Course in Macro: Econ 8200

I: Reassessing the Role of Heterogeneity for Business Cycles

José Víctor Ríos Rull
Penn, CAERP, UCL

With material developed jointly with Akihisa Kato, Zhen Huo and by Dirk Krueger

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  - Health and Longevity
- But as Macroeconomists, should we care?

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  - In Heterog Agents Ec changes in aggregates may happen and matter: Land Values.

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- The Great Recession has highlighted its shortcomings: How come we got such a large recession.

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- Why could they generate larger fluctuations?
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    1. Recessions hit (lower earnings, more unemployment) more vulnerable (poor) households more.
    2. Poor households have a higher Marginal Propensity to Consume out of income than rich households (Parker et al., 2013; Misra and Surico, 2014)

Heterogeneity (Inequality) in 2006:
Marginal Distributions

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Top 1%	8.0	8.2	30.9	33.5

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- a: Bottom 40% holds basically no wealth
- y, c: less concentrated

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	% Share of:		Exp.Rate
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- 80% poorest acount for 63% of consumption

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   3.2 A lot of agents in the states where their behavior is non linear (close to zero cash in hand).

Original Findings: Heterogeneity does not matter

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- Heterogeneous agents models are like Rep Agent models for business cycle purposes. (Also confirmed in life-cycle models (Ríos-Rull, 1996)).

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  3. Large enough shocks

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- Unemployment insurance system with size $\rho = 50\%$.

Net Worth	Data		Model
% Share held by:	PSID, 06	SCF, 07	
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$Q2$	0.8	1.2	1.2
$Q3$	4.4	4.6	4.7
$Q4$	13.0	11.9	16.0
$Q5$	82.7	82.5	77.8
90 – 95	13.7	11.1	17.9
95 – 99	22.8	25.3	26.0
Top 1%	30.9	33.5	14.2
Gini	0.77	0.78	0.77

- Get's inquality almost right at the very bottom

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- Rudimentary life cycle is crucial for level of consumption rates and their decline with wealth.

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- If we were to think of Endogenous Labor, it would be Worse (Guerrieri and Lorenzoni (2017))

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- Yet Evidence (Fagereng et al. (2021), Crawley and Kuchler (2021)) points to much larger Marginal Propensities to Consume.
- So Heterogeneous Agent Models with Incomplete Markets have arised as an alternative (Carroll (1997), Auclert et al. (2020), Alves, Bustamante, Guo, Kartashova, Lee, Pugh, See, Terajima, and Ueberfeldt (2022)) because they have poor people that respond to transitory income changes while less concerned with direct changes in real interest rates (Blundell et al. (2008)).

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  - Habits or sticky expectations to delay a bit the response (Auclert et al. (2020)) rather than the more grounded rational inattention (Sims (2003), Mackowiak and Wiederholt (2009)).

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- Overall, indirect effects of an unexpected changes in interest rates, operating through a general equilibrium increase in labor demand (Kaplan et al. (2018)) outweigh intertemporal substitution mechanisms.

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- These margins open the door to other type of shocks (financial shocks, government policy shocks, international shocks).

A second update: Heterogeneity and the new margins

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    - These are mechanisms that transform a drop in consumption into drops in TFP without reallocation of output to investment. Triggered by drops in Consumption.

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    - The economy is too rigid to turn negative wealth effect into an expansion via harder working

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- More financial stability than standard new-Keynesian inflation-output tradeoffs.

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- Standard Heterogeneous Incomplete Markets Model (Bewley (1984), Imrohoroğlu (1989), Huggett (1993), Aiyagari (1994))
- Large Amount of Wealth, some in fixed supply (fixed factors, land), some reproducible (physical capital with adjustment costs and buildings), and risk free liquid assets.
- Large Wealth Concentration: Due to
  - Shocks to Earnings
  - Shocks to Shares of Local Businesses (the fixed factor in production)
- Incomplete markets: there are are financial frictions
  - Loan to Value Restrictions
  - Interest to Income Restrictions
  - Non tradable assets (not very important)
- Sluggish wages
- We also explore slow adjustment of nontradable prices (insufficient devaluation)

- Details of the environment
- Discussion of how to Map the model to data
- A bunch of Impulse Responses

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The Environment: First the Steady State:

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Household Problem: State is $\{\eta, \epsilon, \theta^e, \theta^x, a\} = \{z, a\}$

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- Imports are the Numeraire

Nontradable Sector with undiscriminating hiring costs

And Skill specific Separation Rates

$$\Omega^e(k,\{n^\epsilon\}) = \max_{v,k',m,e}\Big\{p^e\ F^e\,(k,n) - m - p^e e - \kappa v - \phi^n(n',n) \\ - w\ n + \frac{\Omega^e(k',\{n^{\epsilon}{}'\})}{1+r'}\Big\}$$

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- Dividends $\pi^e = p^e \; F^e\,(k,l) - m - p^e e - \kappa v - \phi^n(n',n) - w\sum_\epsilon n^\epsilon \epsilon$

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Some other Relevant Features

- Export Sector Similar to Non-tradable
- Rich households have no real use for a lot of housing
- Poor/middle households are very leveraged and constrained. They have less housing than they would like.
- Financial constraints limit and change the value of land.

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- Non homotetic Utility to prevent housing purchases by the rich

Parameterization for St St	
Risk aversion for consumption	2.0
Satiation level for housing	4.5
Loan to value ratio	0.8
Annual world interest rate	4.0%
Relevant Out of St St Elasticities	
Wage elasticity	0.5
TFP elasticity (with externality) (small)	0.3
Elasticity of Substitution bw nontradable and import	0.8
Adjustment cost coefficient (to be fine tuned)	1.57

	Target	Model
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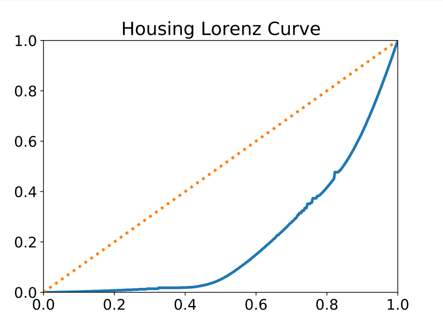
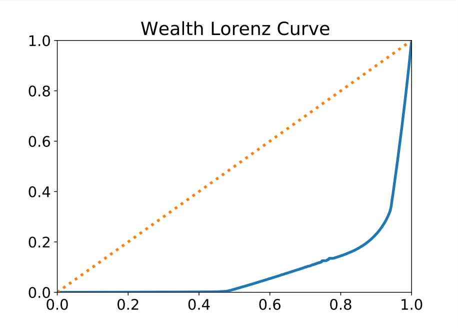
Relative Price of Nontradable	1.00	1.00
Share of Export	0.30	0.30
Employment Rate	0.92	0.92

	Target	Model	Tool	Value
Output	1.00	1.00	TFP in Export	0.73
Capital-to-Output	2.00	2.00	Capital dep. rate	0.025
Housing-Value-to-Output	1.80	1.76	Util shifter in housing	0.50
Debt-to-GDP	0.00	0.02	Discount rate	0.92
Wealth-to-Output	4.50	4.57	Dep. rate in housing	0.008
Wealth Gini	0.82	0.82	Top Share holdings	13.20
Frac. of H held by bottom 70%	0.25	0.27	$\widehat{h}_1$	0.98
Frac. of H held by bottom 80%	0.39	0.41	$\widehat{h}_2$	1.80
Frac. of H held by bottom 90%	0.58	0.64	σ_h	2.98
Relative Price of Nontradable	1.00	1.00	TFP in e	0.73
Share of Export	0.30	0.30	CES weight on e	0.75
Employment Rate	0.92	0.92	wage	0.96





- Gini coeff: housing 0.63, Wealth 0.82 (data 0.82 in 2007 SFC)

2 Putting the Model to Use: Experiments

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  3. Wage rigidity: Directly from Wage dynamics:

- We look at the transition. It involves solving for the steady state and then iterating backwards (with the additional problem of solving for equilibrium prices. Hard, but not too hard. Dynare can do it.)

Experiment: Tightening of credit

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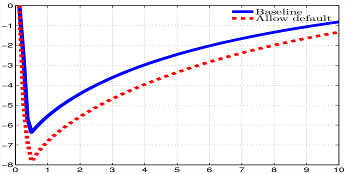
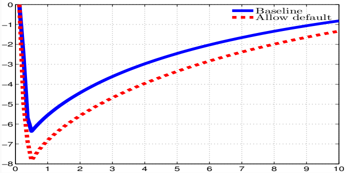
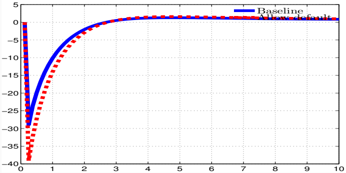
1. An Economy with Default
   - Over three months the down payment changes from 20% to 40%
   - The borrowing interest rate's surcharge goes from zero to 1.%
2. Long Run Properties
   - Like in all heterogeneous agents models, more frictions imply that in the long run output and wealth end up being higher.
   - But in our economies the transition is associated to a recession.



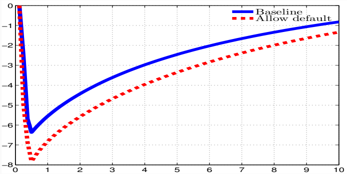
Consumption



Consumption



Investment



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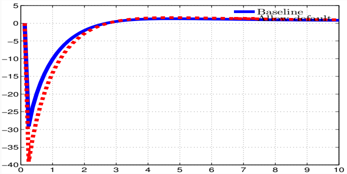
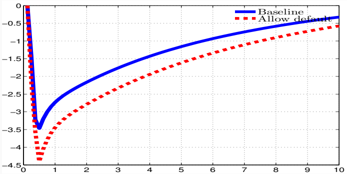
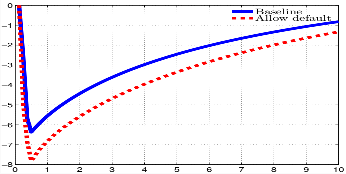


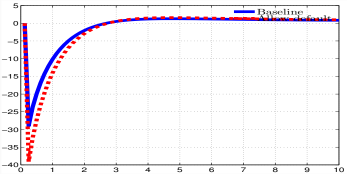
Investment



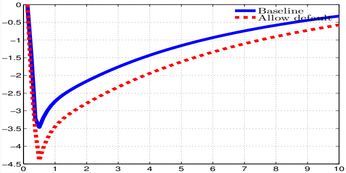
Output



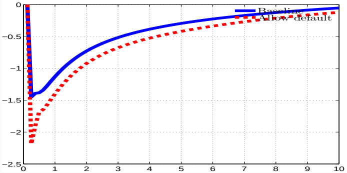
Consumption



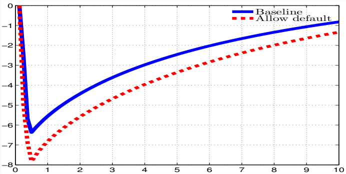
Investment



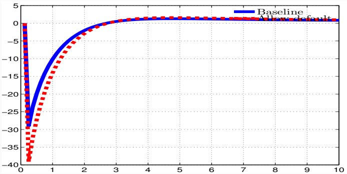
Output



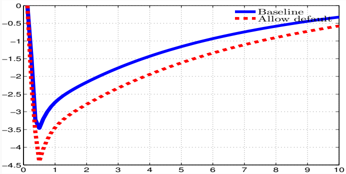
TFP



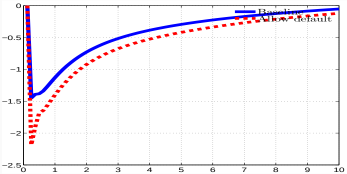
Consumption



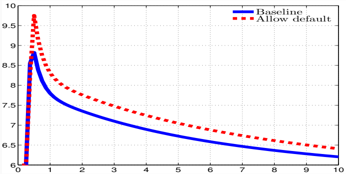
Investment



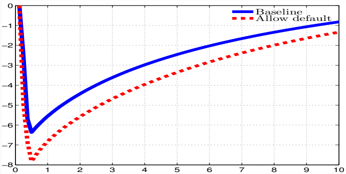
Output



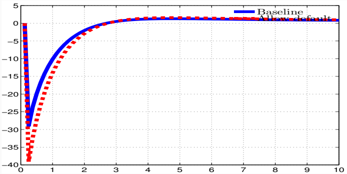
TFP



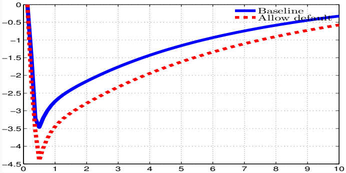
Unemployment rate



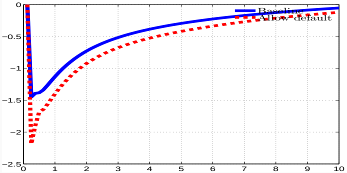
Consumption



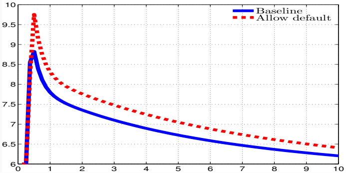
Investment



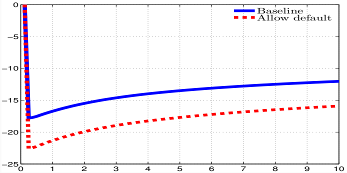
Output



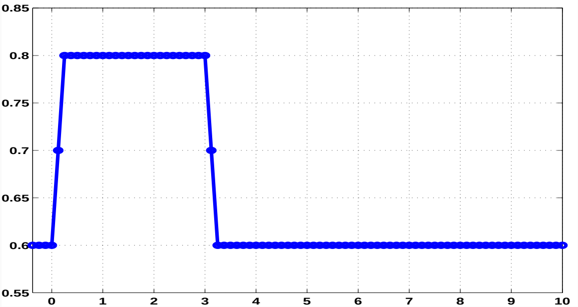
TFP



Unemployment rate

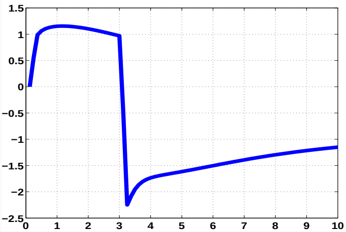


Housing Prices

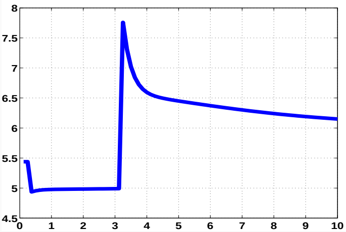


Loan to value ratio λ

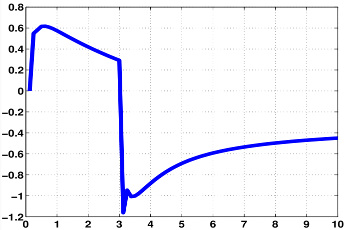
Another Experiment A Credit Cycle



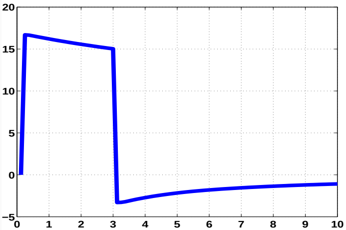
Real output



Unemployment rate



TFP



Housing price

- MIT shocks are NOT the way to study fluctuations.

- Traditionally very complicated methods have been proposed. Some of them based on *quasilinearity* or aggregate capital is the only thing that matters (Krusell and Smith Jr. (1997,?)) interesting really happens. There are modern linearization versions based on Reiter (SeHyoun Ahn and Wolf (2017) and Childers (2016)).

- They approximate somehow the distribution of agents and look for its equilibrium law of motion.

But we can do a lot better than that

- There is a wonderful recent innovation Boppart et al. (2018) that uses the Impulse Response from an MIT Shock as a Numerical Derivative to evaluate linear approximations.

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    - Consider now a sequence of innovations labeled $\{\epsilon_t\}_{t=0}^{T}$. Then a linear approximation to x in period t, labeled $\widehat{x}_t$ is

$$\widehat{x}_t = x_0\epsilon_t + x_1\epsilon_{t-1} + x_2\epsilon_{t-2} + \ldots\ldots$$

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    - And we are done!!!!
- Adding more shocks is linearly more costly

1. Increase in Interest Rate (world event or Policy) 1% (Baseline)

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2 Perfect Storm: Base + Financial Constraint: Max LTV 80% $\rightarrow$ 60% + (p^x − 3%)

Assess Equilibrium Implications

1 Increase in Interest Rate (world event or Policy) 1% (Baseline)

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3 Base without any negative effect on TFP

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2. Perfect Storm: Base + Financial Constraint: Max LTV 80% $\rightarrow$ 60% + (p^x − 3%)
3. Base without any negative effect on TFP
4. Base with price stickiness (insufficient devaluation)

- A Temporary but persistent increase in the (World) Interest Rate

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- With TFP Externality only on Nontradables

First Experiment

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  - TFP Elasticity wrt expenditures .5

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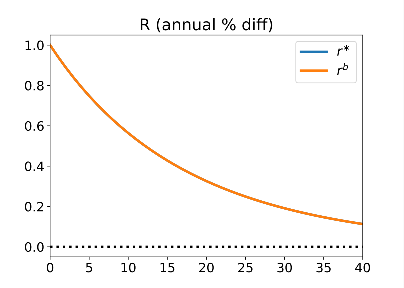
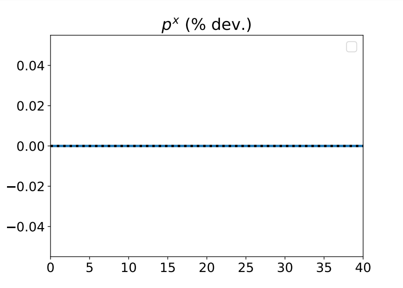
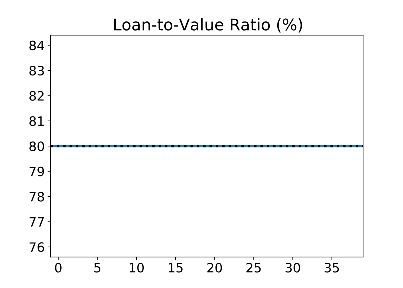
  - Import Elasticty .8

1- Exogenous Shifter: (Only r moves)

p^x because of devaluation LTV Does Not







1- Asset Prices & Quantities (Financial and Total Wealth)

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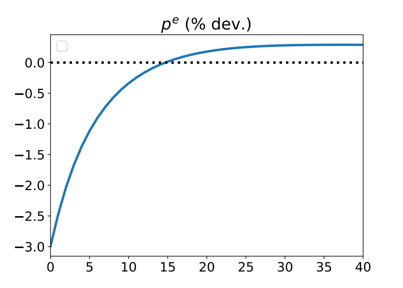

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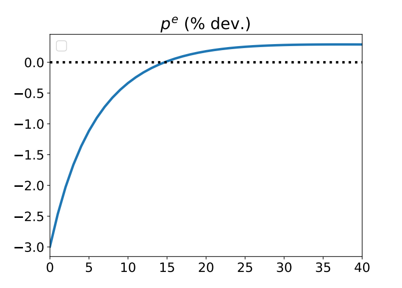

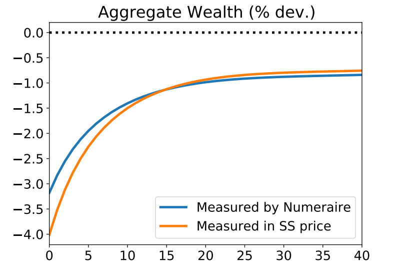

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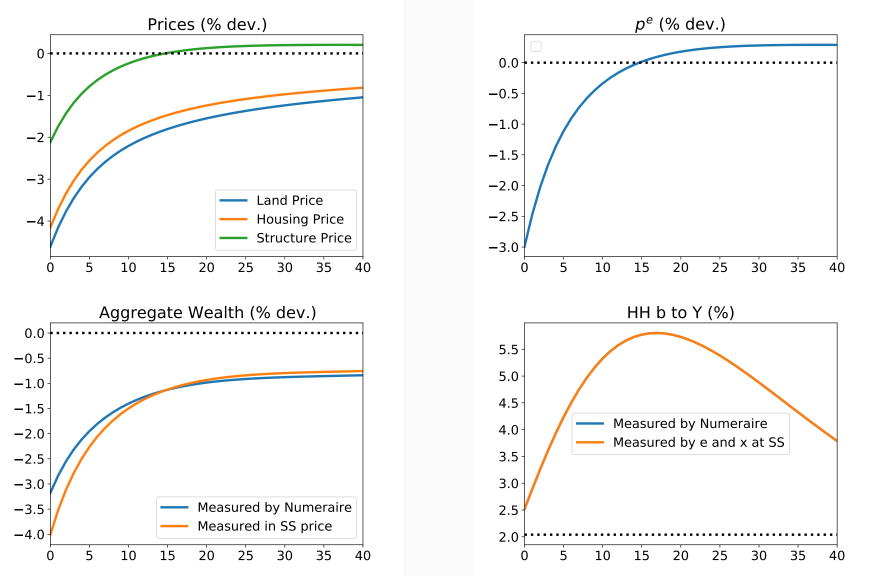
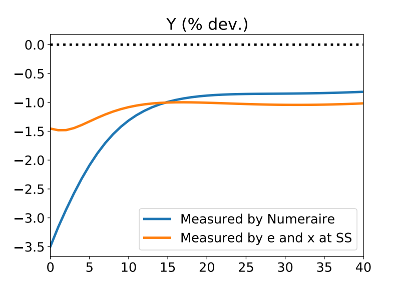
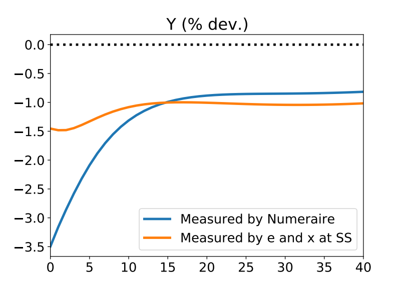
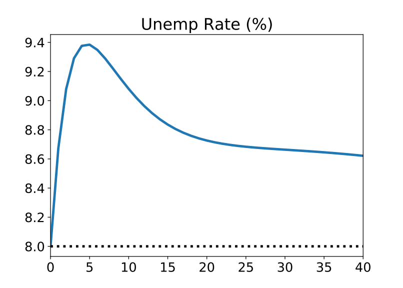
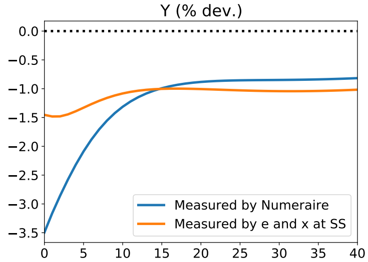


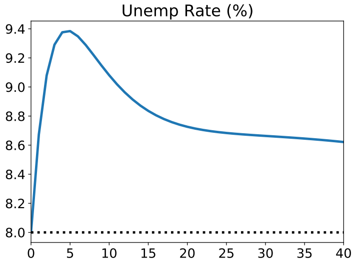

Y (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
0
5
10
15
20
25
30
35
40
Measured by Numeraire
Measured by e and x at SS

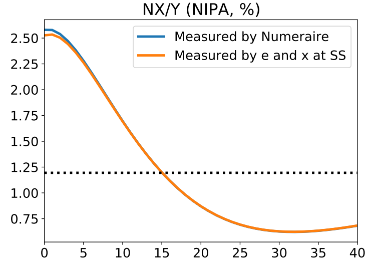
1- Main Business Cycle Objects






Y (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
0 5 10 15 20 25 30 35 40
Measured by Numeraire
Measured by e and x at SS


Unemp Rate (%)
9.4
9.2
9.0
8.8
8.6
8.4
8.2
8.0
0 5 10 15 20 25 30 35 40


NX/Y (NIPA, %)
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0 5 10 15 20 25 30 35 40
Measured by Numeraire
Measured by e and x at SS

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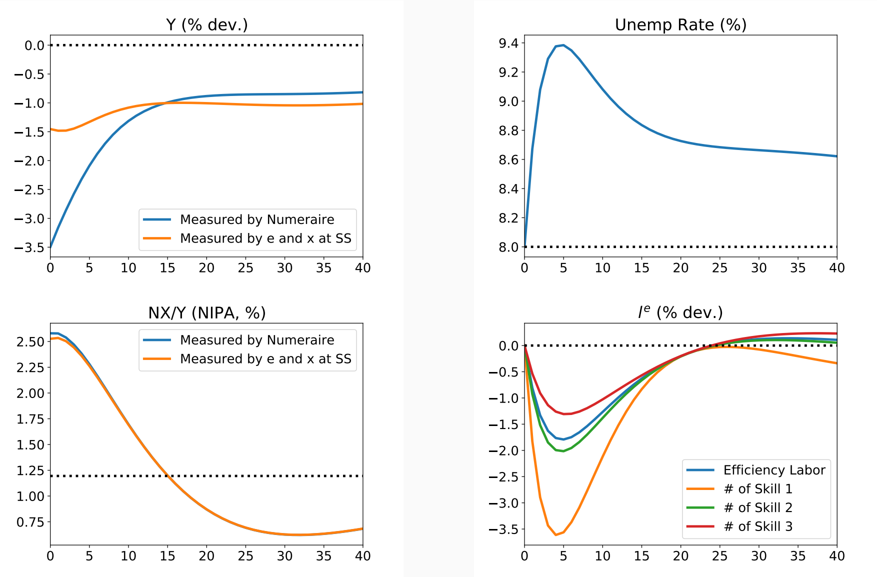
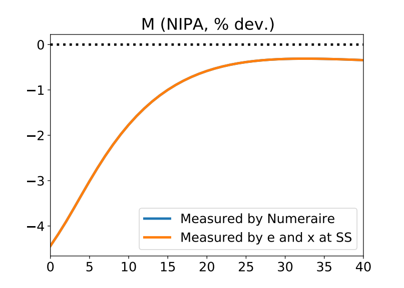
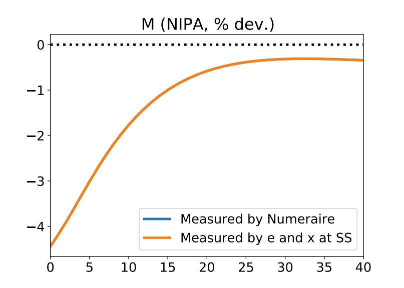
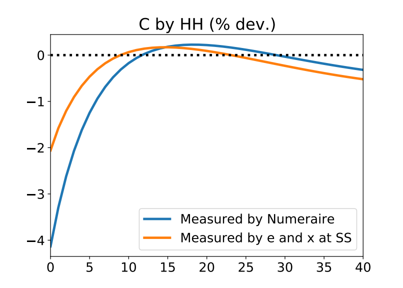
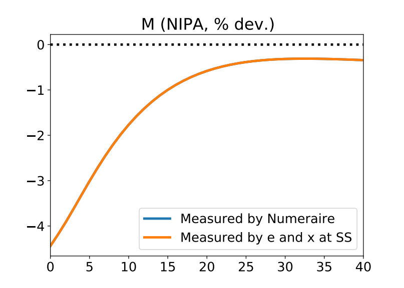


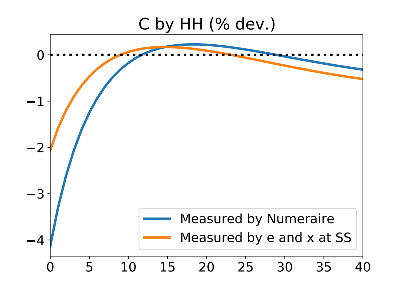

M (NIPA, % dev.)
0
−1
−2
−3
−4
0
5
10
15
20
25
30
35
40
Measured by Numeraire
Measured by e and x at SS

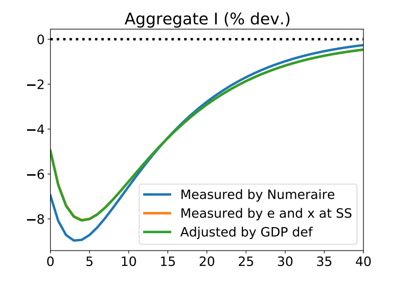

M (NIPA, % dev.)
0
−1
−2
−3
−4
0 5 10 15 20 25 30 35 40
Measured by Numeraire
Measured by e and x at SS


C by HH (% dev.)
0
−1
−2
−3
−4
0 5 10 15 20 25 30 35 40
Measured by Numeraire
Measured by e and x at SS

1- GDP Components







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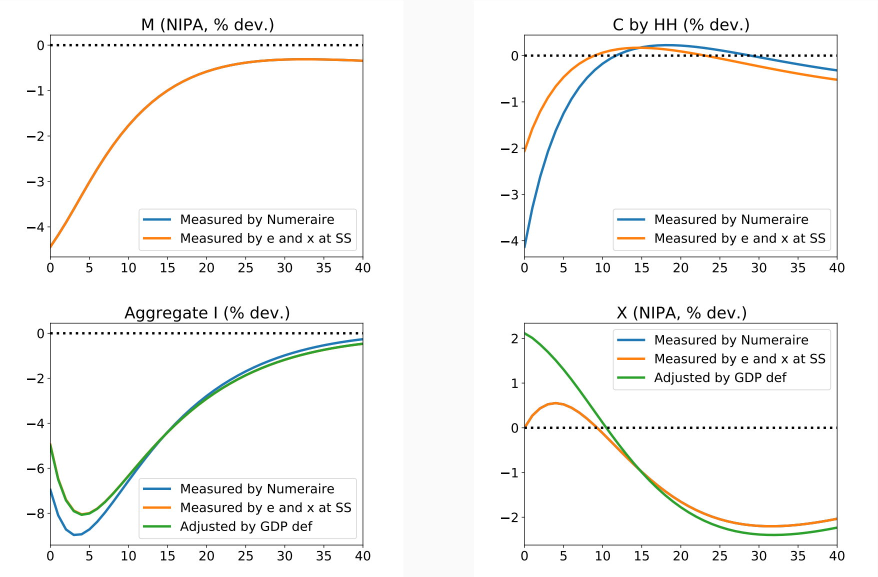
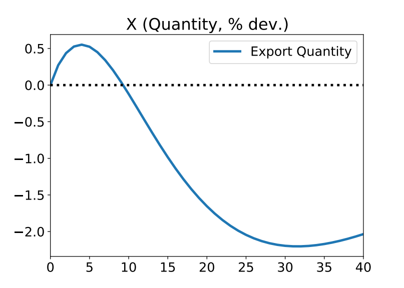
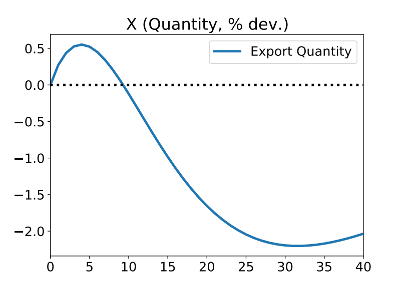
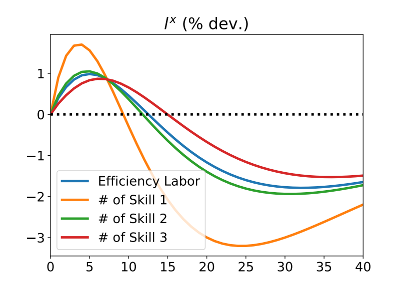
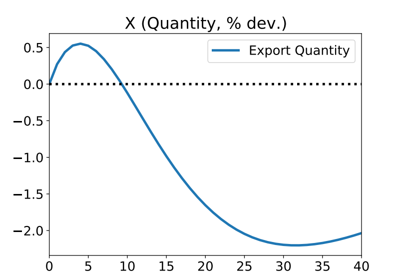


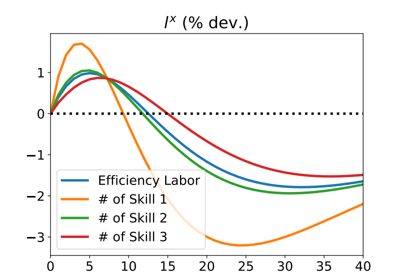

X (Quantity, % dev.)
Export Quantity
0.5
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
30
35
40

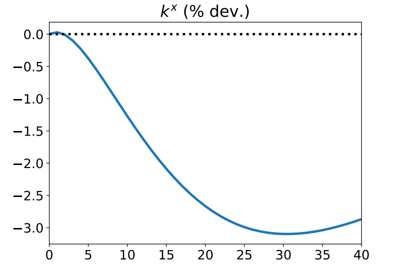
1- Sector

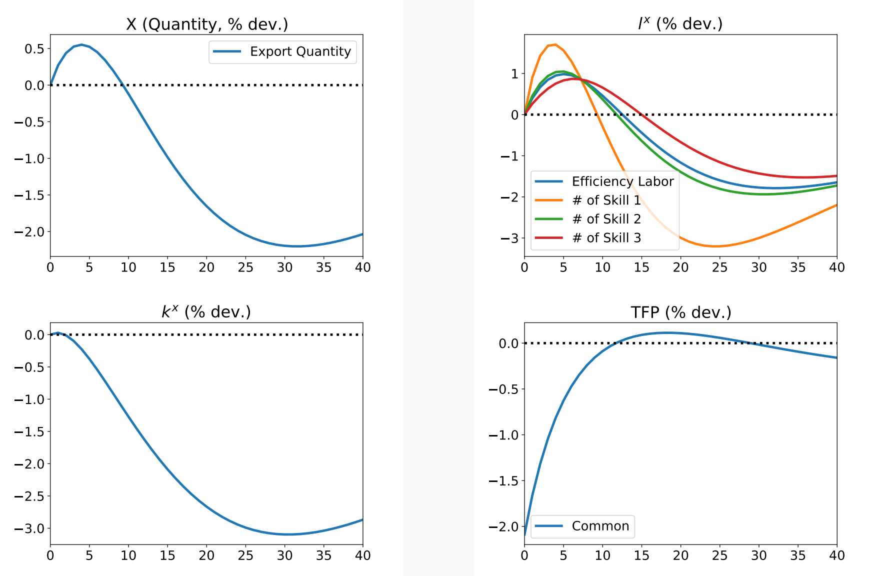

X (Quantity, % dev.)
Export Quantity
0.5
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
30
35
40

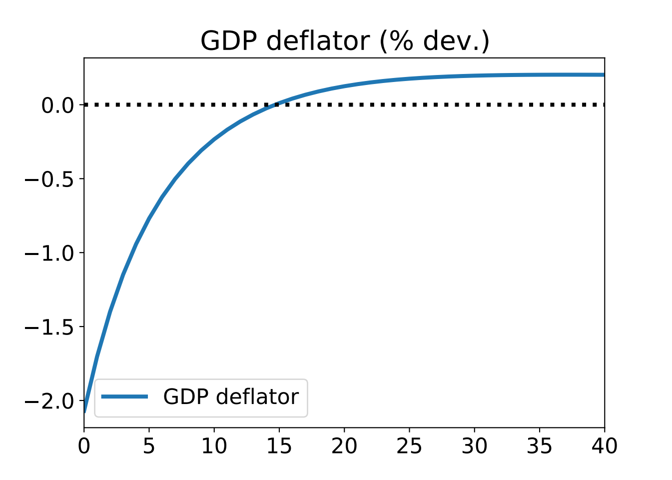

l^x (% dev.)
Efficiency Labor
# of Skill 1
# of Skill 2
# of Skill 3
1
0
−1
−2
−3
0
5
10
15
20
25
30
35
40

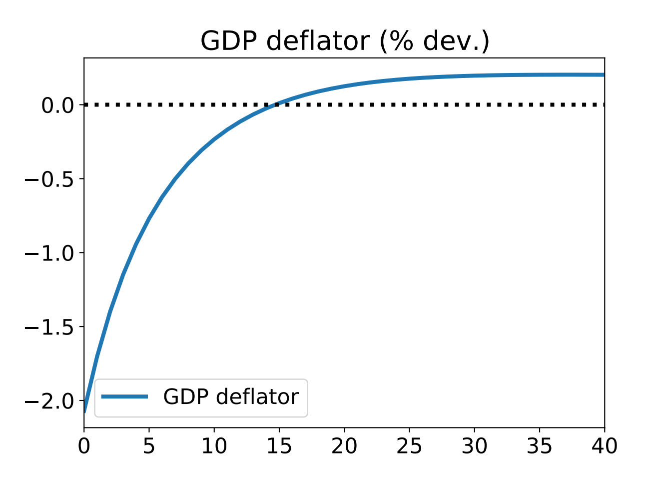

X (Quantity, % dev.)
Export Quantity
0.5
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
30
35
40

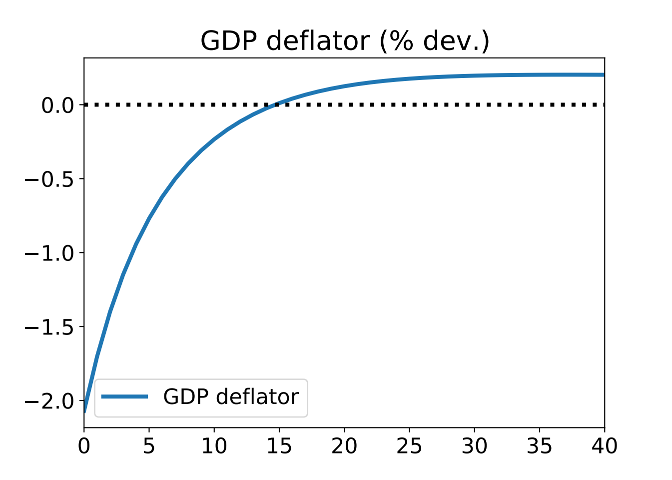

l^x (% dev.)
Efficiency Labor
# of Skill 1
# of Skill 2
# of Skill 3
1
0
−1
−2
−3
0
5
10
15
20
25
30
35
40

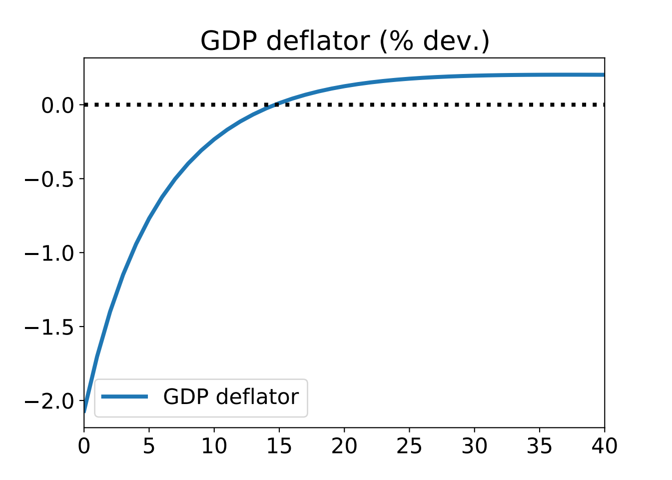

k^x (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
0
5
10
15
20
25
30
35
40


X (Quantity, % dev.)
Export Quantity
l^x (% dev.)
Efficiency Labor
# of Skill 1
# of Skill 2
# of Skill 3
k^x (% dev.)
TFP (% dev.)
Common

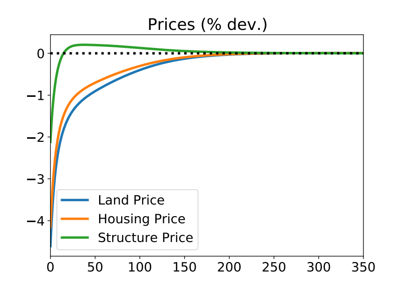

GDP deflator (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
GDP deflator
0
5
10
15
20
25
30
35
40

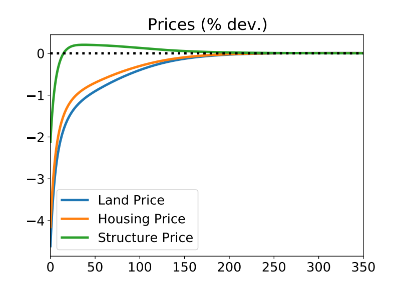

GDP deflator (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
GDP deflator
0
5
10
15
20
25
30
35
40

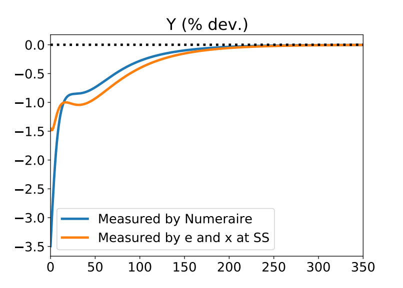

GDP deflator (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
30
35
40
GDP deflator

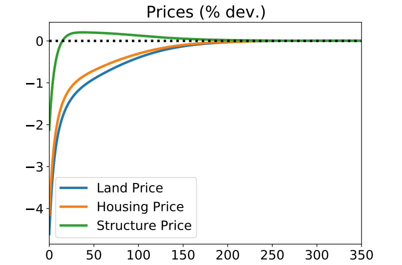

GDP deflator (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
0
5
10
15
20
25
30
35
40
GDP deflator

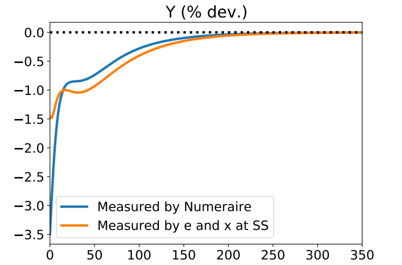
1- The Longer View: 87 years

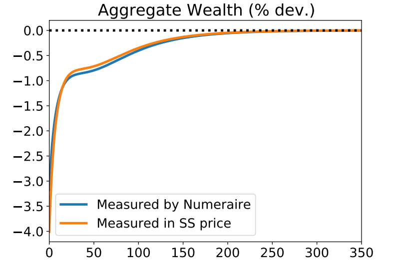



Prices (% dev.)
0
−1
−2
−3
−4
0
50
100
150
200
250
300
350
Land Price
Housing Price
Structure Price

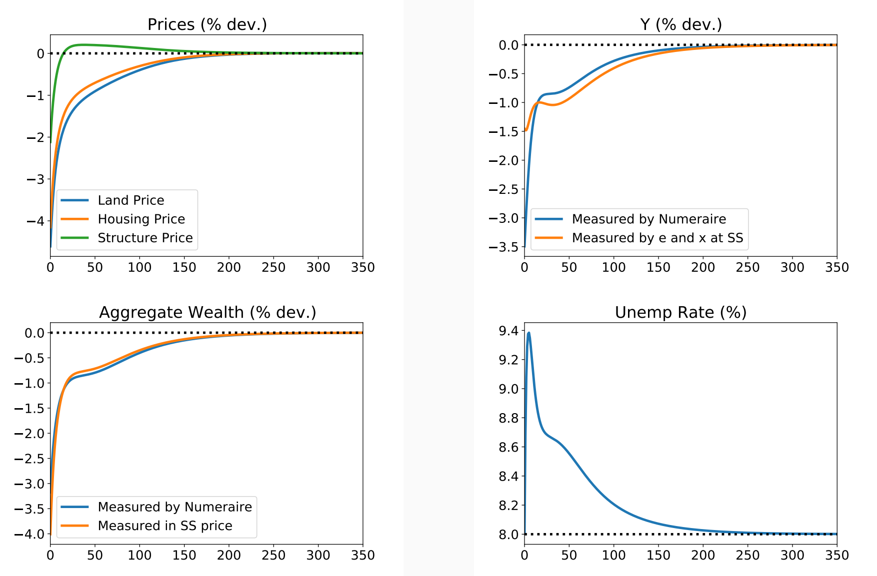

Y (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
0
50
100
150
200
250
300
350
Measured by Numeraire
Measured by e and x at SS


Prices (% dev.)
0
−1
−2
−3
−4
0 50 100 150 200 250 300 350
Land Price
Housing Price
Structure Price


Y (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
0 50 100 150 200 250 300 350
Measured by Numeraire
Measured by e and x at SS


Aggregate Wealth (% dev.)
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
0 50 100 150 200 250 300 350
Measured by Numeraire
Measured in SS price

1- The Longer View: 87 years



- Sizeable Recession With Large Drop of Wealth

- Sizeable Recession With Large Drop of Wealth
- Large Drop of Consumption.

- Sizeable Recession With Large Drop of Wealth
- Large Drop of Consumption.
- Large Reduction in Employment

- Sizeable Recession With Large Drop of Wealth
- Large Drop of Consumption.
- Large Reduction in Employment
- Large Devaluation

1- Takeaways from a 1% persistent but temporary real interest rate hik

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- Large Reduction in Employment
- Large Devaluation
- But Large Improvement in Balance of Payments (large reduction of imports)

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- Large Drop of Consumption.
- Large Reduction in Employment
- Large Devaluation
- But Large Improvement in Balance of Payments (large reduction of imports)
- Exports move up then down. Slowly due to adjustment costs in investment and productivity propagation
- Recessions are Long (Aguiar and Gopinath (2007))

- A Temporary but persistent Increase in Interest Rates

- A Temporary but persistent Increase in Interest Rates
- A 3% Temporary but persistent Decrease in the Terms of Trade

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2th Experiment: Perfect Storm: The Great Recession?

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    - TFP Elasticity wrt expenditures .5

2th Experiment: Perfect Storm: The Great Recession?

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$$\log w_t - \log w^{ss} = \psi^w \left(\log Y_t - \log Y^{ss}\right)$$

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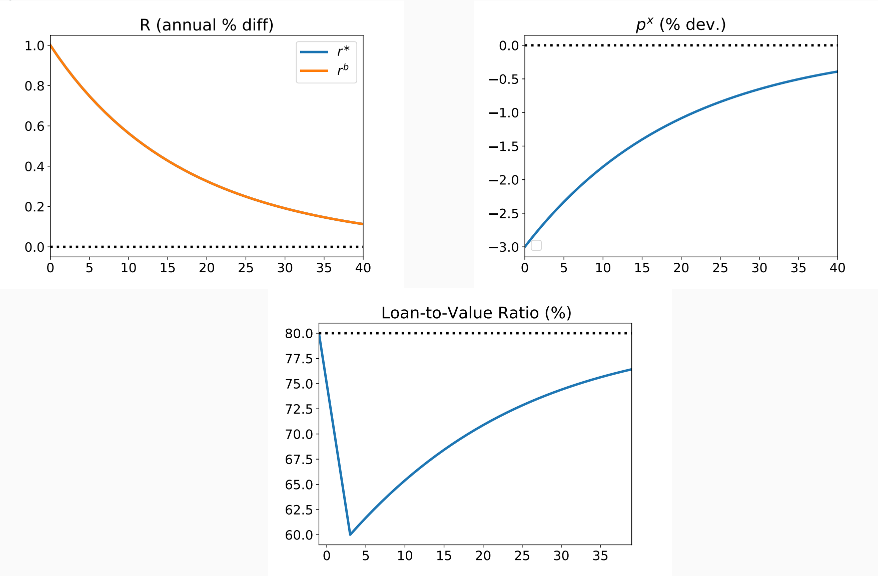
$$\log w_t - \log w^{ss} = \psi^w (\log Y_t - \log Y^{ss})$$

    - Import Elasticty .8

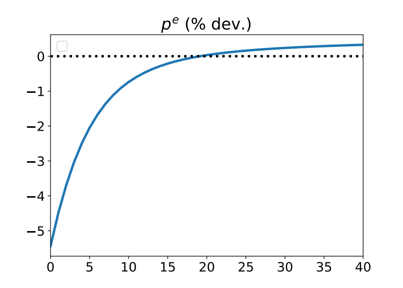
2. Exogenous Shifters: r moves 1% and p^x 5%

p^x Much more because of devaluation; LTV Does Not

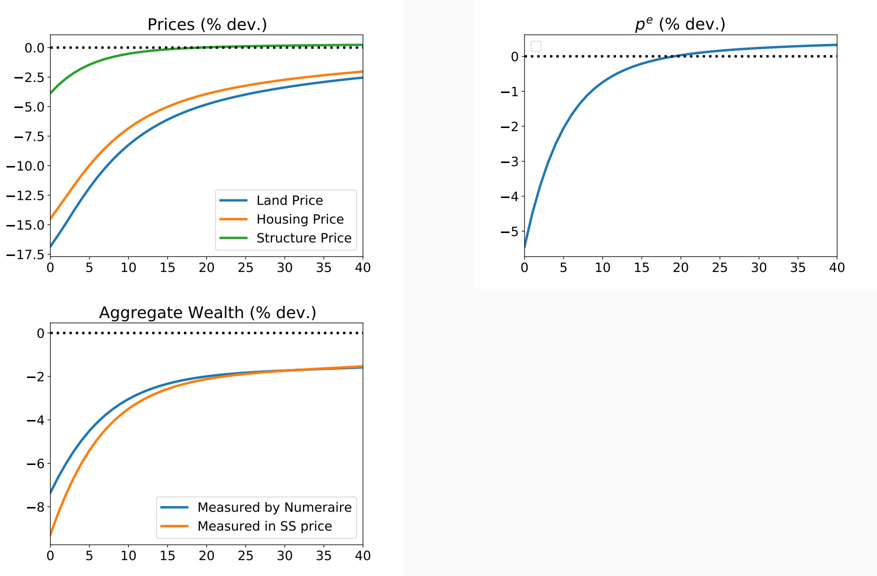



Prices (% dev.)
0.0
−2.5
−5.0
−7.5
−10.0
−12.5
−15.0
−17.5
0
5
10
15
20
25
30
35
40
Land Price
Housing Price
Structure Price

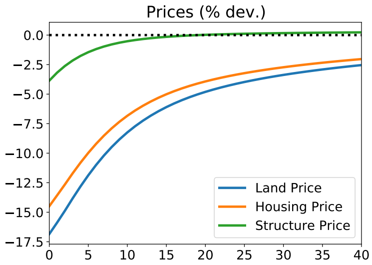
2. Asset Prices & Quantities (Financial and Total Wealth)

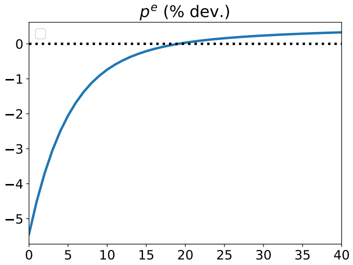


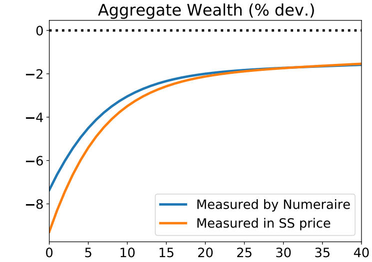
2. Asset Prices & Quantities (Financial and Total Wealth)

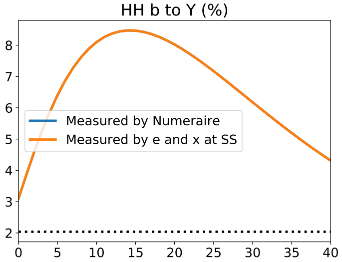


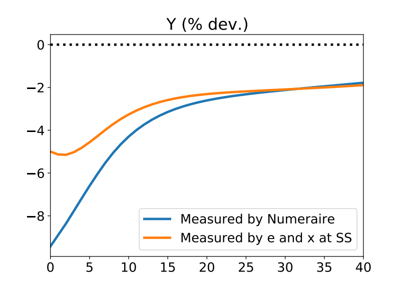
2. Asset Prices & Quantities (Financial and Total Wealth)

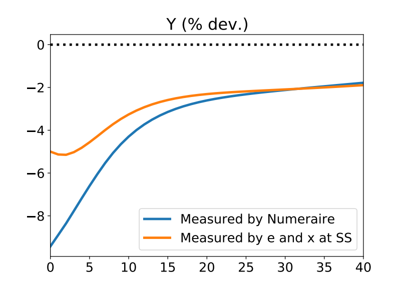


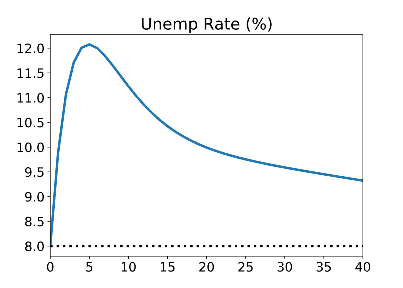


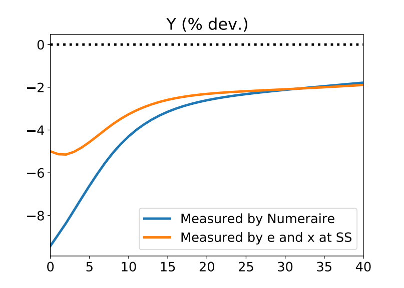


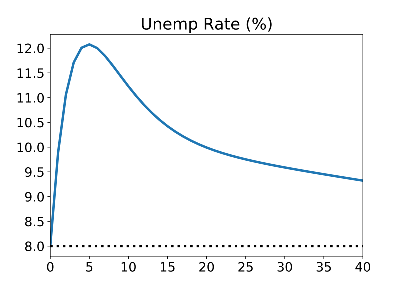


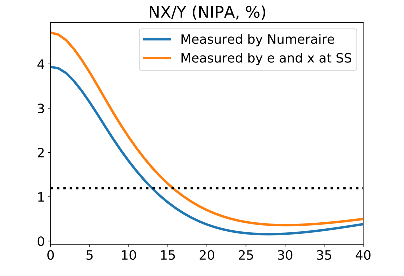

Y (% dev.)
0
−2
−4
−6
−8
0
5
10
15
20
25
30
35
40
Measured by Numeraire
Measured by e and x at SS


Y (% dev.)
0
−2
−4
−6
−8
0
5
10
15
20
25
30
35
40
Measured by Numeraire
Measured by e and x at SS

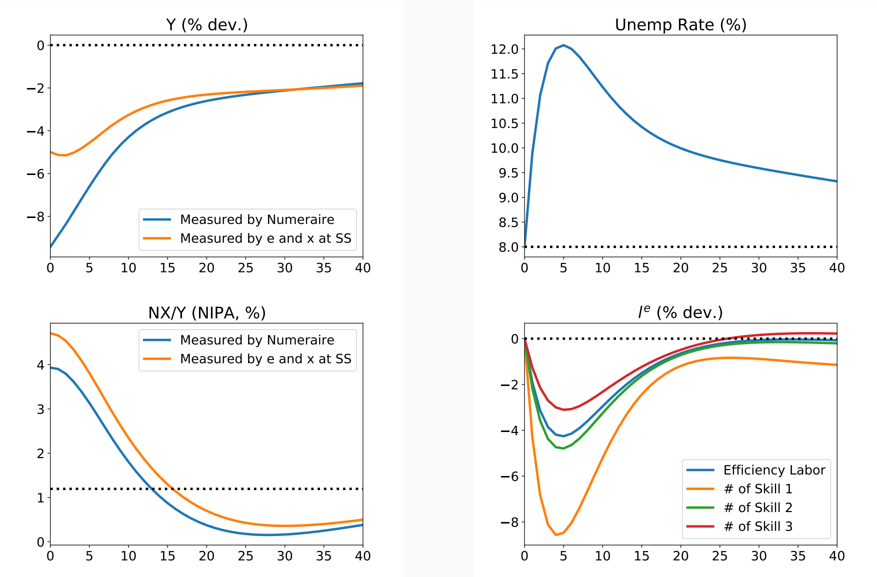

Unemp Rate (%)
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
0
5
10
15
20
25
30
35
40

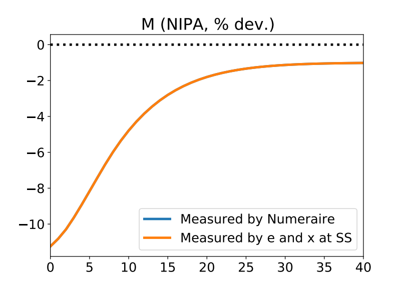

Y (% dev.)
0
−2
−4
−6
−8
Measured by Numeraire
Measured by e and x at SS
0 5 10 15 20 25 30 35 40


Unemp Rate (%)
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
0 5 10 15 20 25 30 35 40

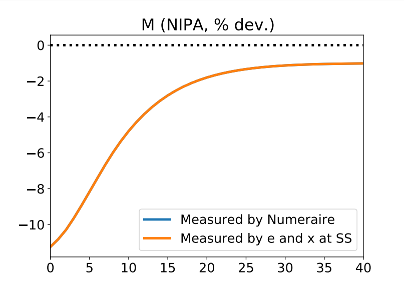

NX/Y (NIPA, %)
Measured by Numeraire
Measured by e and x at SS
4
3
2
1
0
0 5 10 15 20 25 30 35 40

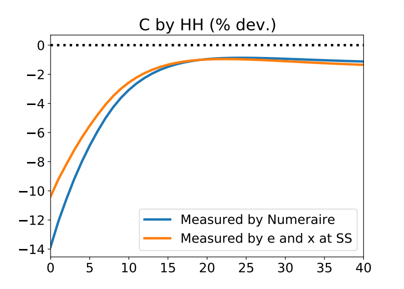
2. Main Business Cycle Objects




M (NIPA, % dev.)
0
−2
−4
−6
−8
−10
0
5
10
15
20
25
30
35
40
Measured by Numeraire
Measured by e and x at SS

2. GDP Components





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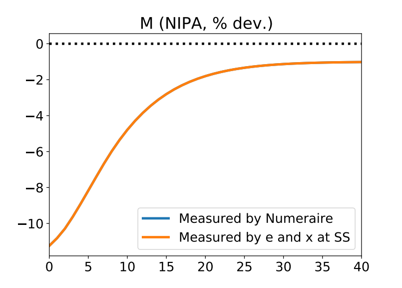

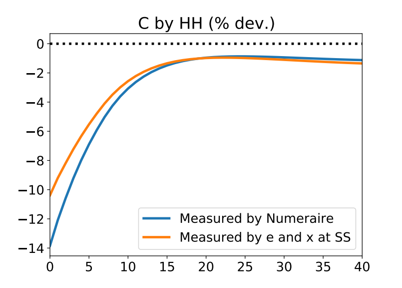

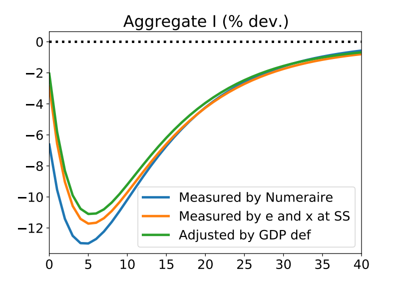

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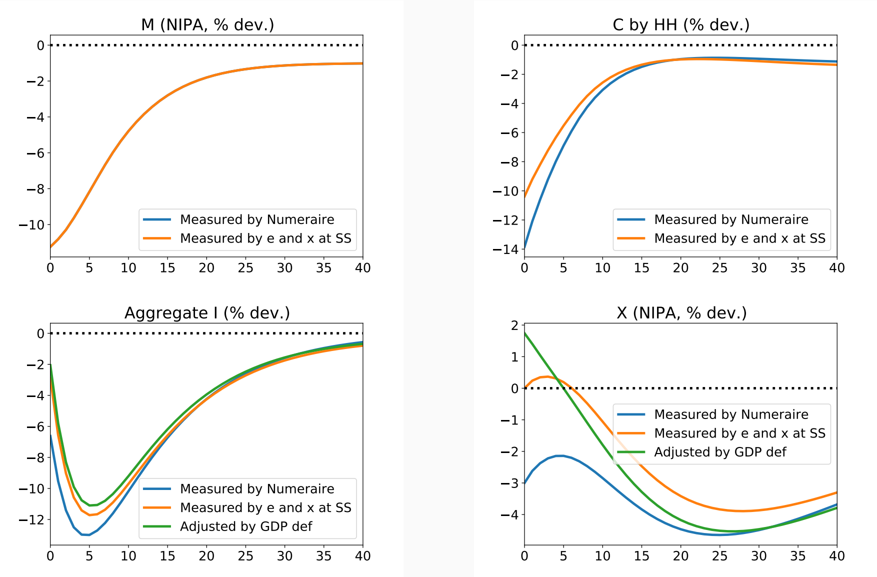

- Everything Larger

- Everything Larger

- Very Large Devaluation relative to price decrease

- Everything Larger
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- Huge Drop of Consumption, Investment and Exports

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- Humongous reduction of imports: Sizeable Improvement in Balance of Payments.

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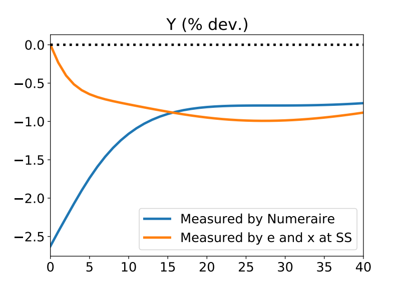
- Very Large Devaluation relative to price decrease
- Huge Drop of Consumption, Investment and Exports
- Huge Reduction in Employment
- Humongous reduction of imports: Sizeable Improvement in Balance of Payments.
- Not consistent world wide. Need much larger drop in foreign demand.

3- No Amplification via Expenditure Externality



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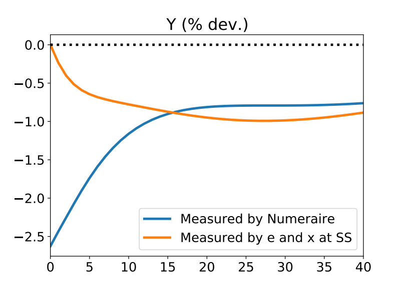

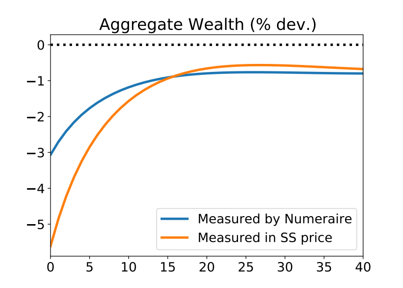

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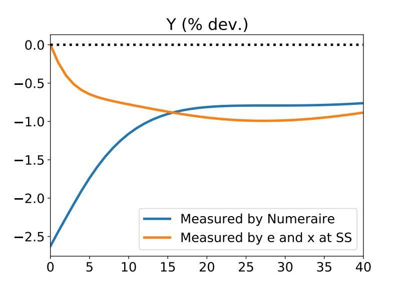
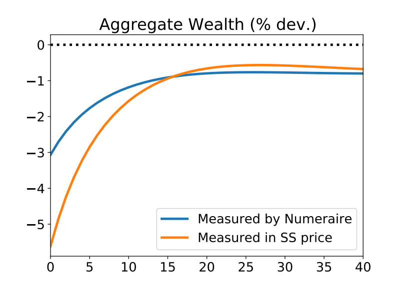
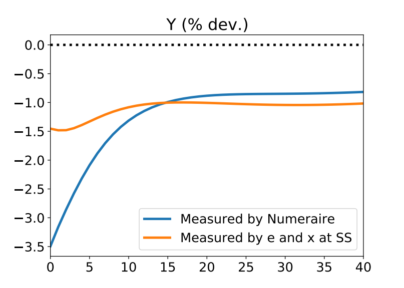
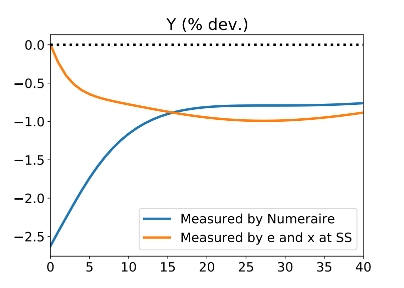
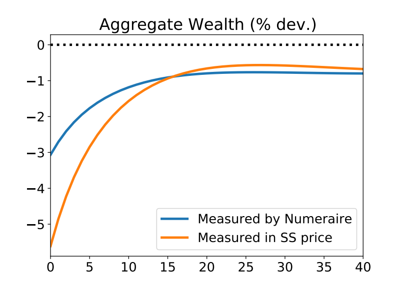




Comparing with Baseline







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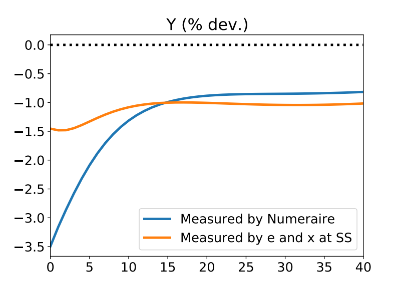
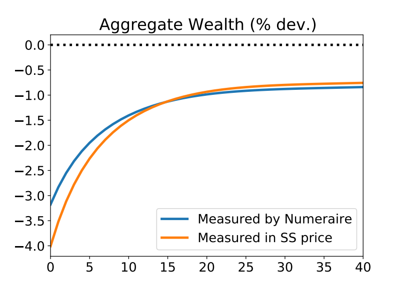




- Elastic Non-tradable price no market clearing on non-tradables, demand determined quantities

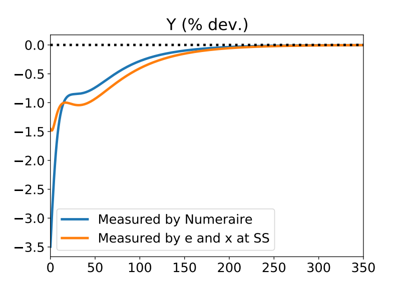
- A Temporary but persistent Increase in Interest Rates
- Elastic Non-tradable price no market clearing on non-tradables, demand determined quantities
- Reduction in Max LTV from 80% to 60%
- With TFP Externality
    - TFP Elasticity wrt expenditures .5
    - Wage Adjustments ($\psi^w = .5$)

$$\log w_t - \log w^{ss} = \psi^w \left(\log Y_t - \log Y^{ss}\right)$$

    - Import Elasticty .8

Comparing with output across horizons between base and partial devaluation

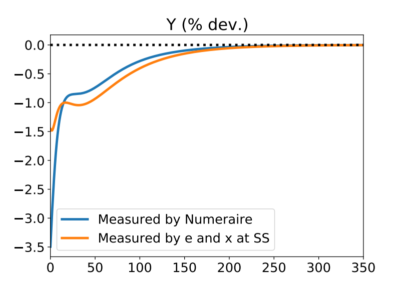
Baseline



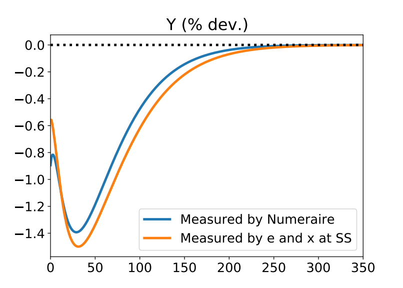
Partial Devaluation

Comparing with output across horizons between base and partial devaluation

Baseline



Partial Devaluation



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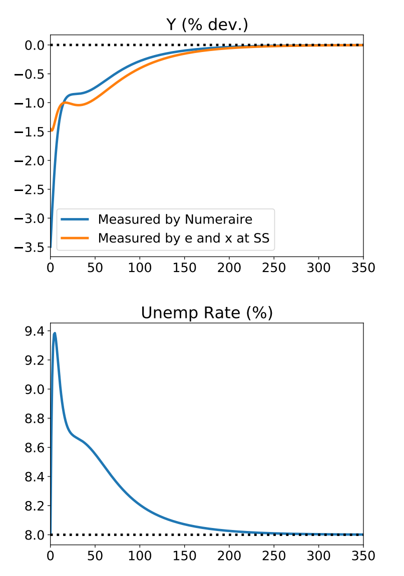
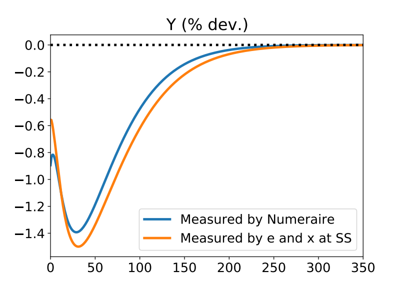
Baseline



Partial Devaluation



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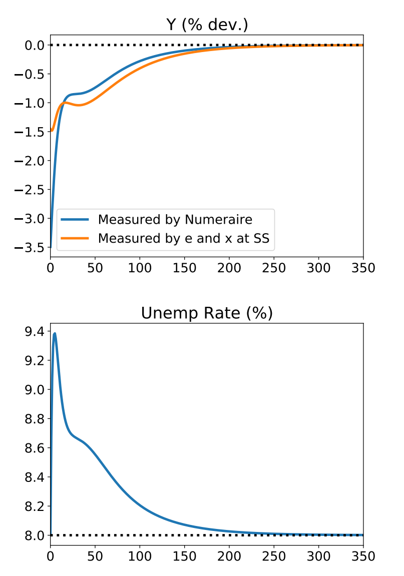
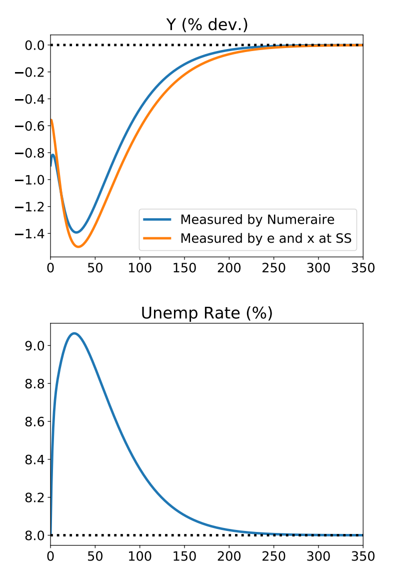
Baseline



Partial Devaluation



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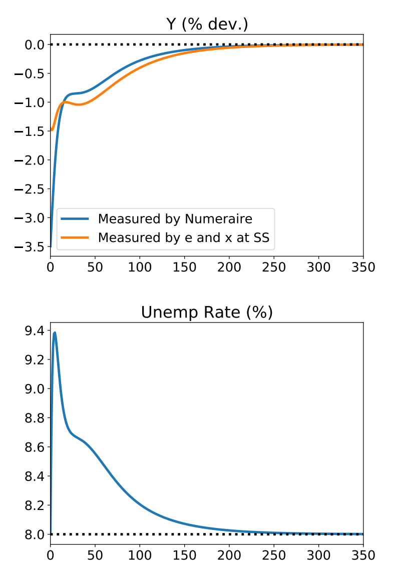
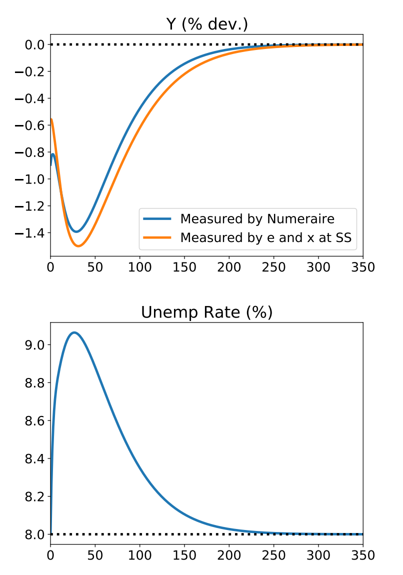
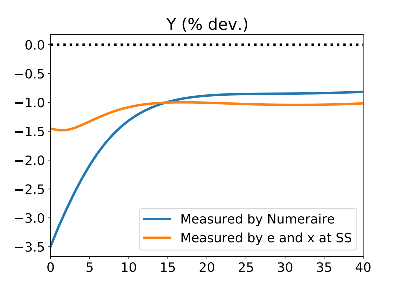
Baseline



Partial Devaluation

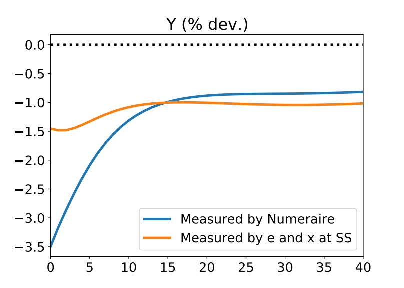


Baseline



Perfect Storm

Baseline



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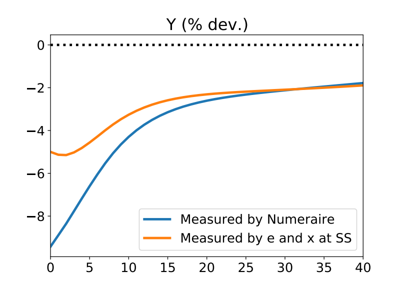
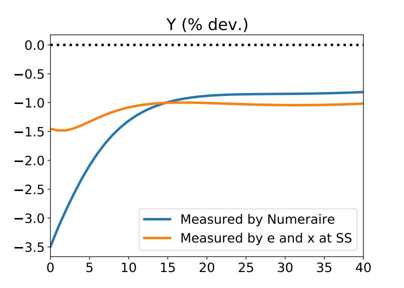


Comparison between all Economies: Output

Baseline



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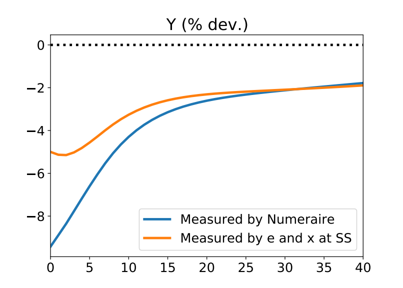
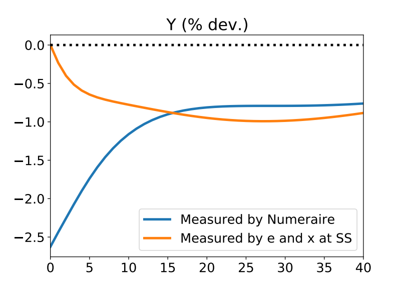


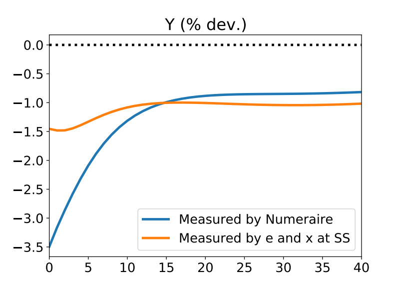
No TFP Externality



Insufficient Devaluation

Comparison between all Economies: Output

Baseline



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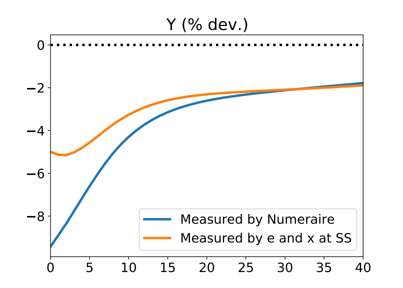

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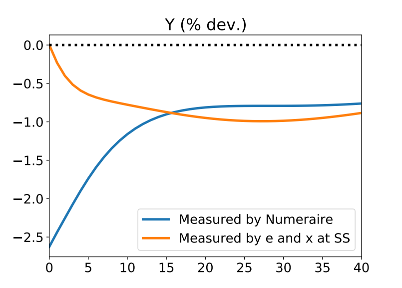

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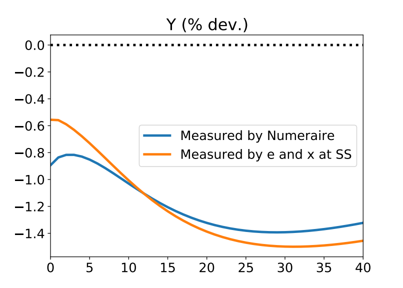
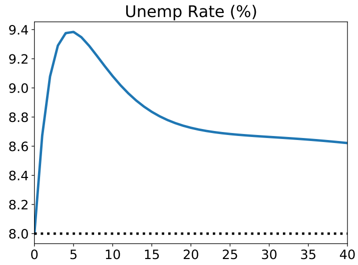
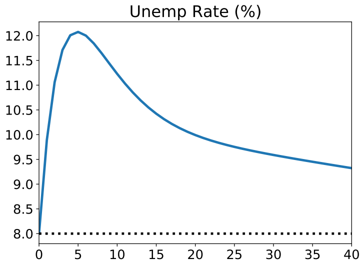


Comparison between all Economies: Unemployment

Baseline



Perfect Storm



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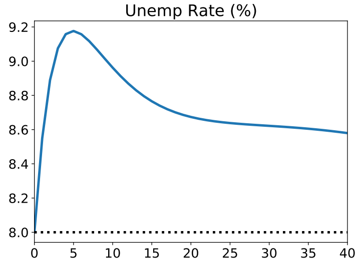
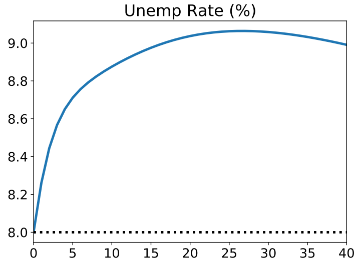


Insufficient Devaluation



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What we want to have but do not have YET

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- Have a modern New Keynesian structure to model the link between nominal and real interest rates

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- Build more Asset prices and productivity propagation into those models.

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- In other work we show how expansionary policy (with house price increases) put households more at risk for later interest rate hikes.

Thank you very much

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