly, Lustig, van Nieuwerburgh (2016), Kelly, Pastor, Veronesi (2016), Reis (2021), ...

Outline

1. A framework for measuring implicit promises and their impact
2. Evidence of promises using corp bond option prices
3. Evidence of long-term distortions in the corp bond market
4. Additional examples: BoJ purchases, QE, bank equity injections 2008, etc

Promises as Conditional Policy

Simple Example: No Promises

Announcement at date 0, purchases at date 1

Pre-Announcement: price p_0, p_1

$$p_0 = E[p_1]$$

$\Rightarrow E[.]$: risk-neutral expectation

Announcement: quantity of purchases Q

$$p_0' = E[p_1 + \mathcal{M}Q] = p_0 + \mathcal{M}Q \quad \Rightarrow p_0' - p_0 = \mathcal{M}Q$$

$\mathcal{M}$: effectiveness per unit policy

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$\mathcal{M}$: effectiveness per unit policy

- Paper: model as in Vayanos Vila (2022) Fed absorb assets from specialists $\rightarrow$ low risk premia from date 1 on
- E.g. $\Delta p_0' =$ \$0.5-1 trillion, $Q =$ \$15 billion $\rightarrow \mathcal{M} =$30-60

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Simple Example: With Promises

Market may infer stronger intervention if conditions worsen

Fed buys additional $Q_{promise}$ if $p_1 < \underline{p}$

Distortion in announcement effect due to promises

$$\underbrace{p_0' - p_0}_{\text{Announcement effect}} = \underbrace{\mathcal{M}\ Q}_{\text{Base effect}} + \underbrace{\mathcal{M}\ Prob[p_1 < \underline{p}]\ Q_{promise}}_{\text{(Implicit) promises}}$$

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- E.g. $Q_{promise}/Q = 5$, $Prob[p_1 < \underline{p}] = 20\%$, $\Rightarrow$ response doubles

No reaction if promise fulfilled $\rightarrow$ Promise already "priced"

- Hesse et al. (2018), Meaning and Zhu (2011), etc: early stage announcements of asset purchases in US / Europe have large effect, later stage announcements do not

Framework

Promises as conditional policy: price support function $g(.)$

$$p_1' = p_1 + g(p_1)$$

- Ex: $g(p_1) = \mathcal{M}\left(Q + 1_{\{p_1 < \underline{p}\}} Q_{promise}\right)$
- Policy not fixed number, but mapping from state of world to intervention
- Focus on price: states are values of price absent intervention
- $g(p)$: doesn't separate $\mathcal{M}, Q$

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How to recover g from data?

- Announcement effect gives $E[p_1' - p_1] = E[g(p_1)]$
- **Option prices reveal change in distribution from p_1 to p_1'**

Recovering Conditional Price Support: Assumptions

A1. *The same risk-neutral distribution* $F : p_1 \to p_0$ *maps implementation date prices into announcement date prices before and after the announcement*

- Pricing kernel *between dates 0 and 1* doesn't change over announcement
- No assumption on relation of risk-neutral vs physical, pricing kernel can change when purchases happen (from date 1 on) as in models (Vayanos Vila)
- Later: supporting evidence, generalization to endogenous pricing kernel

A2. *Order-preserving policy: post-policy price* $p_1' = p_1 + g(p_1)$ *is increasing in* p_1

- E.g., policy does not flip order of bad states and good states

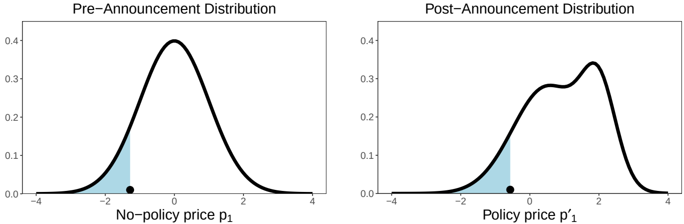
Theorem: under (A1) and (A2) option prices reveal unique $g(p)$

Recovering Conditional Price Support

1. Breeden Litzenberger 1978: Put/call prices across strikes reveal distributions of p_1 and p_1'
2. Solve function $g(.)$ that gets from one distribution to the other (transport problem)

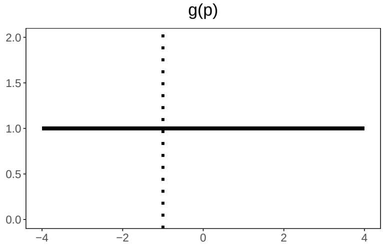
$$F_{p_1}(p_1) = F_{p_1'}(p_1 + g(p_1)) \Rightarrow g(p_1) = F_{p_1'}^{-1}(F_{p_1}(p_1)) - p_1$$

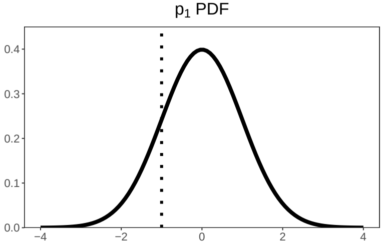
- x-th percentile of p_1 maps to x-th percentile of p_1' ("Q-Q plot")

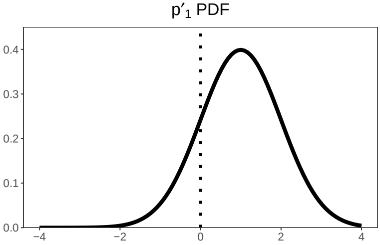


Example 1: Constant Policy

$$p' = p + \mathcal{M}Q$$

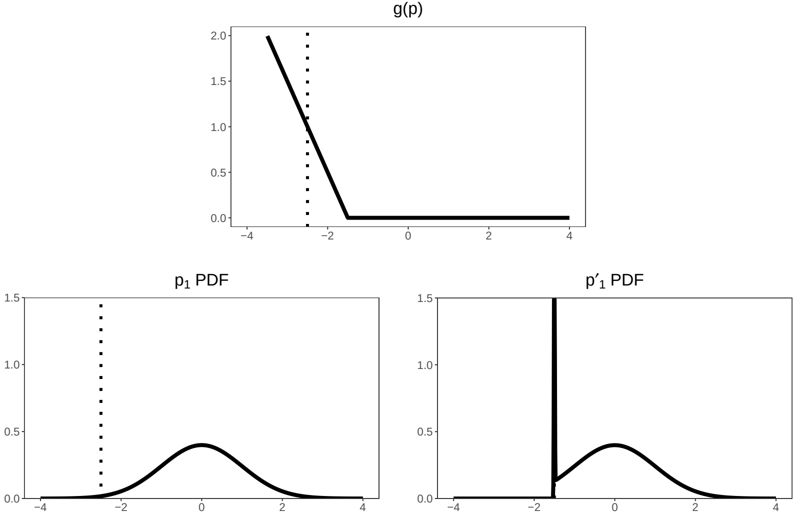






Example 2: Price Floor

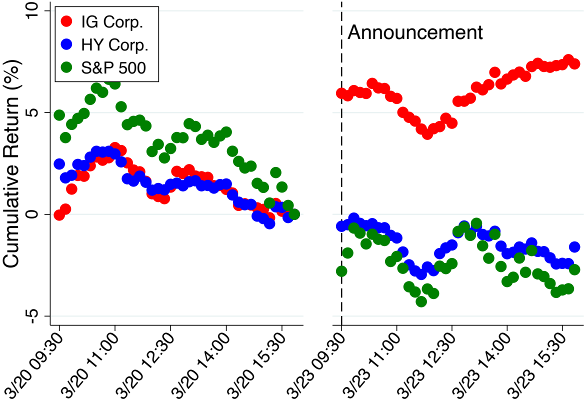
$$p' = max(p, \underline{p})$$



Fed Promises during 2020 Corporate Bond Purchases

March 23: Fed Announces Corporate Bond Purchases

Investment-grade ETF return 7% $\approx$ \$0.5 trillion mkt value
(3 day return 14% $\approx$ \$1 trillion)

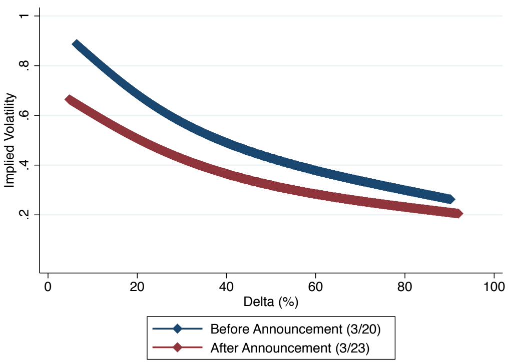


Investment-Grade Bond Options

LQD: largest investment-grade corporate bond ETF

Volatility curve before-after 3/23 announcement

(3 month maturity)

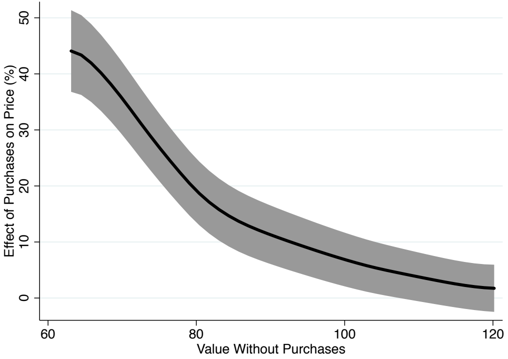


→ *largest volatility drop in the left tail*

Impact of Conditional Fed Policy

$g(p)$ in %: price change due to intervention as a function of no-policy state

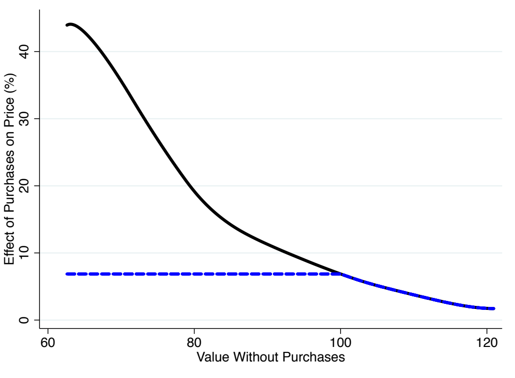
- Ex: if, absent policy, price dropped 20%, Fed would push up by additional $\approx$ 20%



(Re)Interpreting Announcement Effects

What would announcement return have been if

$$\color{blue}{g(p)} = g(p_{med})1_{(p \leq p_{med})} + g(p)1_{(p > p_{med})}$$



Return Response would be 47% smaller

From Price Support to Conditional Quantities

Need additional assumption to back out conditional quantities

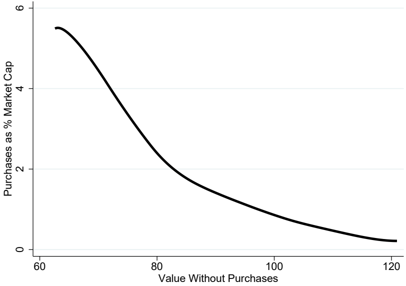
Effectiveness view: $g(p) = \mathcal{M}(p)Q$

- $Q_{realized}$ =0.2% mkt cap, price support $g(.)$ 40% in bad state, $\Rightarrow \mathcal{M}(bad)$=200!

Quantity view: $g(p) = \mathcal{M}Q(p)$, i.e., $\mathcal{M}$ constant

- $g(p)$ informative about *relative* quantities, $\Rightarrow \frac{Q(bad)}{Q(median)} = 5$
- Use realized price & $Q_{realized}$ =0.2% mkt cap $\Rightarrow \mathcal{M} \approx 8$, then do $Q(p) = g(p)/\mathcal{M}$

$\Rightarrow$ **Expect about \$500b purchases in bad states**



What about changes in SDF?

1. High-yield, S&P500 show no change, cuts against broad "macro-SDF" effects

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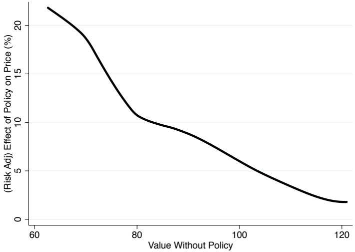

Aggressive risk-adj.: risk prem. 20$\times$ avg IG bonds

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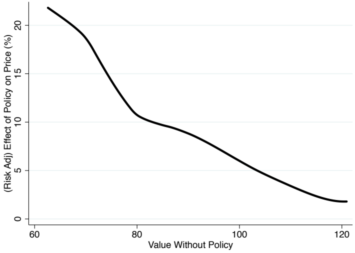


Aggressive risk-adj.: risk prem. 20× avg IG bonds

⇒ Other robustness: liquidity / bid or ask gives same results

A model based on Vayanos and Villa (2021)

- Three dates,0,1,and 2. Risky asset pays $ln(X) \sim N(\mu_0, \sigma^2)$ in date 2
- Three Agents: specialist, inelastic investors , and policy maker
- Inelastic investors have W_I dollars of risky asset, expected to sell B dollars of the asset in date 1
- Specialist has log-utility over wealth and chooses portfolio in date 0 and 1
- Policy maker announces in date 0 policy to purchase $Q = g(p_1)$ bonds in date 1

A model based on Vayanos and Villa (2021)

(1) Prices may be initially “dislocated” or depressed because of fears of future fire sales rather than cash flows (though the source of depressed prices is effectively irrelevant)

(2) purchases affect asset prices through their affect on future risk premiums,

(3) announcements of purchases affect prices even if purchases happen later,

(4) constant purchases of assets require no additional risk adjustment between announcement and purchases

(5) state-dependent purchases (state-dependent q) can alter the pricing of risk between announcement and purchases through their affect on the risk of the asset.

In which states was the Fed expected to buy?

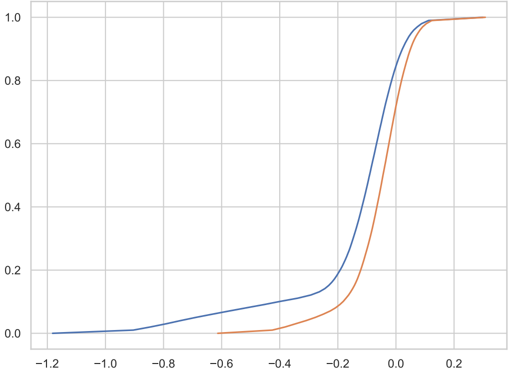
Low corp bond prices (high yields) from 3 channels:

$$\text{yield}_{corp} = \text{risk-free rate} + \text{credit risk premium} + \text{dislocation}$$

1. Risk-free yield: Options on 10 year Treasury Futures
2. Credit risk: Options on IG CDS index
3. Dislocation: bond/CDS basis, copula method gives distribution

In which states was the Fed expected to buy?

Bond basis CDF pre vs post announcement



- Huge drop in left tail of bond-synthetic

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3. Dislocation: bond/CDS basis, copula method gives distribution

Announcement massively shrinks dislocation/basis risk $\Rightarrow$ **strongest intervention in high dislocation states**

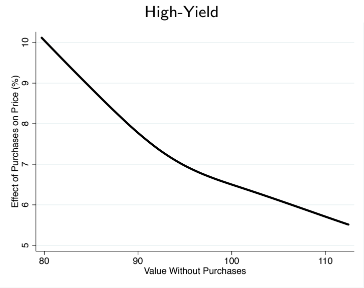
"Markets are functioning pretty well, so purchases will be at the bottom end of the range" (Powell, June 2020)

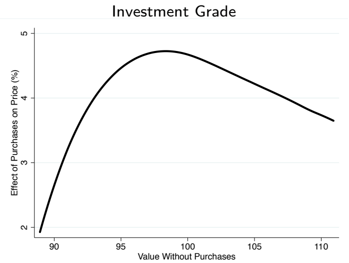
Promises Everywhere: Evidence from Other Announcements

Additional Events

Event	Fraction Explained by Promises
High-Yield April 9th 2020	9%
Oct 13th 2008 (Paulson Plan)	37%
BoJ Purchase Speech	11%
US Quantitative Easing Events:	
Nov 25th 2008	2%
Dec 16th	14%
March 19th	14%
June 19th, 2013 (Tantrum)	9%
ECB Announcements:	
May 10, 2010	24%
Aug 7, 2011	26%
July 26, 2012	9%
Aug 2, 2012	39%
Sep 6, 2012	17%
Average	**18%**

April 9th, 2020: High-Yield Purchases

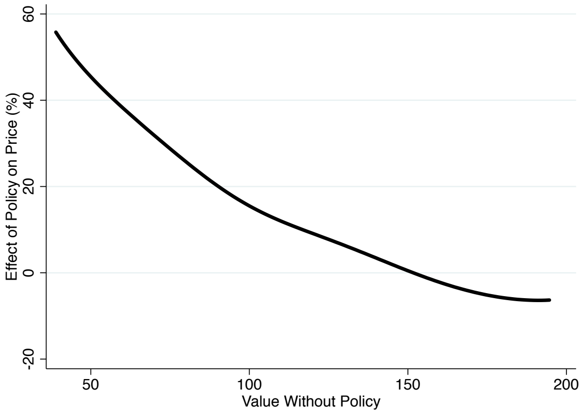




October 13th 2008: "Paulson Plan"

Announcement: equity injections to the banking sector + some guarantees on debt

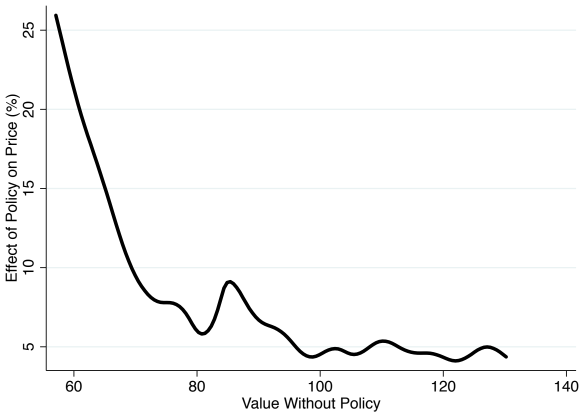
Financial sector ETF (XLF)



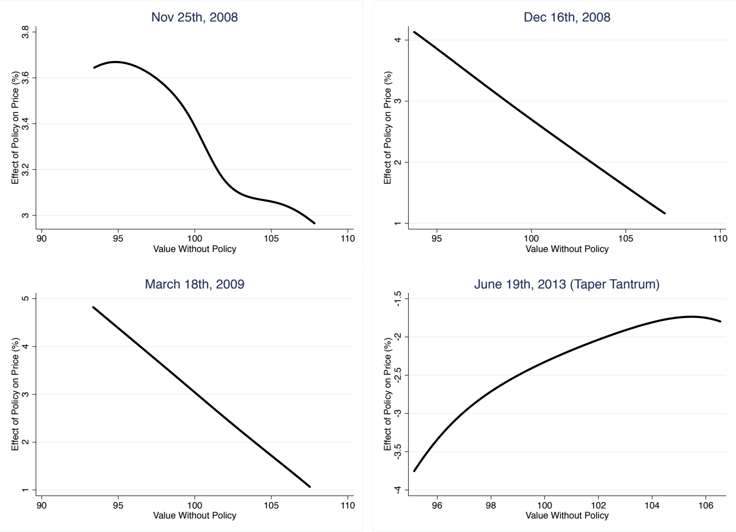
Bank of Japan Asset Purchases, April 2013

Kuroda speech: large purchases of government bonds and equities to drive up asset prices

Nikkei index



US Quantitative Easing: 10 year Treasury



Some Implications

- Long-Term Distortions in the Corporate Bond Market

- Weakening effects

Long term effects

Are corporate bond prices distorted after intervention is over?

- Markets may price in future interventions in case of crash

Three pieces of evidence, post June 2020:

1. **Corporate bond tail risk (options) far less sensitive to equity market tail risk**
2. Corp bond returns less sensitive to changes in VIX
3. Spreads low relative to pseudo-spreads from equity options (Culp Nozawa Veronesi, 2018)

$\rightarrow$ *All point to belief of future intervention in a crash*

$\rightarrow$ *Explosion of issuance, specific to IG debt*
(Becker Benmelech 2021)

Long term effects: Tail risk sensitivity

$$Tail_t^{CorpBond} = \alpha + \alpha_{post} \times post + \beta \ Tail_t^{SP500} + \beta_{post} \ Tail_t^{SP500} \times post + \varepsilon_t$$

	(1) $Tail_t^{CorpBond}$	(2) $Tail_t^{CorpBond}$
$Tail_t^{SP500}$	0.59***	0.43***
	(0.05)	(0.02)
$Tail_t^{SP500} \times post$	-0.78***	-0.63***
	(0.07)	(0.05)
$Tail_t^{SP500} \times covid$		0.68***
		(0.15)
post	0.16***	0.14***
	(0.01)	(0.01)
covid		-0.12***
		(0.03)
Constant	-0.04***	-0.02***
	(0.01)	(0.00)
Observations	2,769	2,769
R-squared	0.25	0.29

Tail is slope of implied volatility 90-10 delta

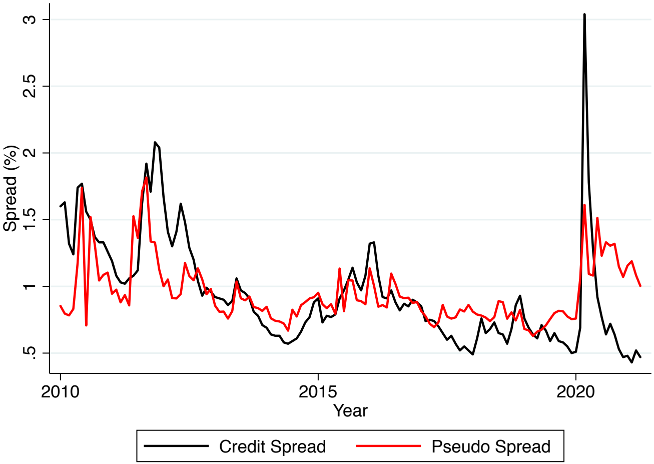
Long term effects: Corp bond returns on VIX

$$r_t^{CorpBond} = \alpha + \alpha_{post} \times post + \beta\ \Delta VIX_t + \beta_{post}\ \Delta VIX_t \times post + \varepsilon_t$$

	(1) $r_t^{CorpBond,e}$	(2) $r_t^{CorpBond,e}$
ΔVIX_t	-0.21***	-0.20***
	(0.02)	(0.02)
$\Delta VIX_t \times post$	0.10***	0.08***
	(0.03)	(0.03)
$\Delta VIX_t \times covid$		-0.05
		(0.04)
$post$	0.04	0.03
	(0.03)	(0.03)
$covid$		-0.12
		(0.34)
Constant	-0.01	-0.01
	(0.01)	(0.01)
Observations	2,987	2,987
R-squared	0.26	0.26

Note: Daily data from 2010-present

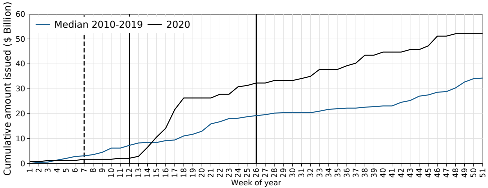
Long term effects: Spreads vs pseudo spreads



Correlation in changes near zero after interventions

Long term effects: Implications

- Results support belief of future purchase in crash, rather than "one-time" small purchase with state-dependent $\mathcal{M}$ to explain option price patterns
- Announcement of purchase if crash today likely far less "effective" (priced in)
- Investment grade debt issuance: Boyarchenko Kovner Shachar 2021



- IG boom but no HY boom (Becker Benmelech 2021)

Revisiting Announcement Effects

We look at government purchases across countries (US,UK,ECB) :

- We find consistent pattern where first interventions have much large multipliers than follow on interventions (close to zero)
- We show even follow on interventions done during acute periods of economic distress (US 2020 and UK 2009) have multipliers close to zero
- Weakening effect as predicted by our framework
- Variation in multiplier does not seem driven by variation in economic conditions
- Important insight: effects were weaker, because these expectations were formed in the first interventions $->$ large multipliers of first interventions overstate their effectiveness

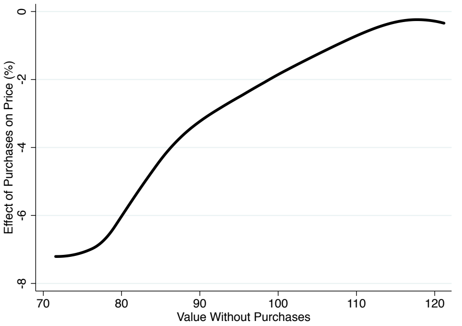
Conclusion

- **Measuring the state-contingent impact of policy announcements**
  - Easy-to-implement method using option prices
- **Important role for policy promises for bond purchases**
  - Much more price support in bad states
  - Big impact on announcement effect (50% comes just from extra left tail)
  - Long-term effects: lower crash risk priced in corp bonds
- Promises matter in many other policy announcements

APPENDIX

Comparison to High-Yield

- High-yield over same window falls, evidence against (broad) pricing kernel view



- Typically, HY and IG highly correlated w IG beta $<< 1$
- Further robustness: risk-adjust w specific pricing kernel assumptions

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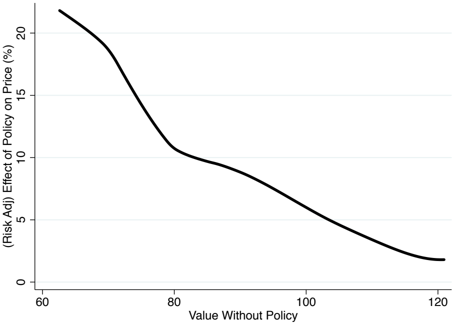
Robustness to changes in SDF

- Potential concern: changing the value of the asset in a given state could modify marginal utility in this state
  - Example: changing the risk of the asset between 0 and 1 modifies the price of risk between 0 and 1
- Test remains valid under the null: If the **true g is constant** our procedure generally recovers it correctly
  - Intuition: just a parallel shift in marginal utility, so no risk pricing effect
  - Formally: true for all SDF that can be written as $M = f(p_1/p_0, \epsilon)$, with ϵ containing exogenous sources of risks
  - Includes power utility, loss aversion, specialist or not, ...

Allowing an endogenous SDF

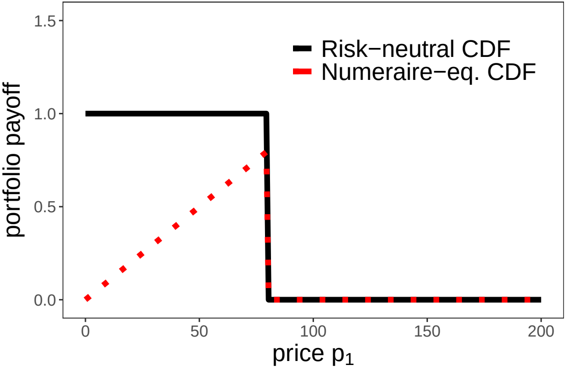
- Assume $M = \frac{\epsilon}{p_1/p_0}$
  - p_1/p_0 endogenous to intervention, ϵ arbitrary but invariant to announcement
  - If $\epsilon = 1$, specialized investor with log utility
- Price support adjusting for change in SDF



- Aggressive risk-adjustment: risk premium 16.5% annualized for IG bonds

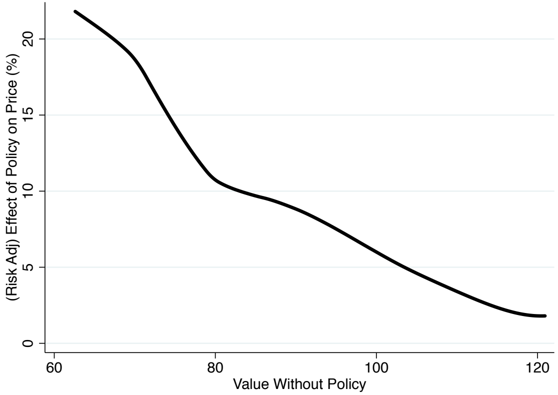
Risk Adjustment

- Risk adjust for "specialized" investor (entire portfolio in IG bonds) w log utility
- Compute CDF, need price of different portfolio of options: digital minus a put



Risk Adjustment

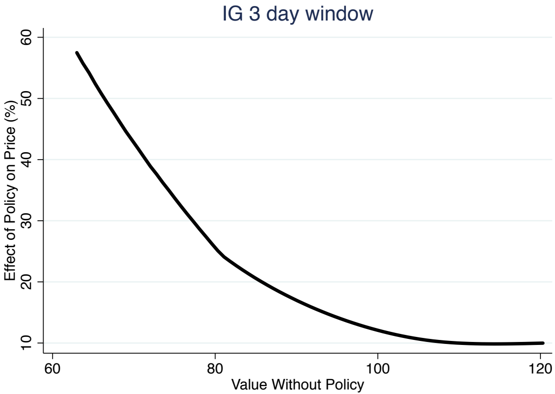
- Price support, adjusting for change in SDF



- Aggressive risk-adjustment: risk premium 16.5% annualized for IG bonds (about 20× unconditional estimate of 0.8% in Giesecke, Longstaff, Schaefer, Strebulaev (2011)) back

Longer 3-day Window

- Pro: more time to digest announcement
- Con: identification, potentially other shocks

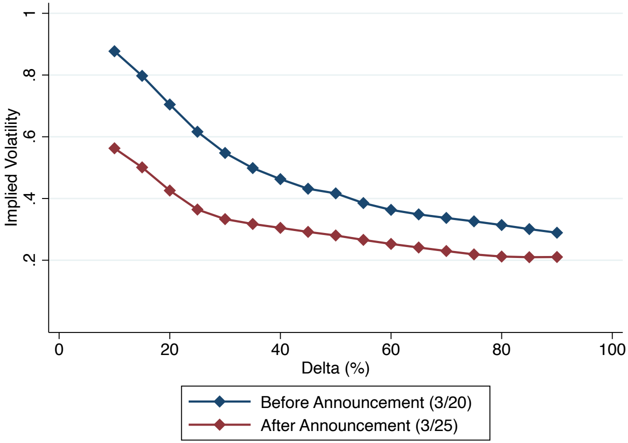


Corporate Bond ETFs

- Corp Bond ETFs $\approx$ \$500 billion assets.
- ETFs trade claims on basket of underlying bonds.
- Authorized Participants can convert ETF to bond basket (or issue ETF shares and deliver basket)
  - Mostly coincide with Primary Dealers

Investment Grade Bond Options

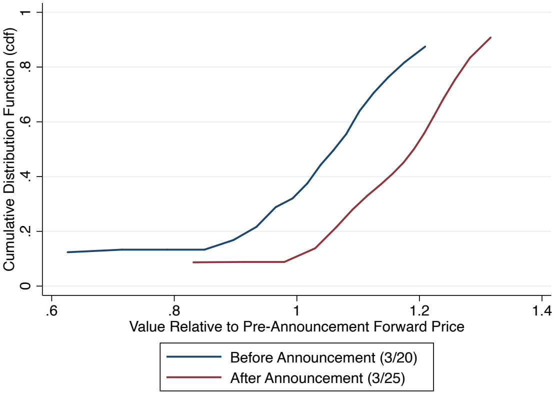
- Volatility curve for LQD options before and after announcement of SMCCF



$\rightarrow$ *disproportionate volatility drop in the left tail*

Bond Price Distributions Around Announcement

- Follow implementation of Malz (2014) to construct CDF
- Left tail of distribution lower post announcement, more price support, consistent with implied vol curve



In which states was the Fed expected to buy?

- Was Fed expected to buy in states of high credit risk? High dislocations? High interest rates?

$$basis = p_{corp} - \underbrace{(p_{tsry} - p_{cds})}_{synthetic}$$

- Construct distribution of synthetic using data on CDX and Treasury options and copula methods w conservative correlation

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CDF Pre-Post Announce

- Huge drop in left tail of bond-synthetic

Correlations

Correlation between CDX and Treasury returns

Correlation between Cash and Synthetic

Comparing Results to Statements

- "Markets are functioning pretty well, so our purchases will be at the bottom end of the range that we have written down" (Powell, June 2020)
  - Yes! 0.2% mkt cap would have been much higher if spreads widened

- "The announcement of the corporate bond facility without putting up one dollar of taxpayer money unlocked the entire primary and secondary market for corporate bonds" (Mnuchin, June 2020)
  - Selling a put option *does* put up taxpayer money in bad states, can't ignore just bc not in money ex-post

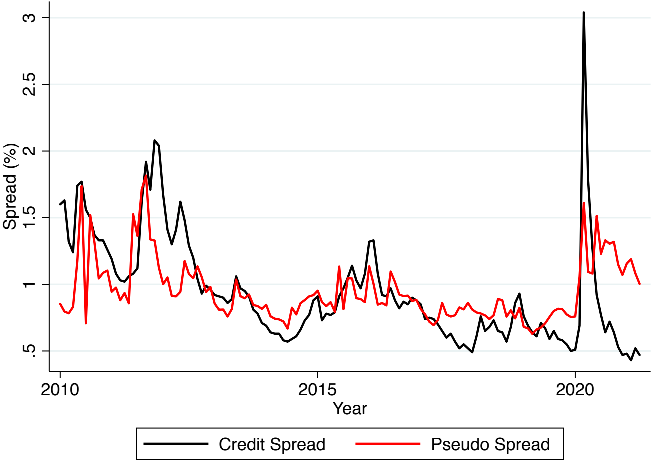
Long term effects: Corp bond returns on VIX

$$r_t^{CorpBond} = \alpha + \alpha_{post} \times post + \beta\ \Delta VIX_t + \beta_{post}\ \Delta VIX_t \times post + \varepsilon_t$$

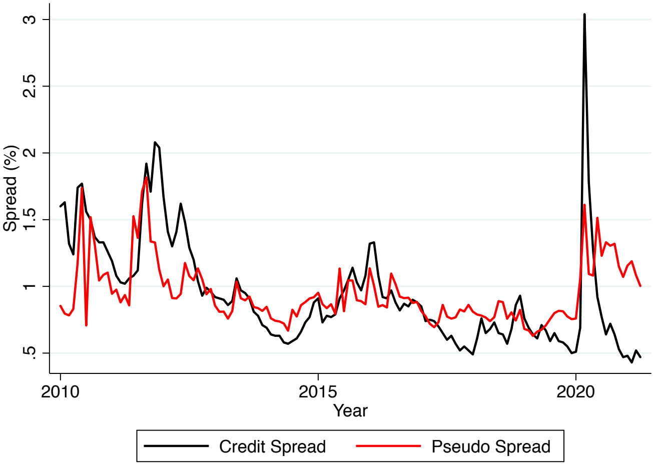
	(1) $r_t^{CorpBond,e}$	(2) $r_t^{CorpBond,e}$
ΔVIX_t	-0.21***	-0.20***
	(0.02)	(0.02)
$\Delta VIX_t \times post$	0.10***	0.08***
	(0.03)	(0.03)
$\Delta VIX_t \times covid$		-0.05
		(0.04)
$post$	0.04	0.03
	(0.03)	(0.03)
$covid$		-0.12
		(0.34)
Constant	-0.01	-0.01
	(0.01)	(0.01)
Observations	2,987	2,987
R-squared	0.26	0.26

Note: Daily data from 2010-present

Long term effects: Spreads vs pseudo spreads

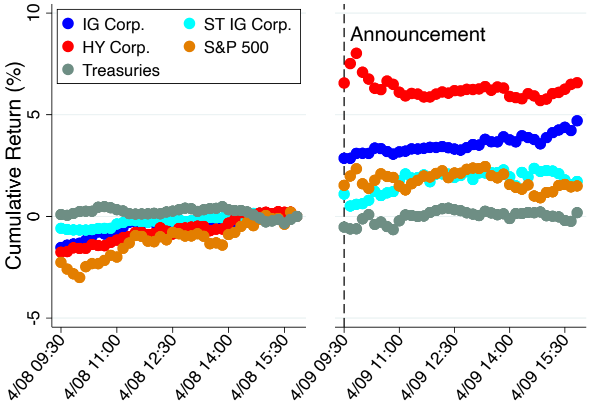


Long term effects: Spreads vs pseudo spreads

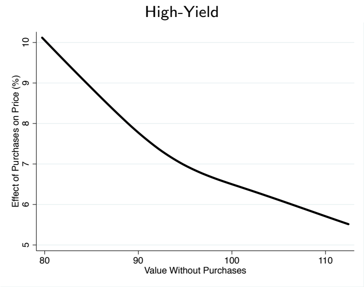


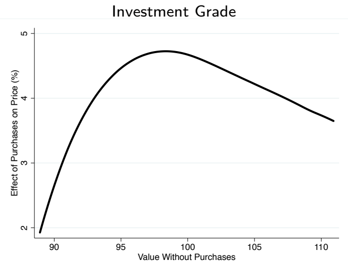
Correlation in changes near zero after interventions

April 9: Expand Scale and Scope of Purchases



April 9th, 2020: High-Yield Purchases

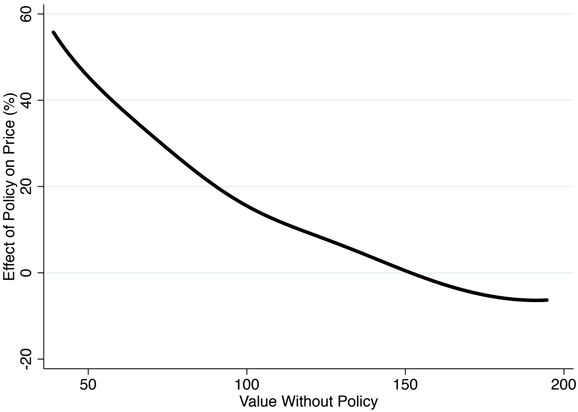




October 13th 2008: “Paulson Plan”

Announcement: equity injections to the banking sector + some guarantees on debt

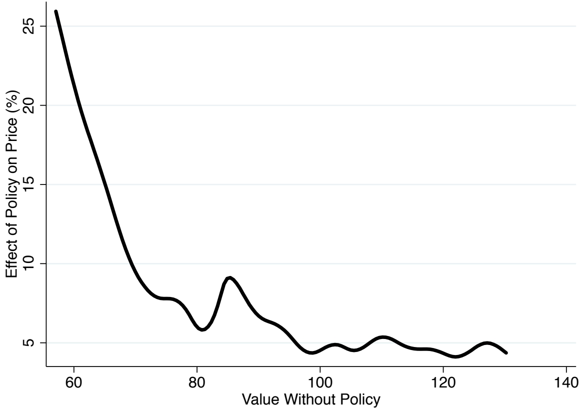
Financial sector ETF (XLF)



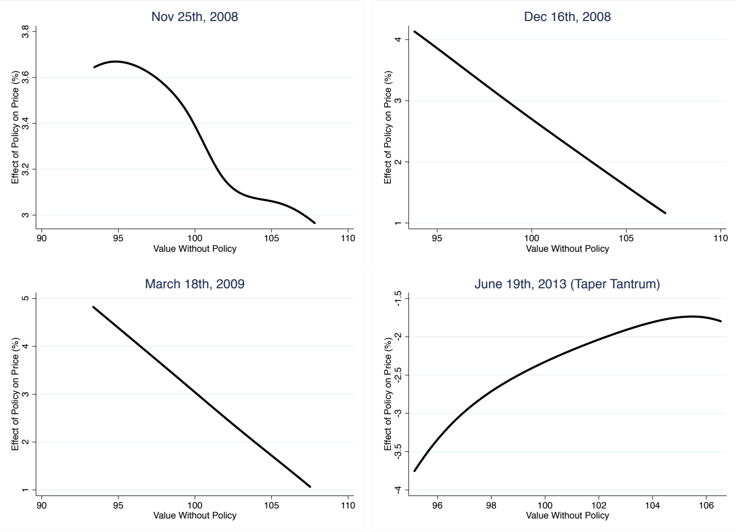
Bank of Japan Asset Purchases, April 2013

Kuroda speech: large purchases of government bonds and equities to drive up asset prices

Nikkei index

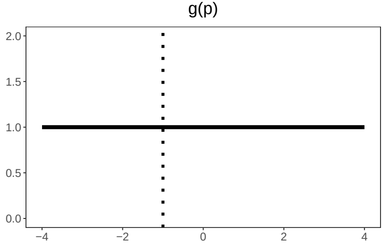


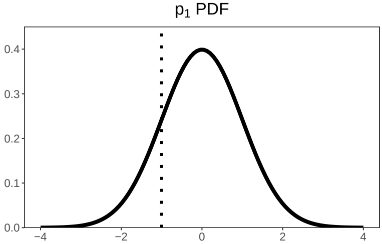
US Quantitative Easing: 10 year Treasury

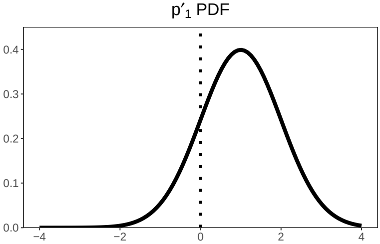


Example 1: Constant Policy

$$p' = p + \mathcal{M}Q$$

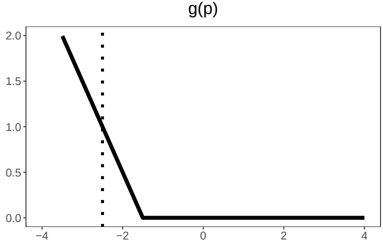


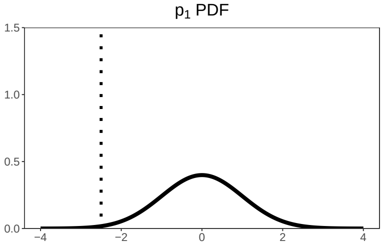


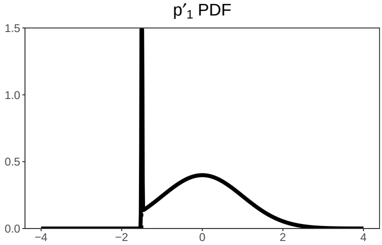


Example 2: Price Floor

$$p' = max(p, \underline{p})$$

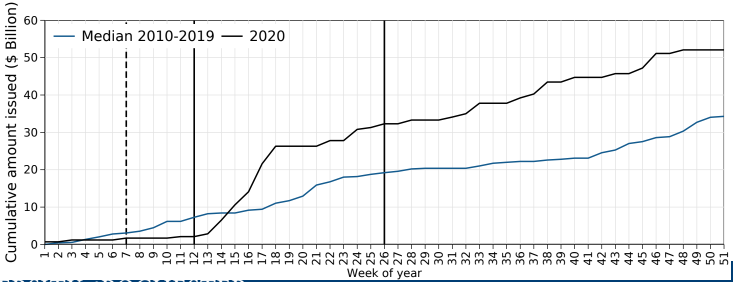






Long term effects: Implications

- Supports belief of future purchase in crash, not "one-time" small purchase with state-dependent $\mathcal{M}$ to explain option price patterns
- Announcement of purchase if crash today likely far less "effective" (priced in)
- Investment grade debt issuance: Boyarchenko Kovner Shachar 2021



- IG issuance boom but no HY issuance boom (Becker