LIABILITY STRUCTURE AND RISK-TAKING:
EVIDENCE FROM THE MONEY MARKET FUND INDUSTRY

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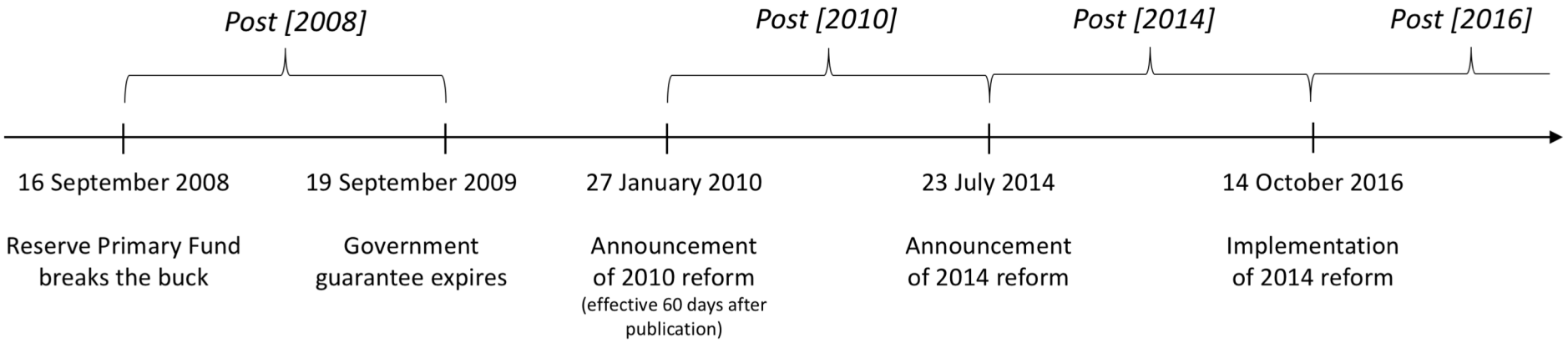
Money Market Funds

- Money market funds' (MMFs) are important financial intermediaries providing short-term funding to:
  - Corporates (prime MMF)
  - Financial institutions (prime MMF)
  - Treasuries (government MMF)
  - Government agencies (tax-exempt MMF)

- MMFs' liabilities have typically been regarded by investors as money-like securities
  - Profitable substitutes for deposits
  - Guaranteed net asset value (NAV) of 1$ for a 1$ investment

Changes in US MMFs' Regulation

- However, MMFs have turned out to be relatively risky
  - Due to its holdings of Lehman's commercial paper, the Reserve Primary Fund "broke the buck" in September 2008 quoting a NAV of 97 cents per 1$
  - This triggered a wide-scale run on US prime MMFs
  - US Treasury guaranteed MMFs' liabilities for a year
- Sweeping regulatory efforts to avoid future runs on MMFs in the US (changes to Rule 2a-7)



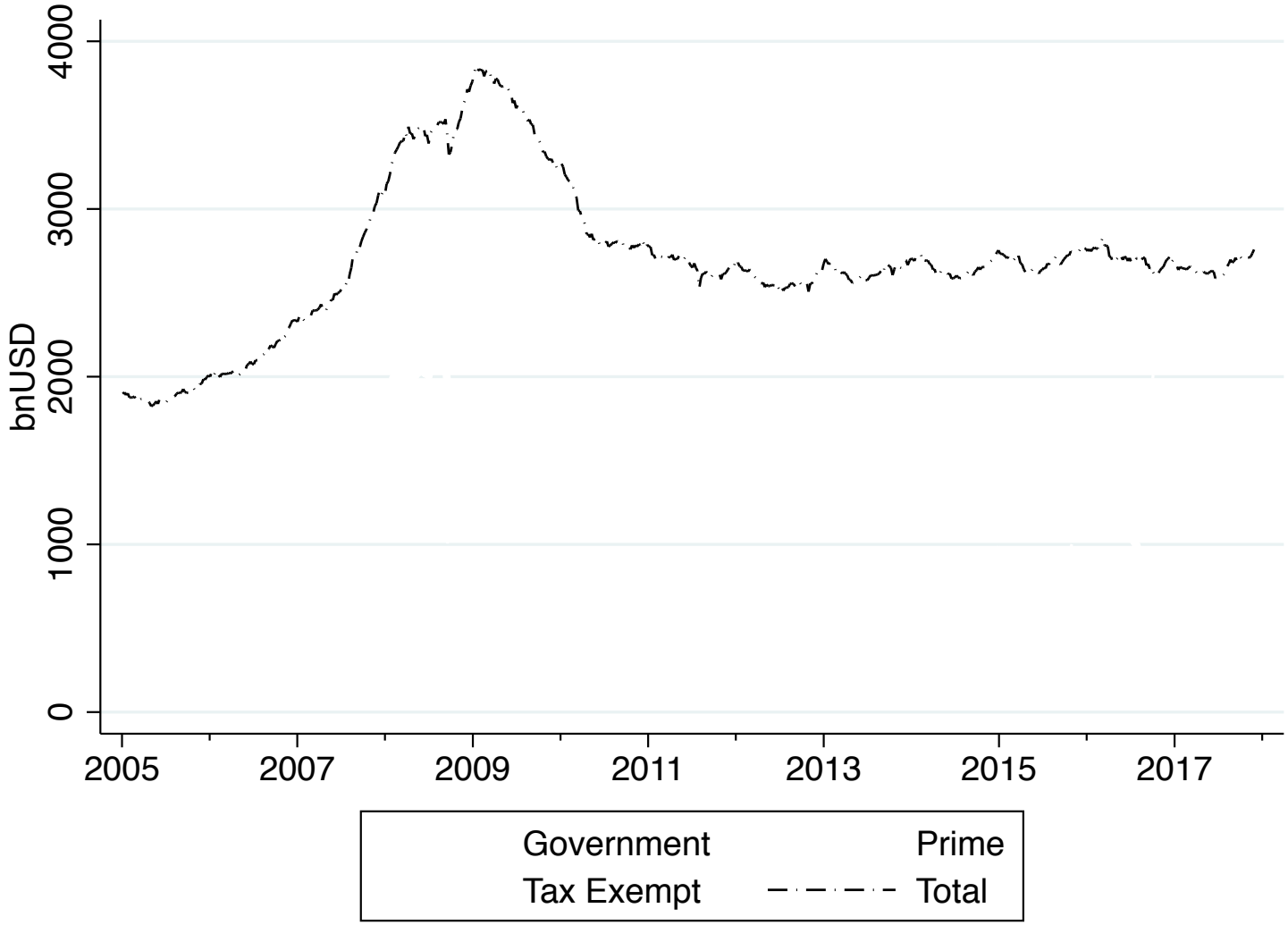
This Paper

- We focus on a specific change in regulation announced in July 2014 that became effective in October 2016

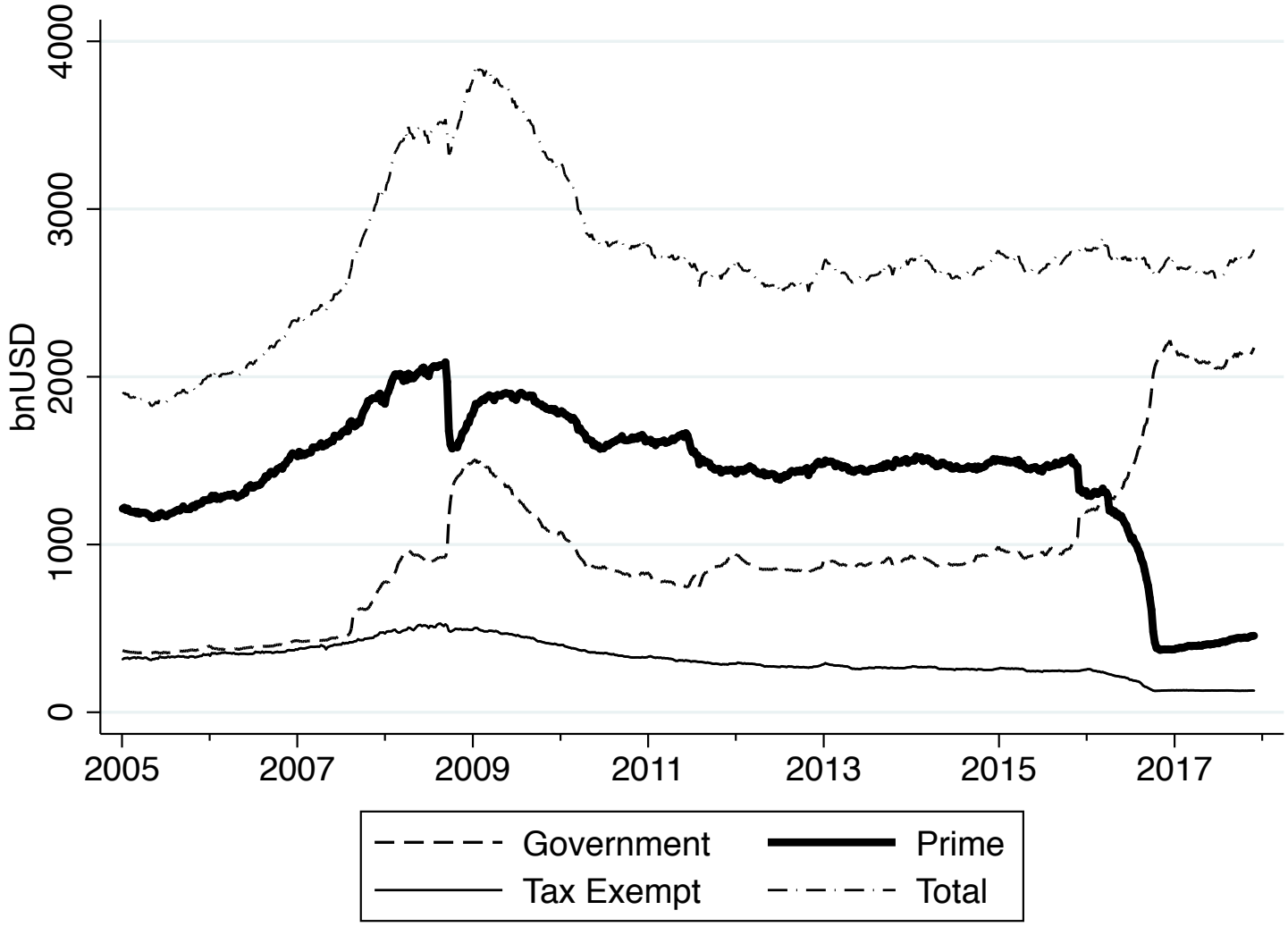
Change	Institutional			Retail		
	Government	Tax-Exempt	Prime	Government	Tax-Exempt	Prime
cNAV to vNAV		X	X			
Fees & Gates		X	X		X	X

- **Result: Overall decrease in the liquidity of MMFs' liabilities**

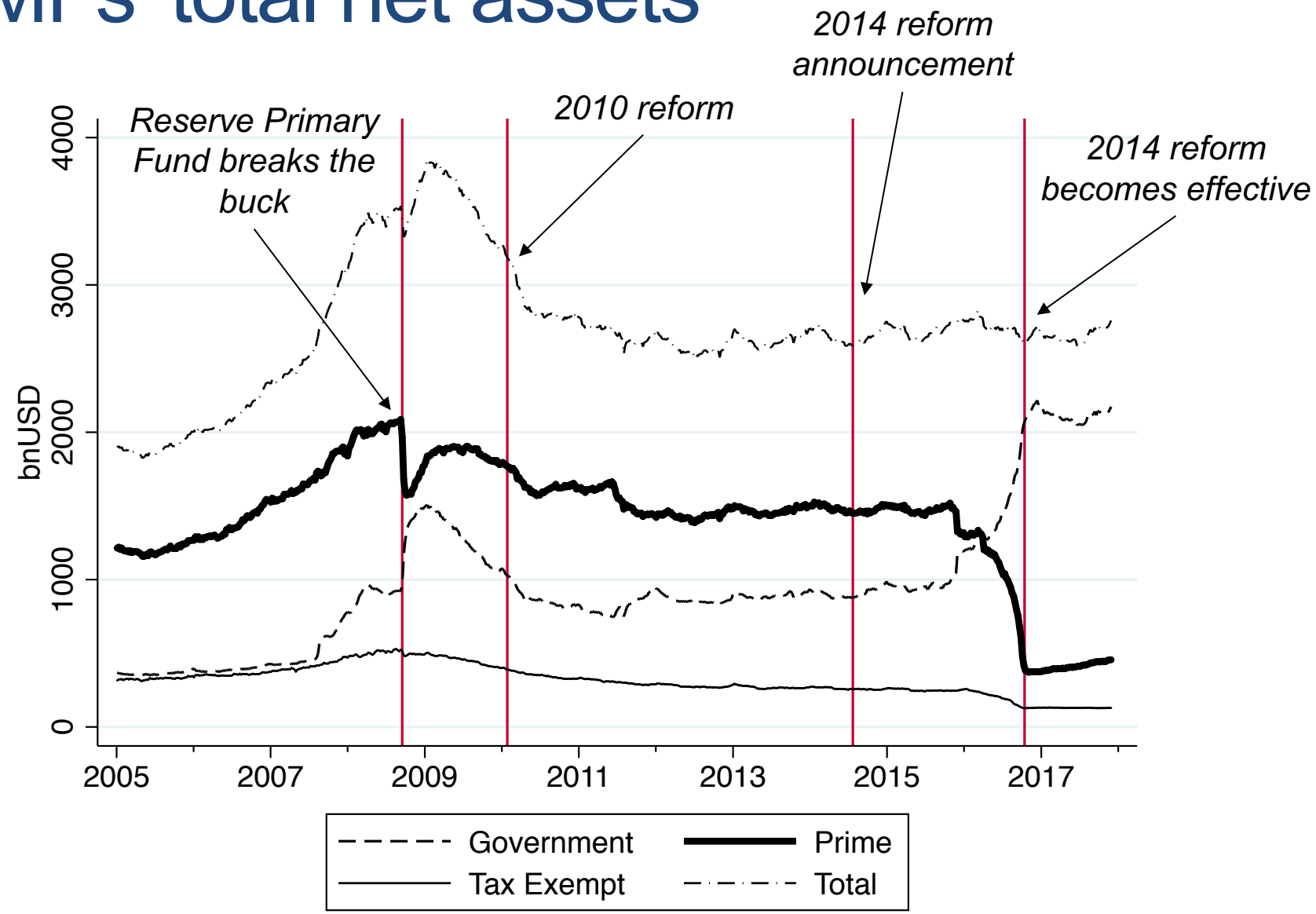
MMFs' total net assets



MMFs' total net assets



MMFs' total net assets



MMFs' assets

Note: Aggregation based on share class type

Research Questions

- **Can intermediaries still create liquidity in the absence of regulations that provide commitment?**
  - Existing theories highlight synergies between the assets and liabilities of financial intermediaries (Hanson, Shleifer, Stein, and Vishny, 2015)
  - Information-sensitive claims are less liquid (Gorton and Pennacchi, 1990; Dang, Gorton and Holmström 2015)

- **Have the changes in the regulation of MMFs' liabilities affected the nature of the services provided by MMFs?**
  - On the one hand, MMFs may have decreased the riskness of their claims to provide as safe assets as before
  - On the other hand, regulations may have strengthened investors incentives to monitor and MMFs' incentives to provide high yields
  - Is the private sector able to create liquidity in the absence of regulation? (Holmstrom and Tirole 2011)

- **Any spillovers effects for issuers and other intermediaries?**

What we do

- Have changes in regulation affected the money-likeness of MMFs' liabilities?
- Did investors start to monitor more?
- How has the structure of the money market industry changed?
- How has this affected MMFs' risk taking?

What we find

- Have changes in regulation affected the money-likeness of MMFs' liabilities?
  - MMFs appear to have become a poorer substitute for money-like claims such as Treasury bills
- Did investors start to monitor more?
  - The flow-performance sensitivity increased especially for institutional investors
- How has the structure of the money market industry changed?
  - Low-risk MMFs exited from the money market industry
- How has this affected MMFs' risk taking?
  - MMFs appear to take more risk after the reform thus decreasing the supply of funding to safe borrowers
  - Positive spillover effect on the safety of Euro MMFs

Related literature

- Kacperczyk and Schnabl (2013):
  - Funds' risk taking increases in 2008, but less for funds affiliated with financial conglomerates
- Di Maggio and Kacperczyk (2017), La Spada (2017):
  - Zero lower bound policies led money market funds to exit the industry and increased the risk taking of the remaining funds
- Schmidt, Timmermann, and Wermers (2016) & Gallagher, Schmidt, Timmerman, and Wermers (2016):
  - Institutional investors in MMFs are more responsive to information events (during 2008 and the Eurozone Crisis)

Data

- iMoneyNet
  - January 2005 to November 2017
  - Weekly/monthly share class level data of US MMFs
    - Variables include: net assets and various characteristics of the underlying portfolios , and more
    - 1108 unique share classes aggregated to 383 unique fund portfolios
  - Monthly issuer level data of MMF holdings
  - Weekly share class level data of Offshore MMFs

- Ultra-short bond fund quarterly assets: CRSP Mutual Funds
- Issuer default probabilities: NUS-RMI Credit Research Initiative
  - Matched manually to iMoneyNet holdings data based on issuer name
- Additional variables from FRED, ECB, Bloomberg

Money-likeness of MMFs liabilities

$$Ln(Total\ net\ assets)_t = \alpha + \beta \cdot (T\text{-}bill - OIS)_t + \varepsilon_t$$

- Outstanding MMFs' assets should increase when demand for money like securities is high
  - Similar test for ABCP by Sunderam (2015)

- (Inverse) proxy for the demand of money-like securities:
  - Treasury Bill Spread over the Overnight Indexed Swap (OIS) rate

Prime MMFs become less money-like

	(1)	(2)	(3)	(4)	(5)
	Ln(Total net assets)				
(T-bill – OIS)	-0.250***	-0.178***		-0.178***	-0.168***
	(0.056)	(0.032)		(0.032)	(0.041)
(T-bill – OIS) · Post		6.174***			
		(1.208)			
Post		0.153			
		(0.179)			
(T-bill – OIS) · Post [2014]				3.034***	3.024***
				(0.903)	(0.906)
(T-bill – OIS) · Post [2016]				0.274***	0.263**
				(0.105)	(0.109)
Post [2014]			-0.269***	0.083	0.067
			(0.047)	(0.076)	(0.081)
Post [2016]			-1.461***	-1.408***	-1.423***
			(0.021)	(0.033)	(0.043)
(T-bill – OIS) · Post [2008]					0.269***
					(0.061)
(T-bill – OIS) · Post [2010]					0.104
					(0.187)
Post [2008]					0.212***
					(0.033)
Post [2010]					-0.057*
					(0.034)
Constant	13.913***	14.095***	14.132***	14.095***	14.110***
	(0.040)	(0.015)	(0.014)	(0.015)	(0.030)
Observations	673	673	673	673	673

Ultra-short bond funds become more money-like, closer substitutes for prime MMFs

	(1)	(2)	(3)	(4)	(5)
	Ln(Total net assets)				
(T-bill – OIS)	0.532***	0.366*		0.366*	0.001
	(0.183)	(0.194)		(0.199)	(0.047)
(T-bill – OIS) · Post		-1.468***			
		(0.480)			
Post		0.500***			
		(0.154)			
(T-bill – OIS) · Post [2014]				-0.377	-0.012
				(0.225)	(0.153)
(T-bill – OIS) · Post [2016]				-1.065***	-0.700***
				(0.270)	(0.197)
Post [2014]			0.696***	0.592***	0.900***
			(0.128)	(0.155)	(0.067)
Post [2016]			0.933***	0.695***	1.003***
			(0.132)	(0.170)	(0.091)
(T-bill – OIS) · Post [2008]					-0.021
					(0.074)
(T-bill – OIS) · Post [2010]					2.200
					(2.342)
Post [2008]					-0.434***
					(0.063)
Post [2010]					0.711**
					(0.266)
Constant	10.550***	10.325***	10.223***	10.325***	10.017***
	(0.156)	(0.155)	(0.129)	(0.158)	(0.064)
Observations	51	51	51	51	51

Prime MMFs' Closures

$$Closure_{i,t} = \alpha + \beta \cdot Post_t + X_{i,t}{}'\gamma + \varepsilon_{i,t}$$

- The matrix *X* includes the following control variables:
  - *Institutional*, *Affiliated fund*, *Spread*, *Ln(Family size)*, *Ln(Fund size)*, *Expenses*, *Age*, *Fund flow*, *Fund flow volatility*
- We explore the impact of regulation using the following indicator variables:
  - *Post*, *Post [2008]*, *Post [2010]*, *Post [2014]*, and *Post [2016]*

Prime MMFs' Closures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:				Closure			
Post	0.005**		0.005**				
	(0.002)		(0.002)				
Post [2014]		0.006**		0.006**	0.005**	0.007**	0.007**
		(0.002)		(0.002)	(0.003)	(0.004)	(0.003)
Post [2016]		-0.001**		0.000	-0.001	0.000	-0.001
		(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Post [2014] · Institutional						-0.004	
						(0.002)	
Post [2016] · Institutional						-0.001	
						(0.002)	
Post [2014] · Affiliated fund							-0.003
							(0.003)
Post [2016] · Affiliated fund							0.002
							(0.002)
X	…	…	…	…	…	…	…
Constant	0.003***	0.003***	0.015***	0.014***	0.015***	0.014***	0.015***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	87,890	87,890	75,213	75,213	75,213	75,213	75,213
Adjusted R-squared	0.001	0.001	0.005	0.005	0.005	0.005	0.005

Less risky portfolio – more likely to close

Post [2014]	0.005**	0.004***	-0.008***	-0.017***	-0.016***	-0.021***
	(0.002)	(0.002)	(0.003)	(0.005)	(0.006)	(0.006)
Post [2016]	0.000	-0.001	0.000	-0.004	0.001	-0.002
	(0.001)	(0.001)	(0.002)	(0.006)	(0.007)	(0.007)
Spread	0.000				0.001**	0.000
	(0.000)				(0.000)	(0.000)
Post [2014] · Spread	-0.043**				-0.030*	-0.031*
	(0.018)				(0.018)	(0.018)
Post [2016] · Spread	0.009				0.011	0.010
	(0.008)				(0.008)	(0.009)
Holding risk		-0.010***			0.003	0.000
		(0.002)			(0.002)	(0.002)
Post [2014] · Holding risk		-0.043***			-0.016*	-0.013
		(0.015)			(0.008)	(0.008)
Post [2016] · Holding risk		-0.004			-0.011	-0.008
		(0.009)			(0.009)	(0.009)
Safe holdings			0.015***		0.012***	0.001
			(0.003)		(0.003)	(0.004)
Post [2014] · Safe holdings			0.059***		0.036**	0.048***
			(0.020)		(0.015)	(0.015)
Post [2016] · Safe holdings			0.003		-0.006	0.004
			(0.012)		(0.013)	(0.013)
Maturing in 7 days				0.022***	0.018***	0.015***
				(0.004)	(0.003)	(0.004)
Post [2014] · Maturing in 7 days				0.049***	0.007	0.011
				(0.014)	(0.013)	(0.013)
Post [2016] · Maturing in 7 days				0.001	-0.008	-0.005
				(0.013)	(0.011)	(0.011)
X	...	...	...	...	...	...
Observations	75,213	75,213	75,213	74,272	74,272	74,272
Adjusted R-squared	0.006	0.016	0.017	0.012	0.020	0.022

Flow-performance sensitivity (FPS)

$$Fund\ flow_{i,t} = \alpha + \beta \cdot Post_t \cdot Return_{i,t-1} + X_{i,t-1}{}'\gamma + \varepsilon_{i,t}$$

- The matrix *X* includes the following control variables:
  - *Ln(Fund size)*, *Ln(Family size)*, *Expenses*, *Age*, *Fund flow*, *Fund flow volatility*, *Institutional*
  - *sponsor and week fixed effects*
- We explore the impact of regulation using the following indicator variables:
  - *Post*, *Post [2008]*, *Post [2010]*, *Post [2014]*, and *Post [2016]*
- We use 2 measures of performance (*Return*)
  - *Spread (net) and FRANK (fractional ranking)*

The Reform and the FPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Return measure:	Spread	Spread	Spread	Spread	FRANK	FRANK	FRANK	FRANK	FRANK	FRANK
Dependent variable:						Fund flow				
$Return_{t-1}$	0.007***	0.007***	0.012***	0.012***	0.006***	0.006***	0.007***	0.007***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Post \cdot Return_{t-1}$	0.011***		0.011***		0.005***		0.006***			
	(0.004)		(0.004)		(0.002)		(0.002)			
$Post\ [2014] \cdot Return_{t-1}$		0.002		-0.001		0.005**		0.006***	0.005**	0.007***
		(0.007)		(0.007)		(0.002)		(0.002)	(0.002)	(0.002)
$Post\ [2016] \cdot Return_{t-1}$		0.016***		0.019***		0.007*		0.007*	0.007*	0.008**
		(0.004)		(0.004)		(0.004)		(0.004)	(0.004)	(0.004)
$Post\ [2008] \cdot Return_{t-1}$									0.004*	0.006**
									(0.002)	(0.003)
$Post\ [2010] \cdot Return_{t-1}$									-0.001	0.001
									(0.001)	(0.001)
X	...	...	...	...	...	...	...	...	...	...
Sponsor and week F.E.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	132,749	132,749	128,152	128,152	132,749	132,749	128,152	128,152	132,749	128,152
Adjusted R-squared	0.029	0.029	0.041	0.041	0.029	0.029	0.041	0.041	0.029	0.041

FPS by fund type

Share classes included in sample:	all	retail	institutional	all	all
Dependent variable:			Fund flow		
FRANK		0.003***	0.010***	0.003***	0.005***
		(0.001)	(0.001)	(0.001)	(0.001)
Post · FRANK		0.001	0.007***	0.004**	0.006***
		(0.001)	(0.002)	(0.002)	(0.002)
FRANK1	0.009***				
	(0.003)				
FRANK2	0.005***				
	(0.002)				
FRANK3	0.007***				
	(0.002)				
Post · FRANK1	-0.005				
	(0.006)				
Post · FRANK2	0.010**				
	(0.005)				
Post · FRANK3	0.009*				
	(0.005)				
Institutional $_{t-1}$	0.001**	-0.047**	-0.092***	-0.002***	0.001**
	(0.000)	(0.021)	(0.029)	(0.001)	(0.000)
Post · Institutional $_{t-1}$				-0.005***	
				(0.002)	
FRANK ·Institutional $_{t-1}$				0.006***	
				(0.001)	
Post · FRANK · Institutional $_{t-1}$				0.005**	
				(0.002)	
X	...	...	...	...	...
Sponsor and week F.E.	yes	yes	yes	yes	yes
Observations	128,152	57,231	70,920	128,152	128,152
Adjusted R-squared	0.041	0.046	0.06	0.042	0.041

MMF risk taking

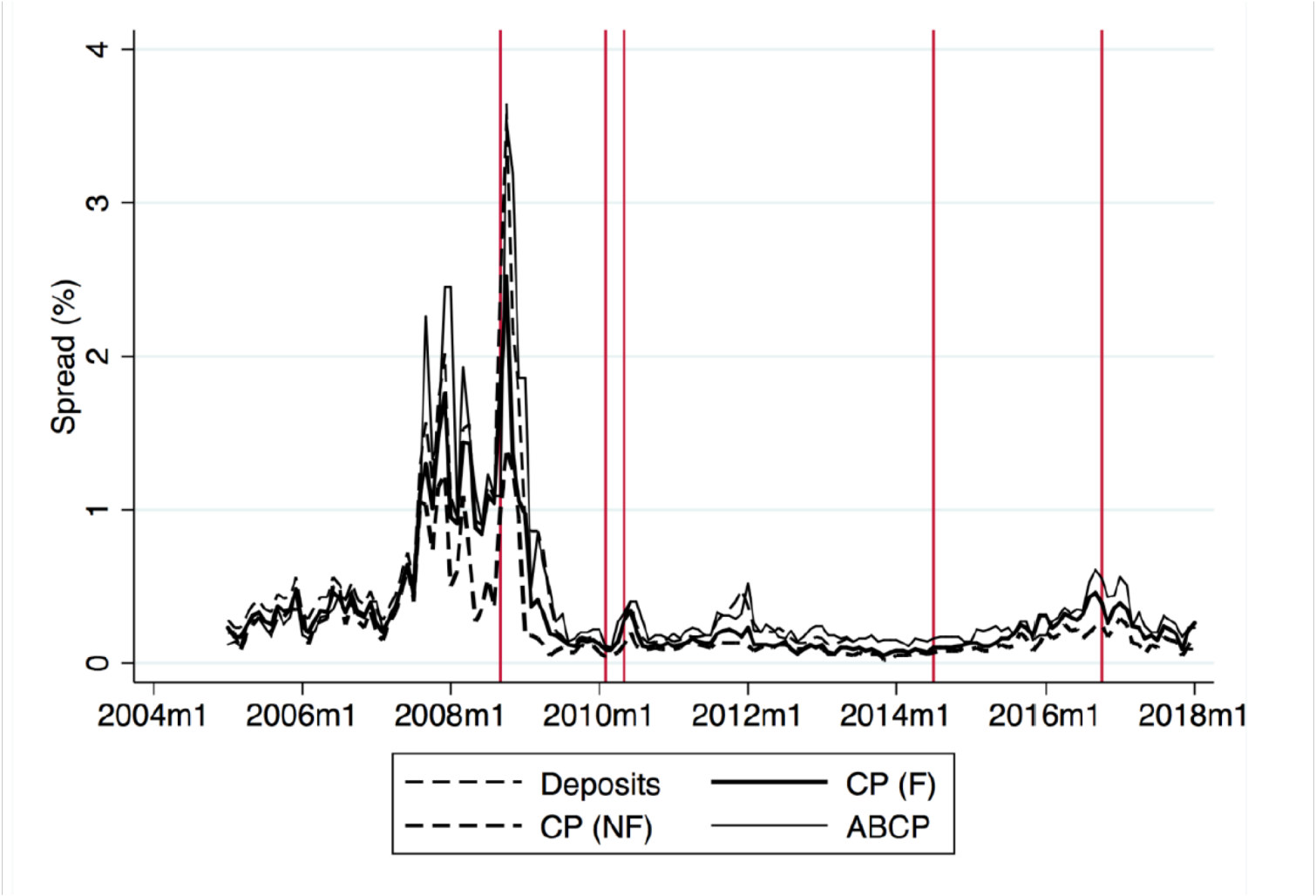
$$Fund\ risk_{i,t} = \alpha + \beta \cdot Post[2014]_t + \gamma \cdot Post[2016]_t + X_{i,t-1}{}'\delta + \varepsilon_{i,t}$$

- The matrix *X* includes the following control variables:
  - *Institutional*, *Affiliated fund*, *Spread*, *Ln(Family size)*, *Ln(Fund size)*, *Expenses*, *Age*, *Fund flow*, *Fund flow volatility*
  - *sponsor and week fixed effects*
- We explore the impact of regulation using the following indicator variables:
  - *Post*, *Post [2008]*, *Post [2010]*, *Post [2014]*, and *Post [2016]*
- We use the following measures of fund risk:
  - *Spread*, *Safe holdings*, *Holding risk*, and *Maturing in 7 days*

MMF risk taking

	(1)	(2)	(3)	(4)	(5)	(6)
Sample period:	2005-2017		2011-2017		2005-2017	
Dependent variable:	Spread					
Post [2014]	0.007	0.005	0.007	0.005	0.006	0.006
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Post [2016]	0.075***	0.046***	0.082***	0.063***	0.050***	0.044**
	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.018)
Sponsor and year F.E.	yes		yes		yes	
Fund and year F.E.		yes		yes		yes
Observations	133,132	133,128	54,988	54,988	37,644	37,644
Adjusted R-squared	0.544	0.608	0.177	0.451	0.594	0.621

Spread by money market instrument



MMF risk taking

	(1) Spread	(2) Safe holdings	(3) Holding risk	(4) Maturing in 7 days
Post [2014]	0.005	-0.010***	0.015***	0.000
	(0.005)	(0.003)	(0.005)	(0.002)
Post [2016]	0.081***	-0.097***	0.071***	0.036**
	(0.018)	(0.008)	(0.013)	(0.015)
Ln(Family Size) $_{t-1}$	0.014***	-0.010***	0.019***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Ln(Fund size) $_{t-1}$	0.013***	-0.019***	0.035***	-0.014***
	(0.001)	(0.000)	(0.001)	(0.000)
Expenses $_{t-1}$	-0.813***	-0.039***	0.072***	-0.066***
	(0.021)	(0.003)	(0.006)	(0.003)
Age $_{t-1}$	-0.000***	0.001***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Fund flow $_{t-1}$	0.065	0.018	-0.033*	-0.018
	(0.051)	(0.012)	(0.018)	(0.017)
Fund flow volatility $_{t-1}$	0.206***	0.548***	-0.660***	0.556***
	(0.051)	(0.017)	(0.022)	(0.015)
Institutional $_{t-1}$	0.007***	0.007***	-0.008***	0.020***
	(0.002)	(0.001)	(0.001)	(0.001)
Affiliated fund $_{t-1}$	-0.034***	0.032***	-0.058***	0.020***
	(0.002)	(0.002)	(0.003)	(0.002)
Sponsor and year F.E.	yes	yes	yes	yes
Observations	128,152	128,152	128,152	126,197
Adjusted R-squared	0.618	0.534	0.52	0.527

Heterogeneity in MMF risk taking after

	(1) Spread	(2) Safe holdings	(3) Holding risk	(4) Maturing in 7 days	(5) Spread	(6) Safe holdings	(7) Holding risk	(8) Maturing in 7 days
Post [2014] · Institutional $_{t-1}$	-0.017***	-0.035***	0.030***	0.003	-0.008***	-0.034***	0.029***	0.003
	(0.003)	(0.003)	(0.005)	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)
Post [2016] · Institutional $_{t-1}$	0.030***	-0.056***	0.049***	-0.022***	0.028***	-0.057***	0.051***	-0.022***
	(0.006)	(0.005)	(0.007)	(0.006)	(0.005)	(0.005)	(0.007)	(0.006)
Post [2014]	0.015***	0.010***	-0.003	-0.001				
	(0.005)	(0.003)	(0.005)	(0.003)				
Post [2016]	0.068***	-0.071***	0.048***	0.046***				
	(0.018)	(0.008)	(0.013)	(0.015)				
X	...	...	...	...	...	...	...	...
Sponsor and year F.E.	yes	yes	yes	yes				
Sponsor and week F.E.					yes	yes	yes	yes
Observations	128,152	128,152	128,152	126,197	128,152	128,152	128,152	126,197
Adjusted R-squared	0.618	0.535	0.521	0.527	0.932	0.541	0.527	0.543

The Effects on Corporate Issuers

$$Y_{i,t} = \alpha \cdot Post[2014]_t \cdot PD_{i,t} + \beta \cdot Post[2016]_t \cdot PD_{i,t} + \Psi_{i,t} + \varepsilon_{i,t}$$

- We look at the following dependent variables:
  - *Ln(Value), Issuer exit,* and *Issuer entry*
- The matrix Ψ denotes issuer and month fixed effects
- *PD* denotes the issuer's 1-month default probability

The Effects on Corporate Issuers

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(value)		Issuer exit		Issuer entry	
PD · Post	4.694***		-0.189***		0.096	
	(1.385)		(0.063)		(0.063)	
PD · Post [2014]		4.548***		-0.171***		0.097
		(1.350)		(0.055)		(0.062)
PD · Post [2016]		9.769**		-0.821***		0.049
		(4.239)		(0.262)		(0.120)
PD	2.533***	2.613***	0.032	0.022	-0.109***	-0.110***
	(0.832)	(0.832)	(0.037)	(0.036)	(0.028)	(0.028)
Issuer and month F.E.	yes	yes	yes	yes	yes	yes
Observations	22,343	22,343	22,343	22,343	22,343	22,343
Adjusted R-squared	0.890	0.890	0.223	0.223	0.213	0.213

Riskier corporate issuers receive relatively more funding on the intensive and extensive margins from US MMFs after the reform

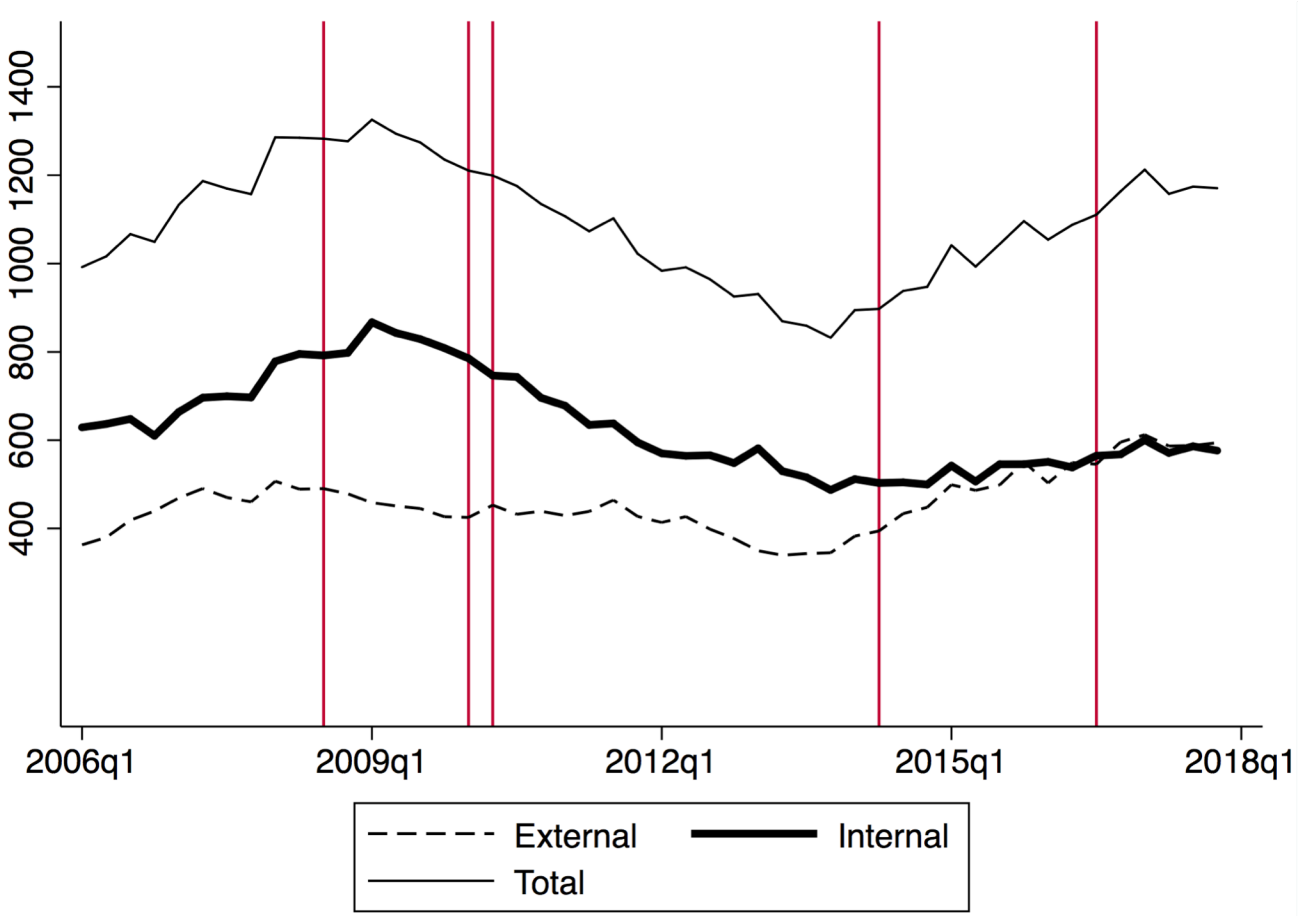
Why riskier firms receive relatively more funding?

Within issuer variation points to a supply effect

	Ln(Value)		Issuer exit		Issuer entry	
Inst. funding · Post · PD	10.899***		-0.135***		0.005	
	(3.703)		(0.037)		(0.031)	
Inst. funding · Post	-0.513***		0.009***		-0.001	
	(0.080)		(0.002)		(0.002)	
Inst. funding · Post [2014] · PD		7.879**		-0.167***		0.003
		(3.194)		(0.046)		(0.032)
Inst. funding · Post [2016] · PD		25.252***		0.037		0.007
		(9.097)		(0.081)		(0.044)
Inst. funding · Post [2014]		-0.132*		0.012***		-0.001
		(0.074)		(0.002)		(0.002)
Inst. funding · Post [2016]		-1.806***		-0.004		-0.002
		(0.146)		(0.004)		(0.002)
Inst. funding · PD	1.186*	1.186*	-0.010**	-0.010**	-0.042	-0.042
	(0.606)	(0.606)	(0.004)	(0.004)	(0.026)	(0.026)
Inst. funding	0.855***	0.855***	0.003***	0.003***	0.004***	0.004***
	(0.087)	(0.087)	(0.001)	(0.001)	(0.001)	(0.001)
Issuer – month F.E.	yes	yes	yes	yes	yes	yes
Observations	44,686	44,686	44,686	44,686	44,686	44,686
Adjusted R-squared	0.728	0.741	0.297	0.298	0.407	0.407

International Spillover Effects of the Reform

- Euro Area MMFs are at least partially substituting US MMFs in the provision of funding to safe borrowers



Euro-area MMFs become safer

	(1)	(2)	(3)	(4)	(5)	(6)
Sample period:	2005-2017		2011-2017		2005-2017	
Dependent variable:	Spread					
Post [2014]	0.000	-0.010**	-0.001	-0.003	-0.004	-0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Post [2016]	-0.080***	-0.085***	-0.080***	-0.080***	-0.083***	-0.083***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Sponsor and year F.E.	yes		yes		yes	
Fund and year F.E.		yes		yes		yes
Observations	61,653	61,652	27,986	27,986	36,868	36,868
Adjusted R-squared	0.546	0.632	0.372	0.516	0.55	0.624

Conclusions

- Following a regulatory change, which made MMFs' liabilities more information-sensitive, less risky MMFs exited the industry.

- The remaining MMFs experienced an increase in the sensitivity of their flows to performance and increased the riskiness of their portfolios.

- Commitment and pledgeability problems hamper private sector's ability to create liquidity in absence of regulation as argued in Holmström and Tirole (2011).