BANK OF ENGLAND

System-wide stress simulation

2019 EBA Policy Research Workshop

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Views expressed are those of the authors and do not necessarily reflect those of the Bank of England or its policy committees.

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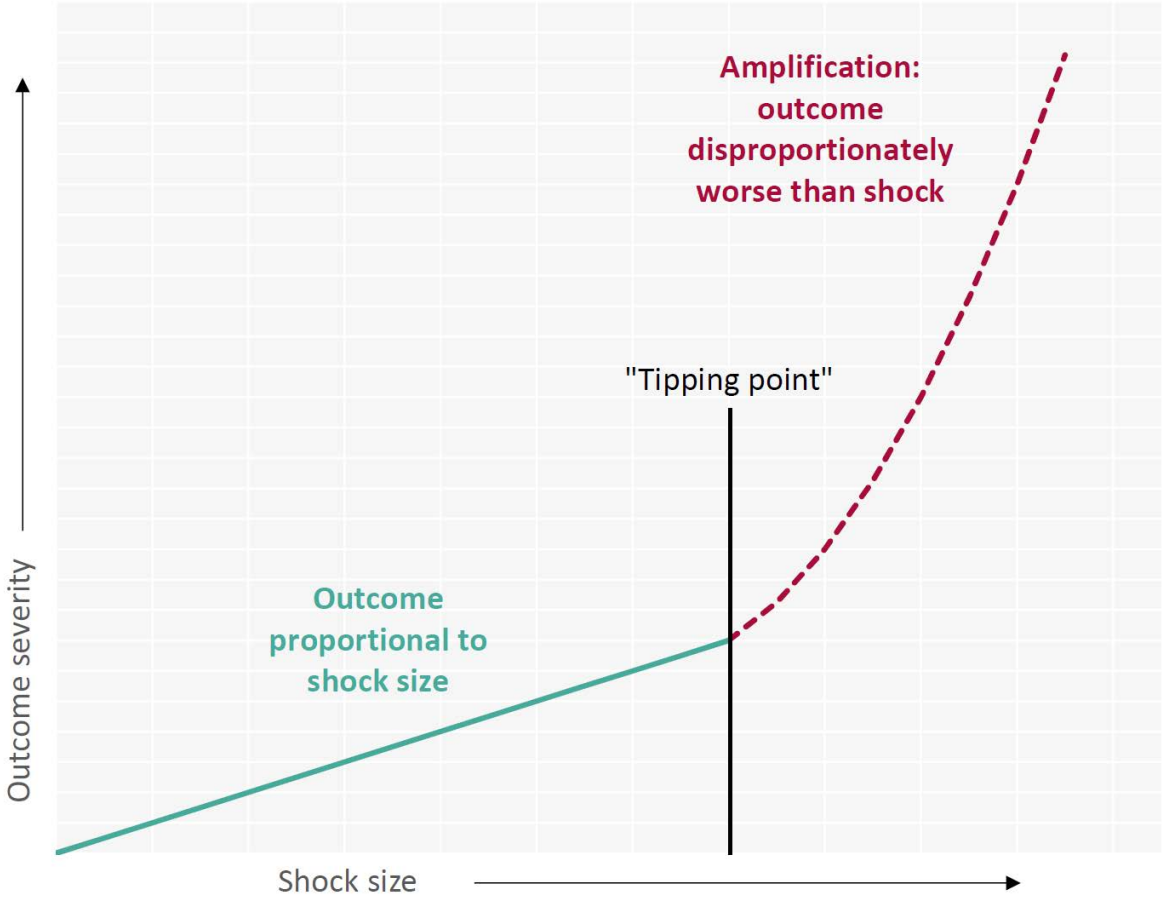
Motivation

- Non-bank, ‘market-based’, finance has grown rapidly, changing the structure of the financial system
- It’s not yet clear how this new structure will affect the system’s response to stress
- And historical data only tell us how stress played out in the past

➢ Develop models to try to understand how stress could propagate across the whole financial system

Goals of system-wide analysis



- Account for changes in financial system **structure**
- Incorporate banks and **non-banks**
- **Simulate** stress events before they occur
- Consider **feedback and amplification** from interaction between sectors
- Look for **tipping points** and non-linear responses
- Test regulations and other changes in **constraints**

Our model

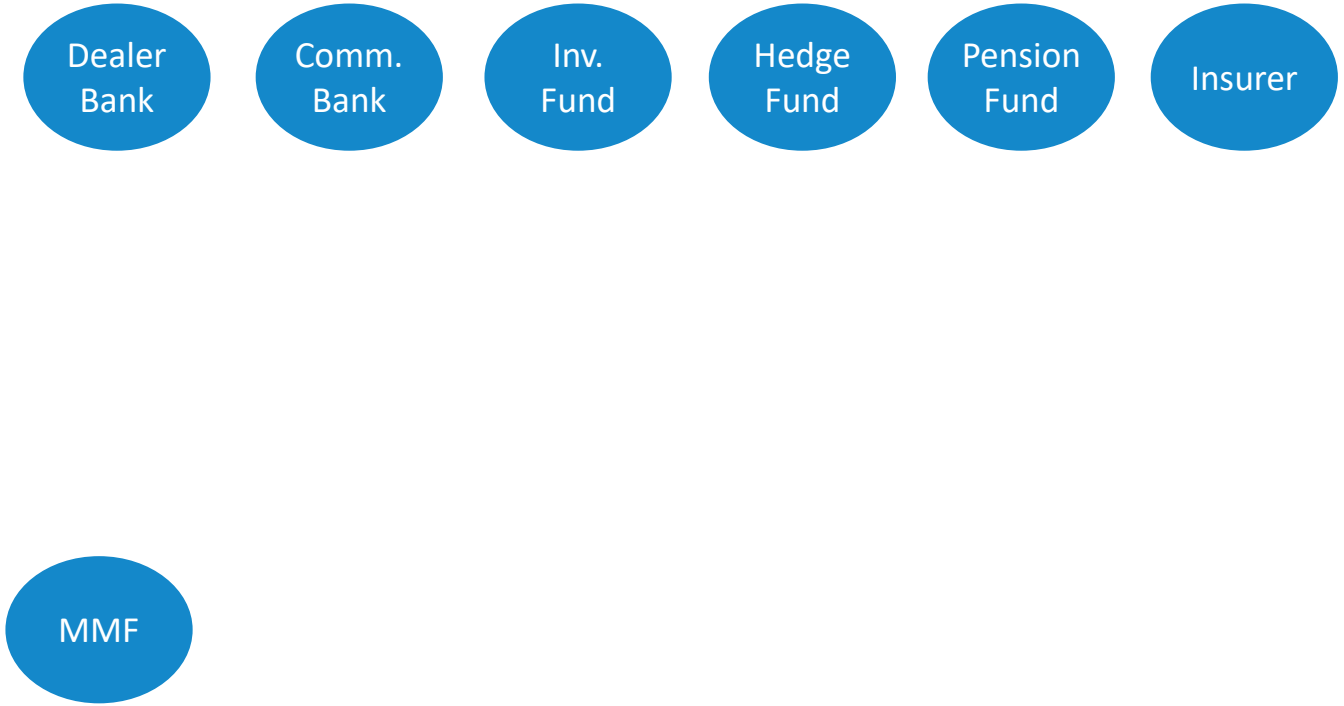
Equilibrium pricing**, representative agent model of **short term stress** in the **UK financial system

- *Equilibrium prices* of traded assets and quantities of funding are determined within the model
- *Key financial sectors* are aggregated and represented as different agents

- Model is designed to simulate *short term market stress* events
- We focus on *UK financial assets and sectors*

Model structure

Model structure



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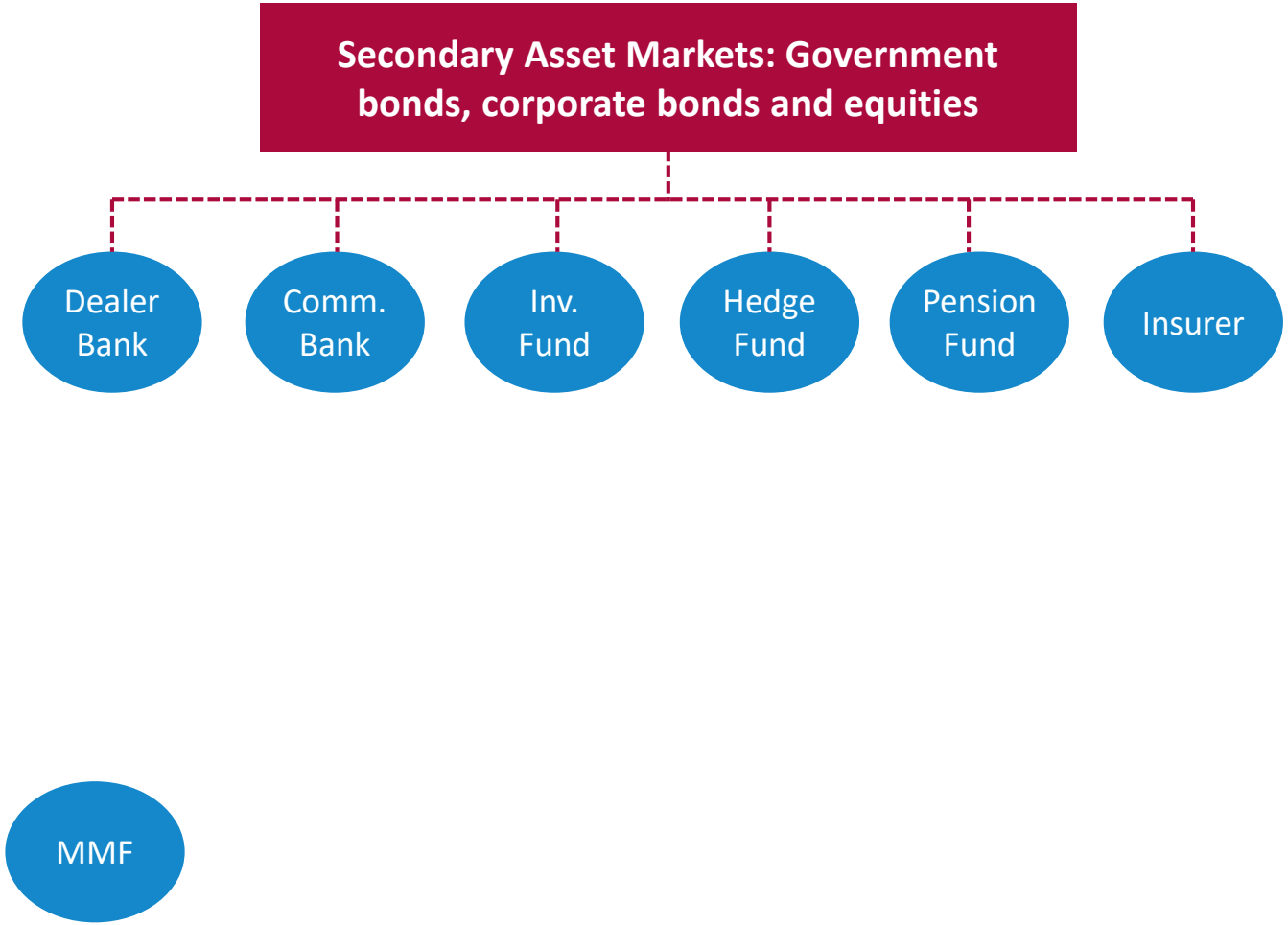

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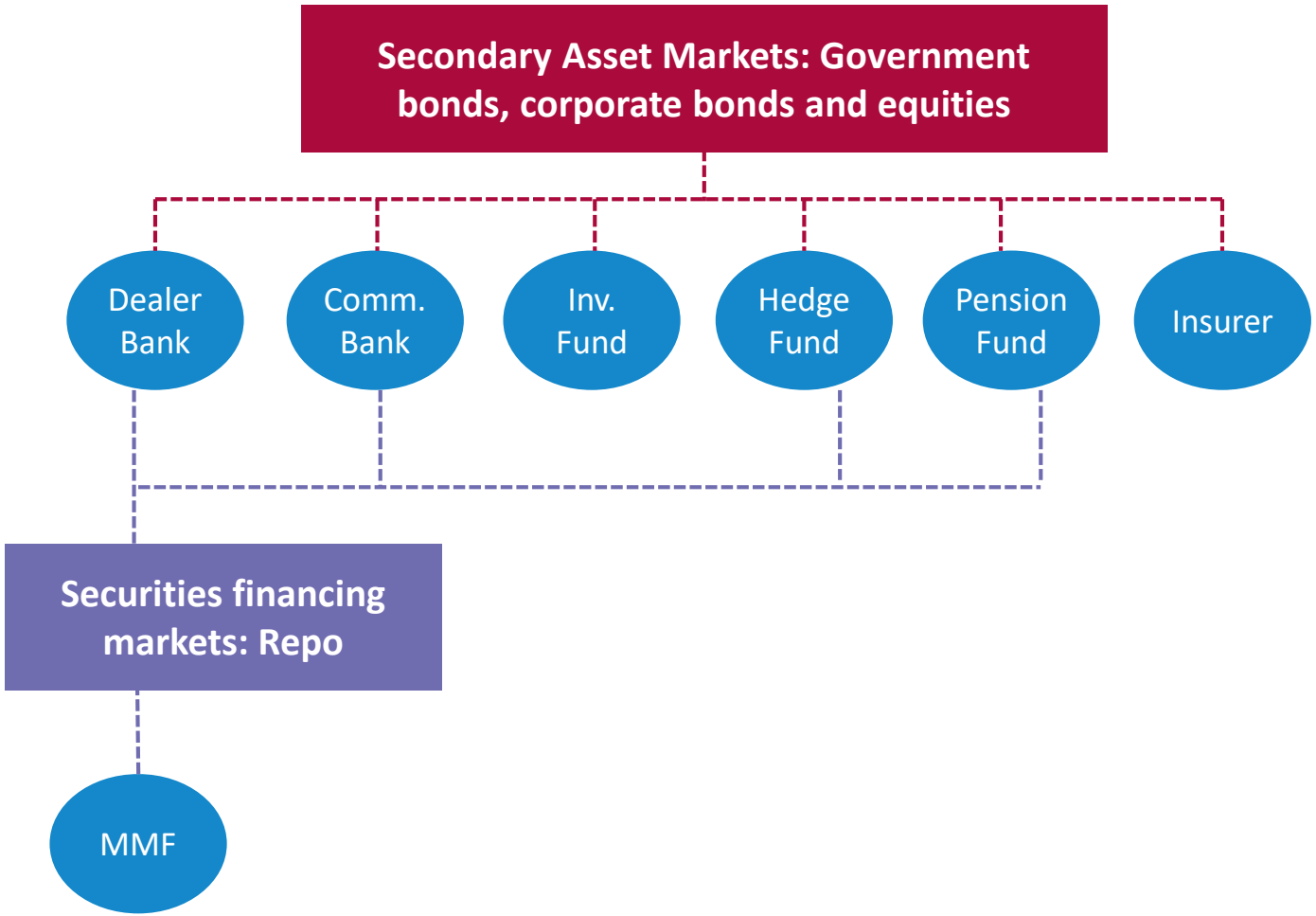

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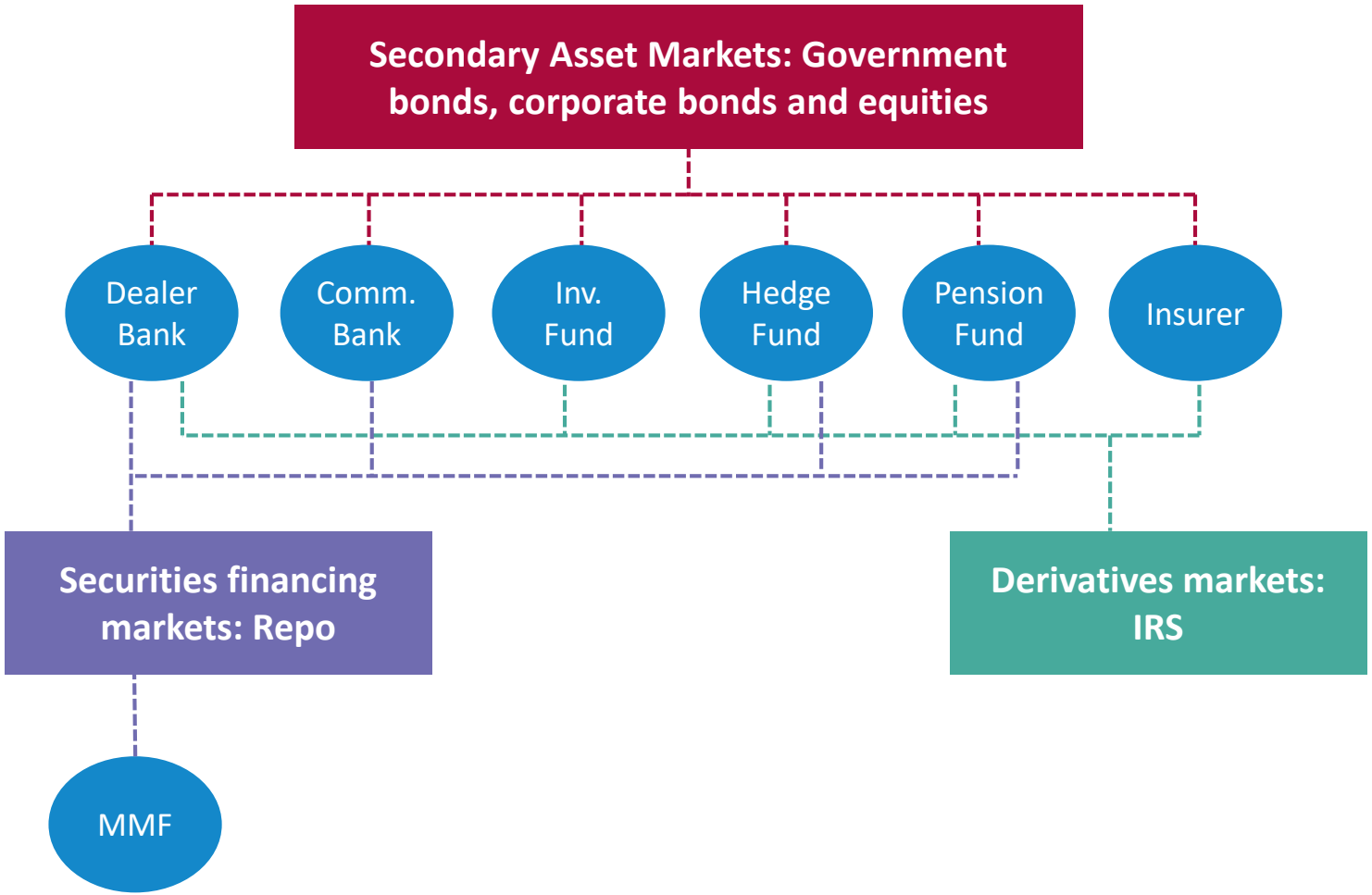

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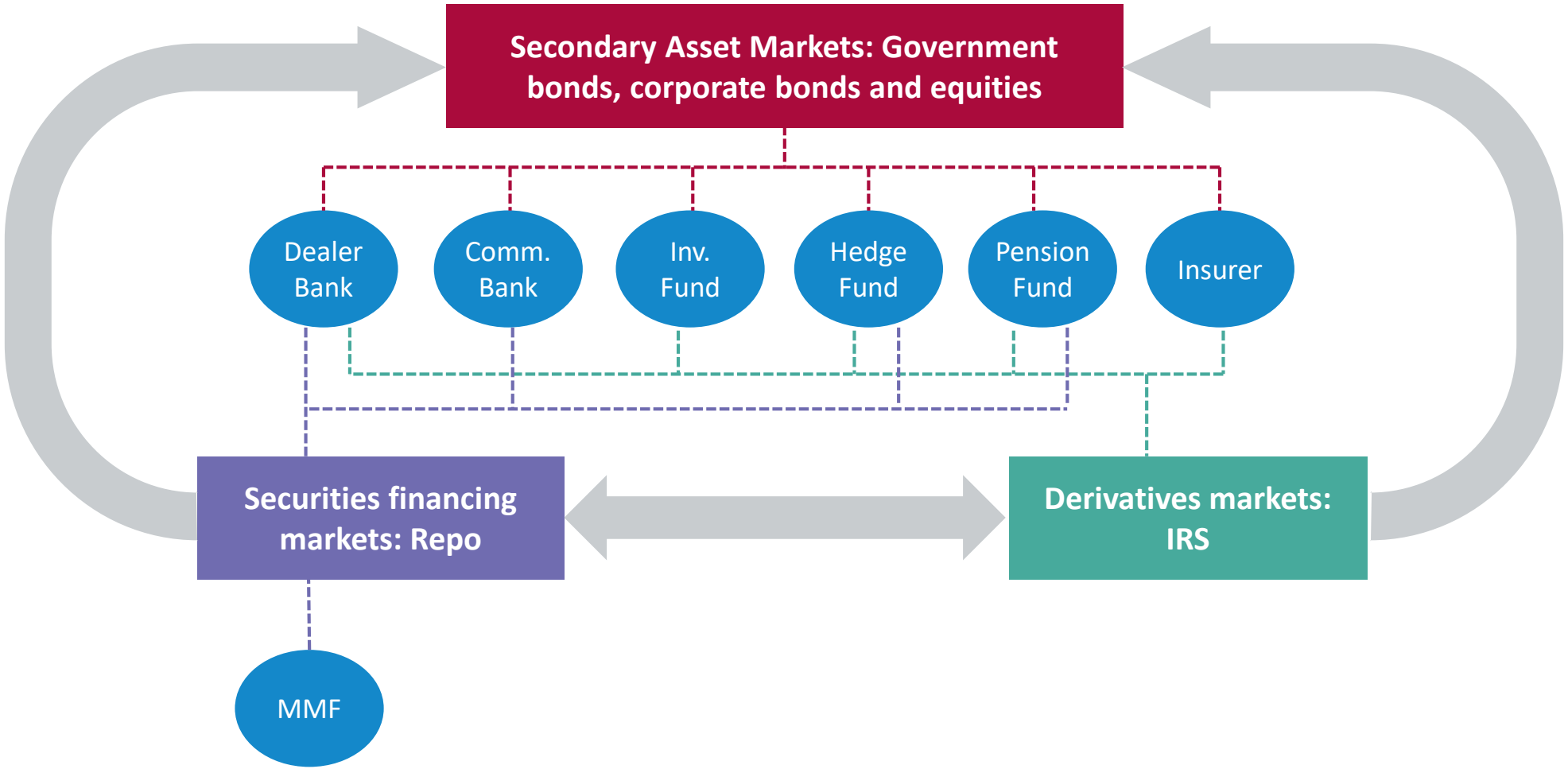

Agents’ objectives and constraints

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Agent
Pension fund
Insurer
Investment fund
Hedge fund
Dealer
Commercial Bank
MMF

Agents' objectives and constraints

Agent	Objectives / role in the model
Pension fund	Choose asset allocation to maximise expected risk-adjusted returns
Insurer	
Investment fund	
Hedge fund	Arbitrageur
Dealer	Intermediate Repo and IRS markets
Commercial Bank	Funding provider into Repo market
MMF	

Agents' objectives and constraints

Agent	Objectives / role in the model	Constraints: Leverage / solvency
Pension fund	Choose asset allocation to maximise expected risk-adjusted returns	
Insurer		✓
Investment fund		
Hedge fund	Arbitrageur	✓
Dealer	Intermediate Repo and IRS markets	✓
Commercial Bank	Funding provider into Repo market	✓
MMF		

Agents' objectives and constraints

Agent	Objectives / role in the model	Constraints	
		Leverage / solvency	Short-term liquidity
Pension fund	Choose asset allocation to maximise expected risk-adjusted returns		✓
Insurer		✓	✓
Investment fund			✓
Hedge fund	Arbitrageur	✓	✓
Dealer	Intermediate Repo and IRS markets	✓	✓
Commercial Bank	Funding provider into Repo market	✓	✓
MMF			

Agents' objectives and constraints

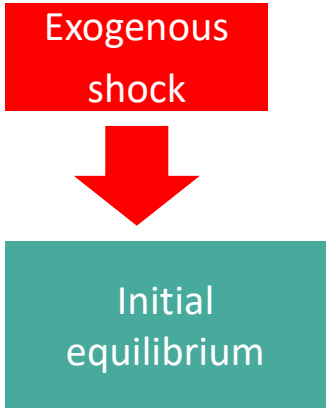
Agent	Objectives / role in the model	Constraints		
		Leverage / solvency	Short-term liquidity	Investors redeem
Pension fund	Choose asset allocation to maximise expected risk-adjusted returns		✓	
Insurer		✓	✓	
Investment fund			✓	✓
Hedge fund	Arbitrageur	✓	✓	✓
Dealer	Intermediate Repo and IRS markets	✓	✓	
Commercial Bank	Funding provider into Repo market	✓	✓	
MMF				✓

Model process

Model process

Initial equilibrium

Model process



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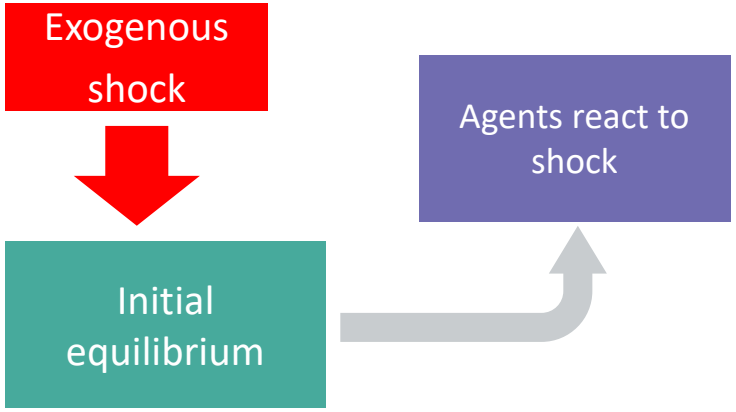

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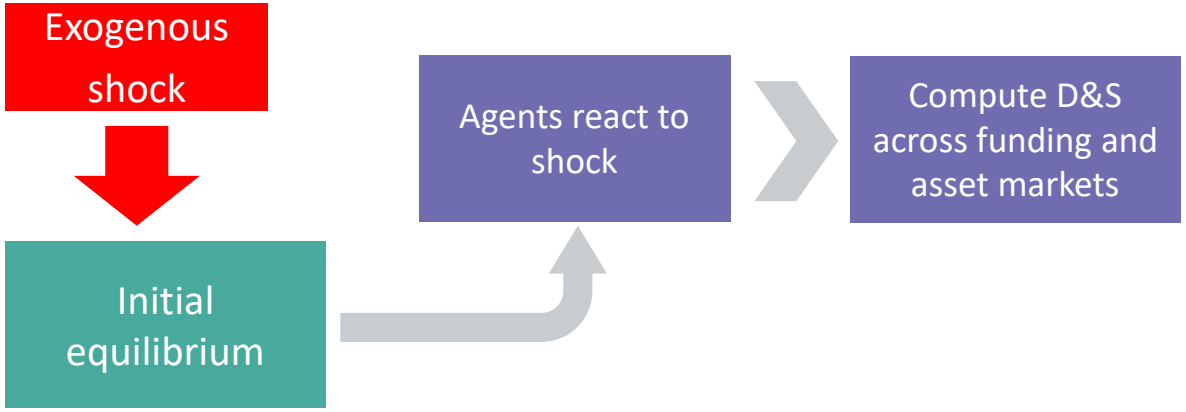

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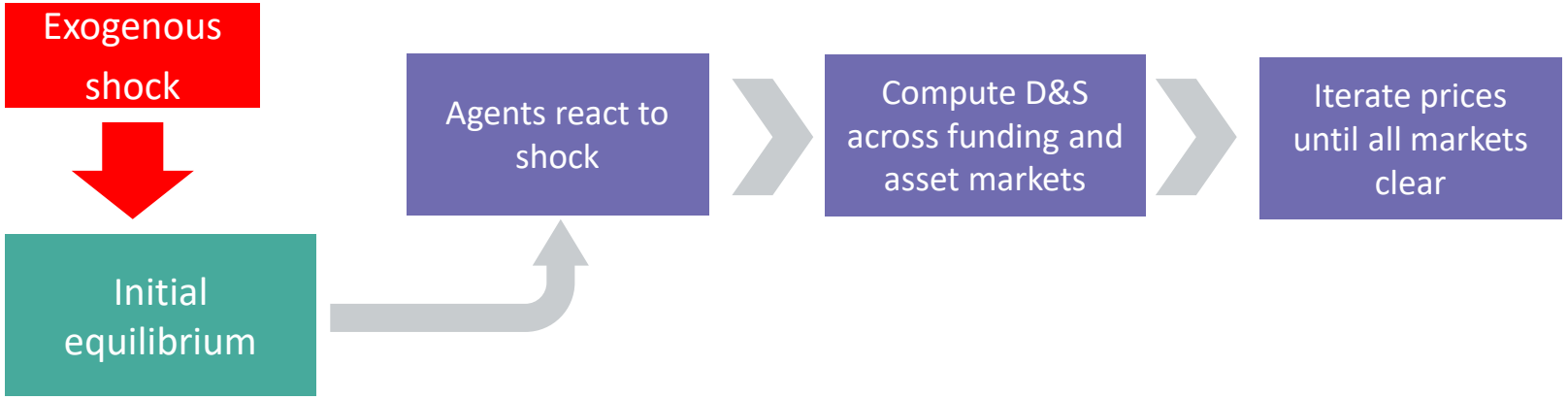

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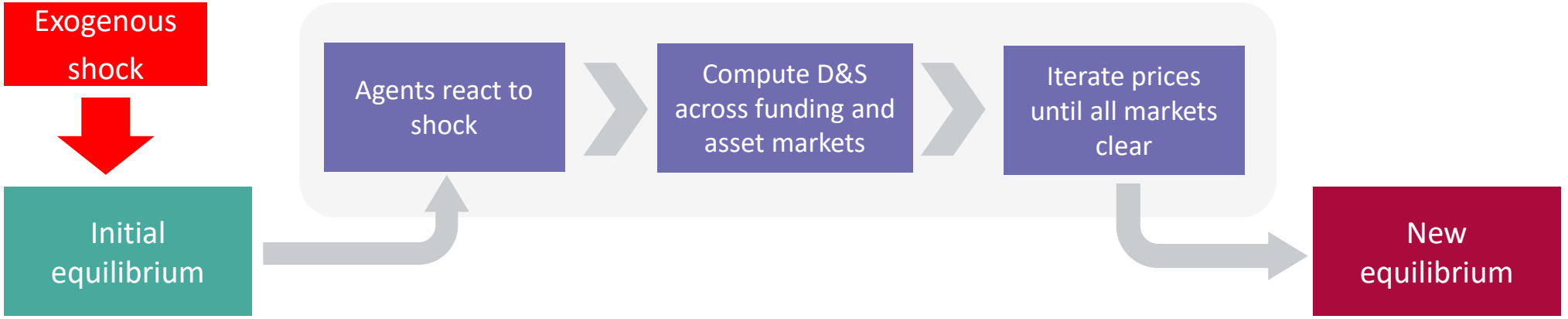

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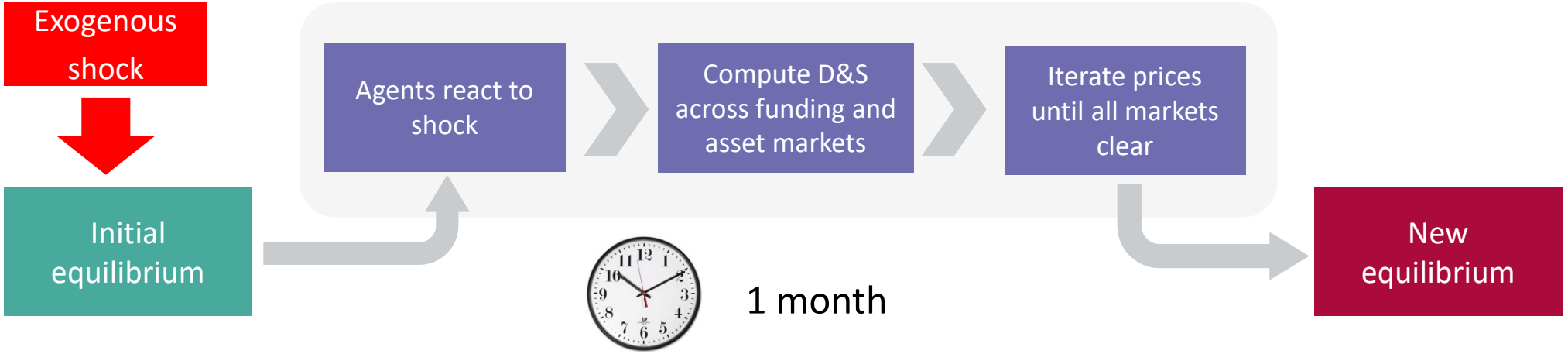

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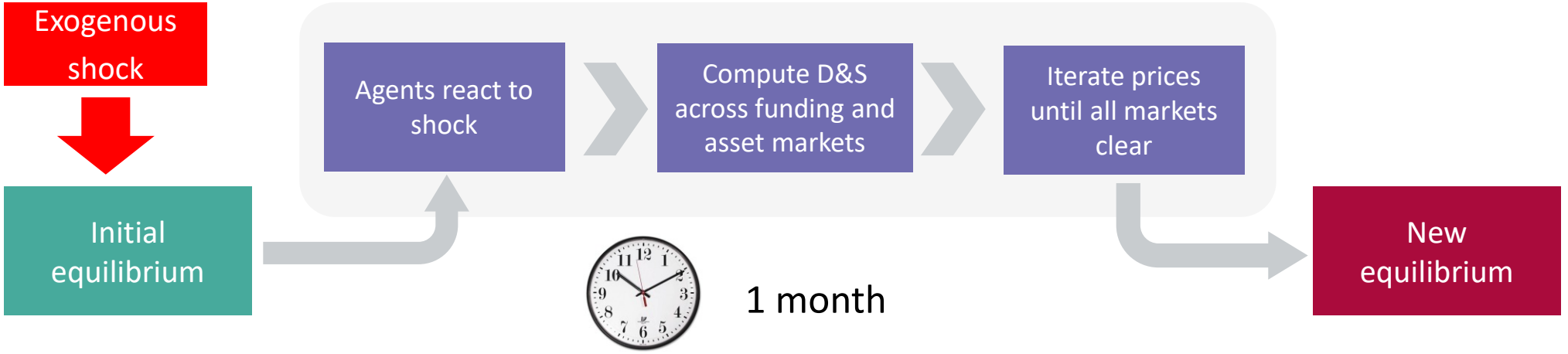


Four categories of exogenous shock:

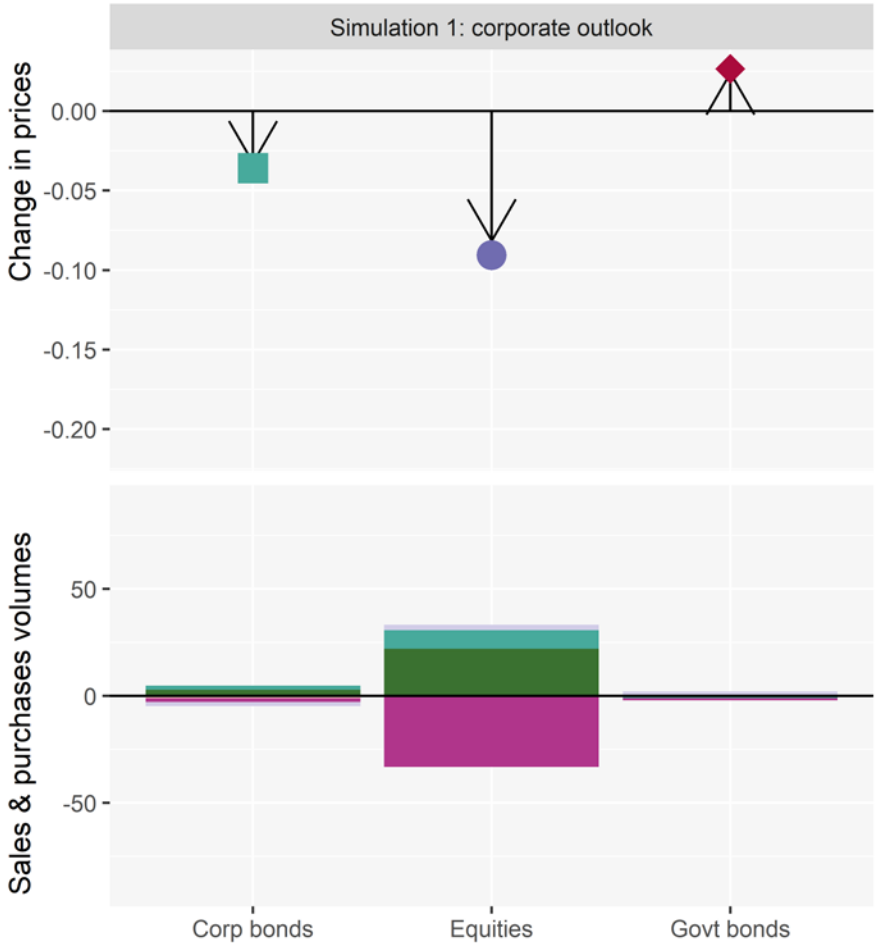
1) Determinants of traded asset prices	2) Price of non-traded assets	3) Household behaviours	4) Constraints
e.g. expected credit loss	e.g. commercial bank's banking book	e.g. investment fund redemptions	e.g. insurer solvency ratio

Results: layered stress scenario

- We illustrate some properties of the model through a layered stress scenario:

Layer 1	Shock to ‘corporate outlook’: lower expected returns on corporate bonds and equities.
Layer 2	Corporate shock + binding dealer leverage ratio
Layer 3	Corporate shock + binding dealer leverage ratio + binding commercial bank risk-based capital ratio

Results: layered stress scenario (1)

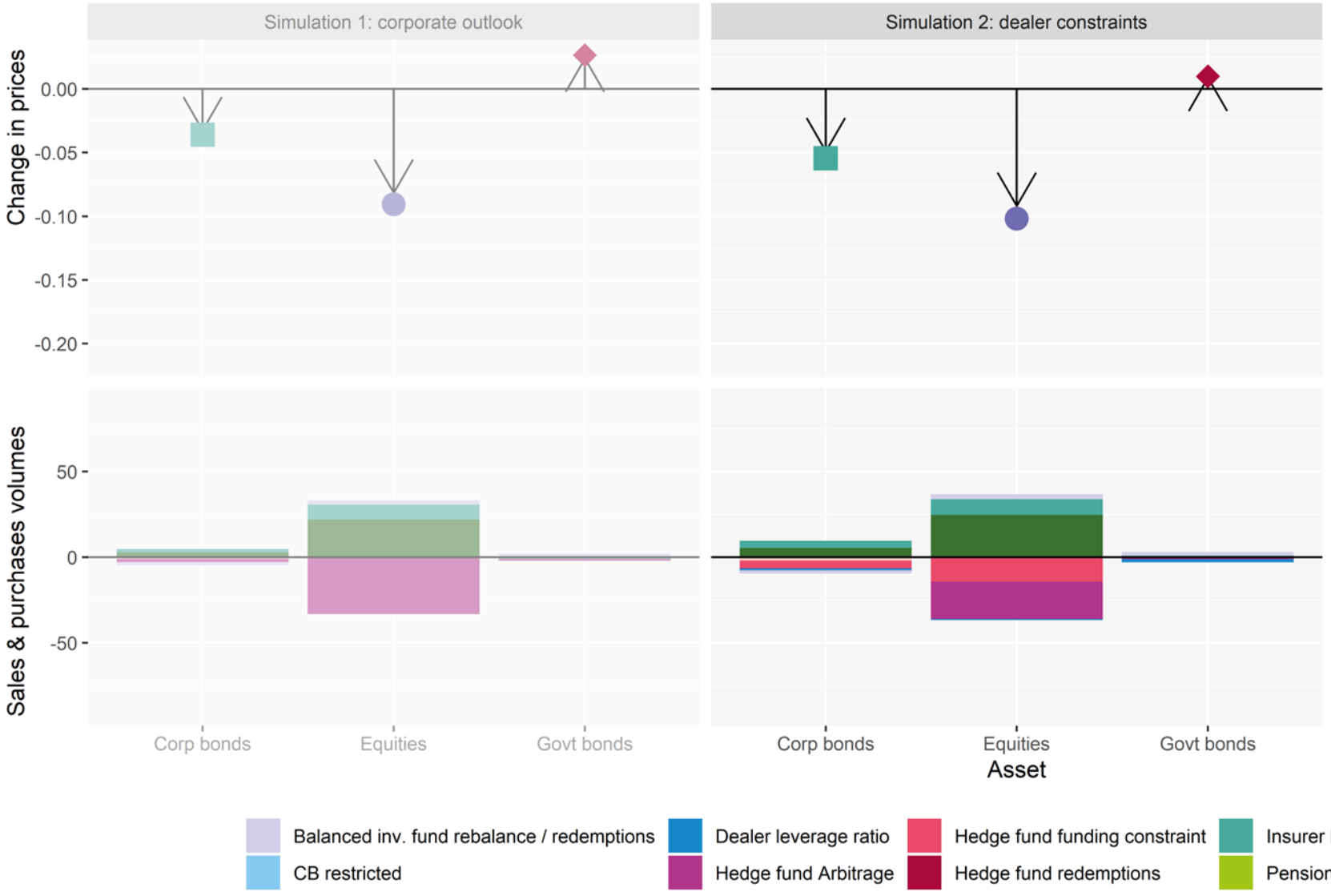


Investors reassess asset allocations

Selling pressure from **hedge fund** & investment fund partly offset by the countercyclical behaviour of **insurer** & **pension fund**.

Balanced inv. fund rebalance / redemptions
CB restricted
Dealer leverage ratio
Hedge fund Arbitrage
Hedge fund funding constraint
Hedge fund redemptions
Insurer Rebalance
Pension fund Hedging
Pension fund Rebalance
Single-asset inv. fund redemptions

Results: layered stress scenario (2)



Dealer deleverages to meet constraint:

- **Sells traded assets**
- **Reduces funding to hedge fund**

Results: layered stress scenario (3)

Commercial bank deleverages / de-risks:

- Focuses sales in equities
- **Further funding squeeze for other agents**

Constraints tighten as asset prices fall:

- Reducing funding provision
- Redemptions from funds
- Forced sales

Results: effect of alleviating constraints

- We can use the model to look at the impact of alleviating specific constraints in a stress scenario
- One way to measure the benefits is to look at how much value destruction is avoided
- In the final layer of our stress scenario UK traded assets fall in value by £221bn
- How could a social planner most effectively reduce this number?

Results: effect of alleviating constraints

Absolute £bn impact on value of traded securities

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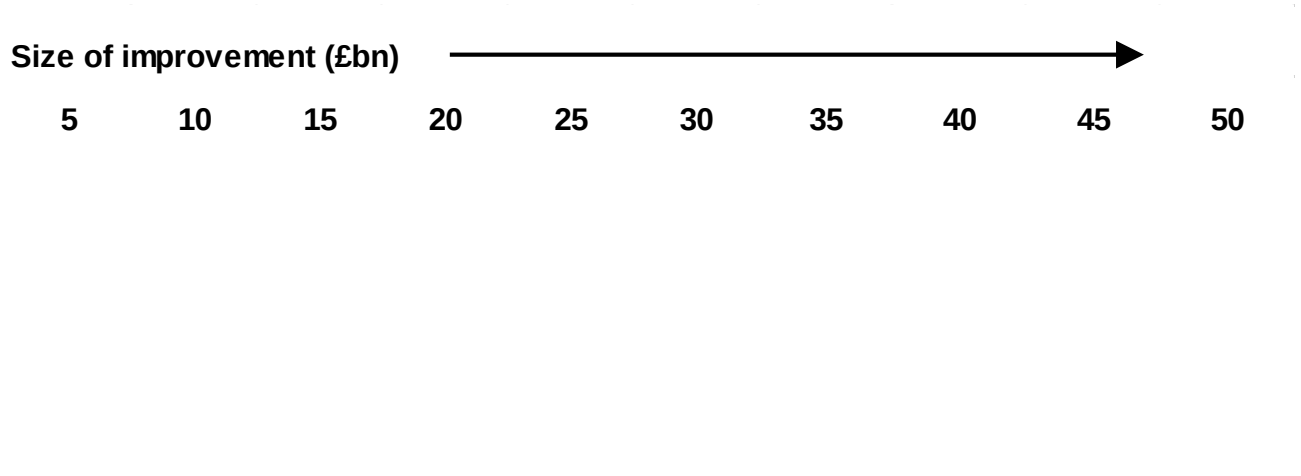
Absolute £bn impact on value of traded securities



Results: effect of alleviating constraints

Absolute £bn impact on value of traded securities

	Size of improvement (£bn) →									
	5	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
Inv. fund liquidity	18	34	56	75	92	105	117	127	156	175
Comm. bank capital	0	0	126	126	126	126	126	126	126	126
Hedge fund liquidity	18	35	48	60	69	78	85	92	98	104
Dealer capital	13	69	70	70	70	75	75	79	79	79

Results: effect of alleviating constraints

Absolute £bn impact on value of traded securities

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Hedge fund liquidity	18	35	48	60	69	78	85	92	98	104
Dealer capital	13	69	70	70	70	75	75	79	79	79

‘Bang-for-buck’ ratios

	Size of improvement (£bn) →									
	5	10	15	20	25	30	35	40	45	50
Inv. fund liquidity	4	3	4	4	4	3	3	3	3	3
Comm. bank capital	0	0	8	6	5	4	4	3	3	3
Hedge fund liquidity	4	4	3	3	3	3	2	2	2	2
Dealer capital	3	7	5	4	3	3	2	2	2	2

Future work

Take account of non-UK sectors

Application to policy-relevant questions

Dynamic model

System-wide stress simulation

https://www.bankofengland.co.uk/working-paper/2019/system-wide-stress-simulation

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