What Assets Should the Central Bank Purchase in a Quantitative Easing Program?

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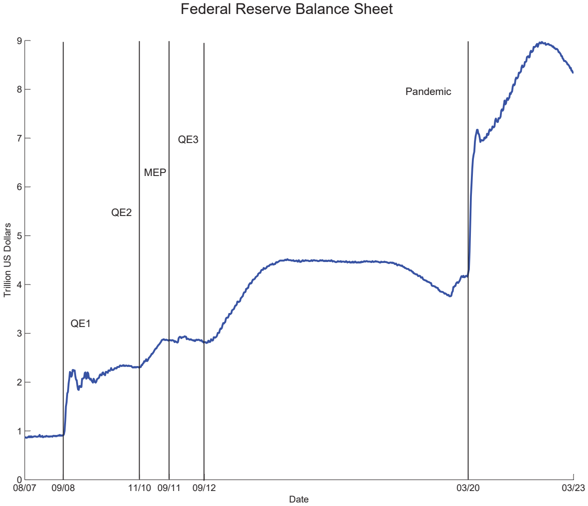
Motivation

Figure 1: Quantitative Easing and Federal Reserves Balance Sheet



Motivation

- Real QE: purchasing long-term government bonds
  - Offer liquidity to the financial market
  - Private bonds yields are also reduced
  - External Funding constraint are released
  - Investment are facilitated
- Purchasing private bonds may be also effective
  - More direct channel to sidestep the financial intermediation for private firms
  - Input-output linkage $\Longrightarrow$ Spillover effects
- Research question:

  Whether different asset (bond) purchases have different aggregate and sectoral effects?

Main Contribution

- Build a multi-sector economy with input-output interactions
  - Heterogeneous sectors: production technology, financial constraints, price rigidity, and agency costs
  - Buy goods from each other as materials inputs
- Recent quantitative studies assume one single sector and have shown how agency costs matter
- Single sector is not able to analyze the unbalanced QE stimulus in different sectors
  - Will the sector with higher capital sensitivity benefit more from the QE?
  - Will purchasing bonds from a specific sector generate a specific stimulative pattern?

  . . .

Preview of the Quantitative Results

- Evaluate different asset purchases in a two-sector model based on US calibration
    - Private bonds issued by each sector
    - Public bonds

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- Evaluate different asset purchases in a two-sector model based on US calibration
  - Private bonds issued by each sector
  - Public bonds
- Price rigidity and agency costs are key sources of heterogeneity in sectoral effects
- Input-output Interactions dampened heterogeneity in sectoral responses
- The central bank faces an intertemporal trade-off
  - Purchasing bonds most subject to agency cost have larger expansionary effects, but are subject to larger deleveraging effects

Model: Agents

The economy consists of:

1) Households composed of workers and bankers

2) Production network with 4 layers

3) Firms that produce physical capital

4) Financial intermediaries

5) A government composed of fiscal and monetary authorities

Model: Households

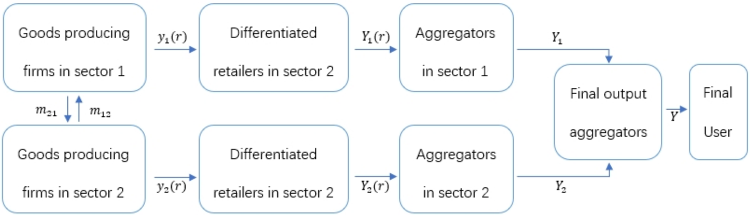
Two types of infinitely-lived members: workers and bankers

Each banker runs a financial intermediary and faces a constant exit probability after which she becomes a worker

Exiting bankers transfer their wealth to the household and are replaced by an equal number of workers who become new bankers

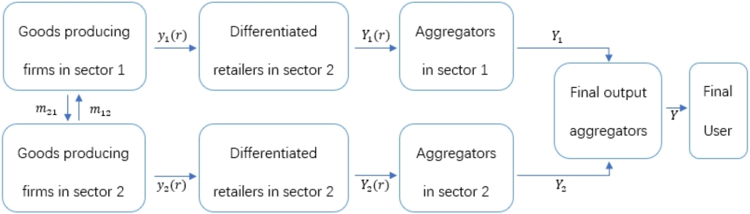
New bankers are received a constant startup wealth

Model: Production Network



- Competitive goods-producing firms.
  - Different sectors would need different capital, labor, and material elasticity, and face different borrowing constraint.
  - Representative firms in the sectors will issue long-term bonds to fund sector capital accumulation subject to the borrowing constraint.

Model: Production Network



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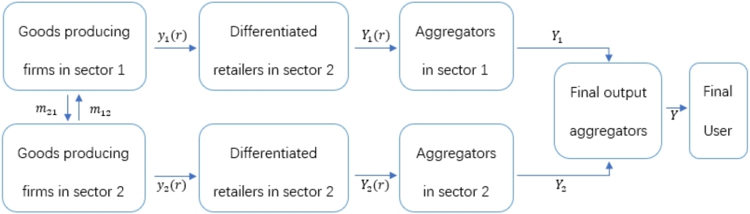
Model: Production Network



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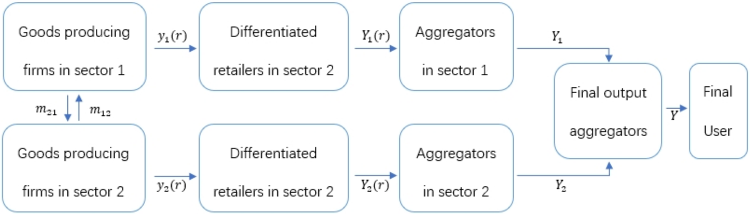
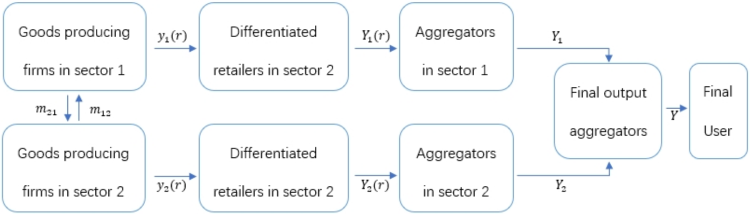
- Competitive sectoral aggregators that aggregate repackaged goods into sectoral output

Model: Production Network



- Monopolistic retailer indexed by *r* produces differentiated good by a repackaging technology, and faces Calvo rigidity
- Competitive sectoral aggregators that aggregate repackaged goods into sectoral output
- Competitive final aggregator that aggregate sectoral output into final goods

Model: Production Network



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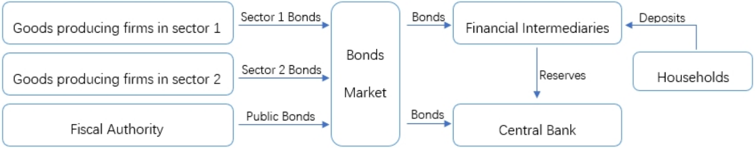
- Competitive sectoral aggregators that aggregate repackaged goods into sectoral output
- Competitive final aggregator that aggregate sectoral output into final goods
- Final users: Households (C), capital producers (I) and fiscal authority (G)

Model: Financial Intermediary and Government



- financial intermediaries that transfer money resources
  - Different kinds of bonds will face different degrees of agency costs
  - The whole economy will face a systematic agency friction.
- Government: fiscal authority and central bank
  - Tax, public bonds and transfer from the central bank funds fiscal authority's expenditures
  - Central bank adjusts policy rate subject to ZLB, and purchases bonds by its reserves at ZLB

Calibration: Two Sector Economy

Theoretical model is applicable to any S

Here we set $S = 2$

- Sector 1: Manufacturing
- Sector 2: Services

Calibration: Production Parameters

- Source: input-output database (KLEM) by Dale Jorgenson,
  - Annual from 1960 to 2005

	Labor Share		Intermediate Share		Capital Share	
Sector	Estimates	s.e.	Estimates	s.e.	Estimates	s.e.
Manufacturing	0.278*	0.012	0.597*	0.011	0.125*	0.013
Services	0.395*	0.011	0.387*	0.014	0.218*	0.007

Calibration

- Input-output : BEA input-output accounts,
  - Annual from 1997 to 2019

	Consumer			
	Manufacturing		Services	
Producer	Estimates	s.e.	Estimates	s.e.
Manufacturing	0.678*	0.021	0.195*	0.015
Services	0.322*	0.021	0.805*	0.015

Calibration: Some Parameters and Solving Strategy

Parameters	Value or Target	Description
β	0.995	Subjective discount rate
h	0.815	Habit information parameter
η	0.276	Inverse Frisch elasticity of labor supply
γ	0.95	Survival rate of financial intermediary
κ	$1 - 40^{-1}$	Coupon decay parameter / Bond duration
ψ_s	0.8	Fraction of investment externally financed
ς_1	0.212	GDP share of manufacturing sector
ξ	8	Elasticity of substitution
μ_1	0.25	Probability of no price adjustment in manufacturing sector
μ_2	0.75	Probability of no price adjustment in service sector
θ	0.579	Fraction of total financial assets that can be diverted by intermediary
θ_s	1	Recoverability parameter for private bonds of manufacturing sector
θ_b	1/3	Recoverability parameter for private bonds of service sector

Solution: Linear approximation, with Occbin (Guerrieri and Iacoviello, 2015) at ZLB

Impulse Responses at the ZLB

An economy is at the ZLB

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Two cases

- Case 1: No QE purchases
- Case 2: QE purchases

Impulse Responses at the ZLB

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Two cases

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Plot the **difference between the two cases**

Figure 2: Benchmark Calibration (Manufacturing: Services: Public = 3:3:1)

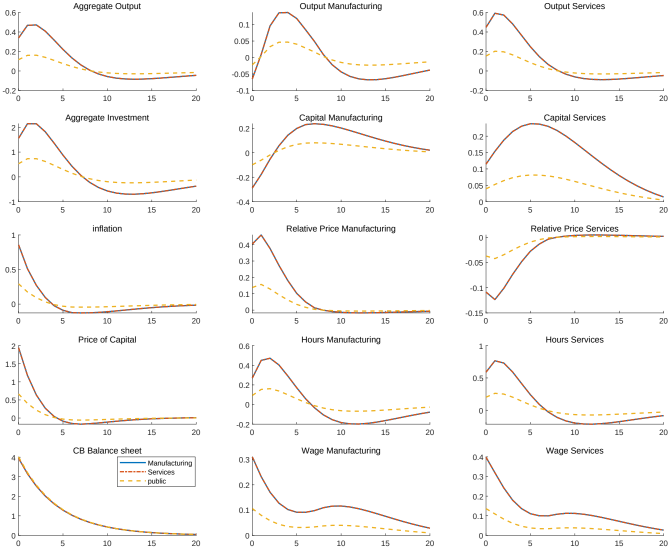
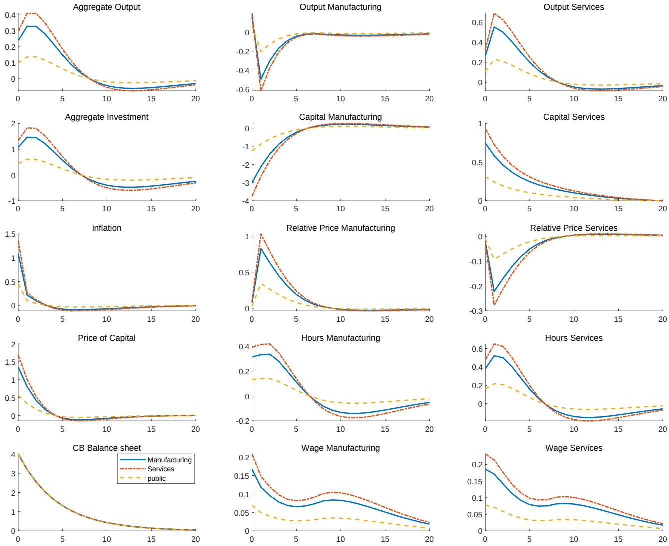


Figure 3: Higher Agency Costs in Services (Manufacturing: Services: Public = 2.4:3:1)



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In an economy with heterogeneous sectors and input-output structure

- The sector with higher price rigidity tends to expand more due to QE

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- The sector with higher price rigidity tends to expand more due to QE
- Aggregate results are generally unaffected by other heterogeneity at the sectoral level except for agency costs
- Input-output linkdages induce comovement and restrict the heterogeneity in sectoral responses

Summary

In an economy with heterogeneous sectors and input-output structure

- The sector with higher price rigidity tends to expand more due to QE
- Aggregate results are generally unaffected by other heterogeneity at the sectoral level except for agency costs
- Input-output linkdages induce comovement and restrict the heterogeneity in sectoral responses
- Purchasing bonds with higher agency costs implies larger expansionary in the short-run and larger contractionary effect in the medium run.