



Course in Macro: Econ 8200

I: Reassessing the Role of Heterogeneity for Business Cycles

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HETEROGENEITY AND INEQUALITY ARE A SIGN OF THE TIMES





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





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 - There is a lot of wealth that can be used efficiently to weather changes in available resources.
- 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 Johnson, Parker, and Souleles (2004), Misra and Surico (2014).



Heterogeneity (Inequality) in 2006:
Marginal Distributions

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Q5	47.5	45.6	82.7	82.5
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- a: Bottom 40% holds basically no wealth
- y, c: less concentrated

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a	% Share of:		Exp. Rate c/y (%)
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- 80% poorest account for 63% of consumption





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 - 3.1 Nonlinear decision rules (at least on the low levels of income and wealth)
 - 3.2 A lot of agents in the states where their behavior is non linear (close to zero cash in hand).





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 2. Moreover, most agents are in the essentially linear part of the state space
- Heterogeneous agents models are like Rep Agent models for business cycle purposes.
Also confirmed in life-cycle models.

WHY IN THOSE MODELS HETEROGENEITY DID NOT MATTER MUCH?





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 3. Large enough shocks

A FIRST UPDATE TO HETEROGENEOUS AGENT MODELS



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



Net Worth	Data		Model
% Share held by:	PSID, 06	SCF, 07	
Q1	-0.9	-0.2	0.3
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 inequality almost right at the very bottom



a Quintile	% Share of:				%c/y	
	y		c		Data	Model
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Q1	8.6	6.0	11.3	6.6	92.2	90.4
Q2	10.7	10.5	12.4	11.3	81.3	86.9
Q3	16.6	16.6	16.8	16.6	70.9	81.1
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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-Lorenzoni-2009)





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- 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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- Can be easily implemented via an expenditure externality ([Krueger, Mitman, and Perri \(2016\)](#))





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





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- Expenditures play a role and adjustment is costly.
 - 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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- We also explore slow adjustment of nontradable prices (insufficient devaluation)



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- Discussion of how to Map the model to data
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 - Incomplete adjustment on the relative price of inputs (insufficient devaluation) after the rate hike



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 - Heterogeneous Households



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- Housing H , a combo of structures S & land L in fixed supply.



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- Imports are the Numeraire



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



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s.t.
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$$k' = (1 - \delta^k)k + \Psi^e(m, e) - \phi^{e,k}[k, \Psi^e(m, e)],$$



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AND SKILL SPECIFIC SEPARATION RATES

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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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- 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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1 Steady State



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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
Output	1.00	1.00



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Share of Export	0.30	0.30



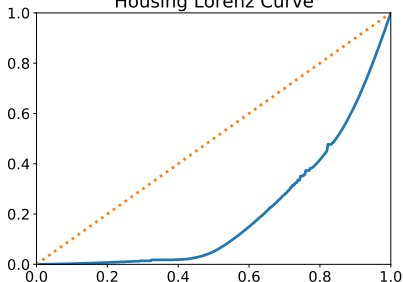
	Target	Model
Output	1.00	1.00
Capital-to-Output	2.00	2.00
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Relative Price of Nontradable	1.00	1.00
Share of Export	0.30	0.30
Employment Rate	0.92	0.92



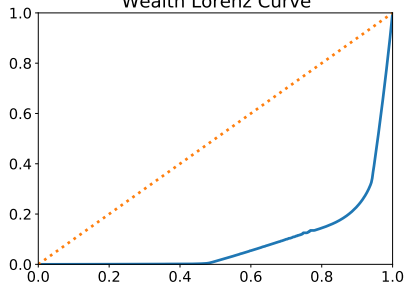
	Target	Model	Tool	Value
Output	1.00	1.00	TFP in Export	0.73
Capital-to-Output	2.00	2.00	Capital dep. rate	0.025
Housing-Value-to-Output	1.80	1.76	Util shifter in housing	0.50
Debt-to-GDP	0.00	0.02	Discount rate	0.92
Wealth-to-Output	4.50	4.57	Dep. rate in housing	0.008
Wealth Gini	0.82	0.82	Top Share holdings	13.20
Frac. of H held by bottom 70%	0.25	0.27	\hat{h}_1	0.98
Frac. of H held by bottom 80%	0.39	0.41	\hat{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



Housing Lorenz Curve



Wealth Lorenz Curve



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

2

Putting the Model to Use:

Experiments





- We can estimate the extent of frictions to generate the Recession.



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 2. Size of Frictions in goods markets: To match productivity changes.
 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.)





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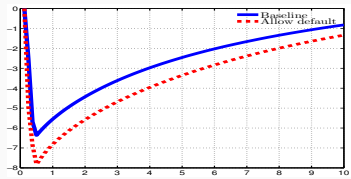


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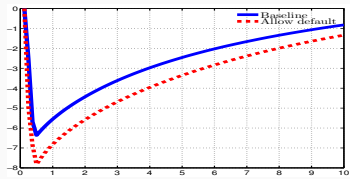
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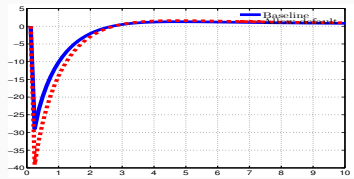
- Like in all heterogeneous agents models, more frictions imply that in the long run output and wealth end up being higher.
- But in our economies the transition is associated to a recession.



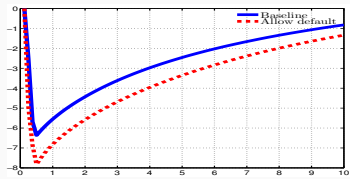
Consumption



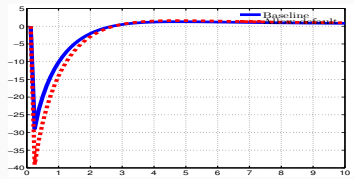
Consumption



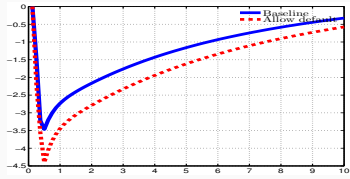
Investment



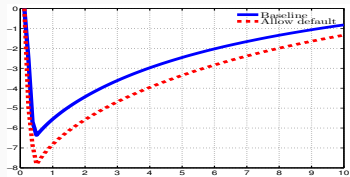
Consumption



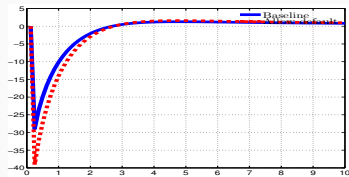
Investment



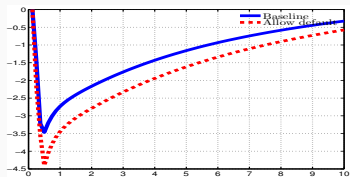
Output



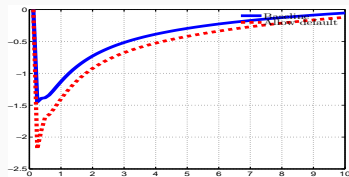
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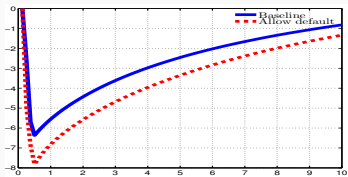
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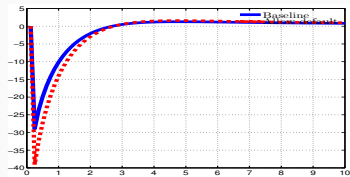
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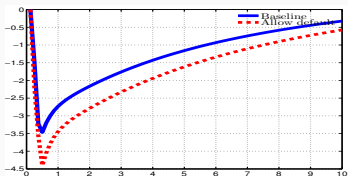
TFP



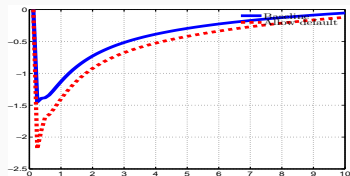
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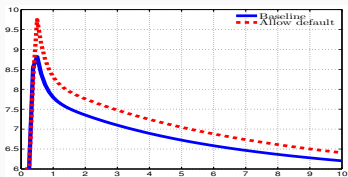
Investment



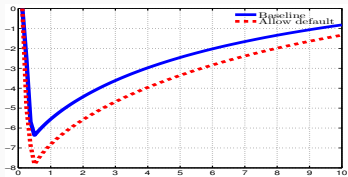
Output



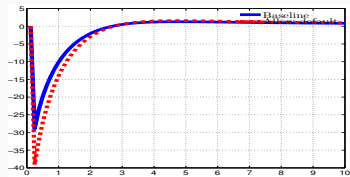
TFP



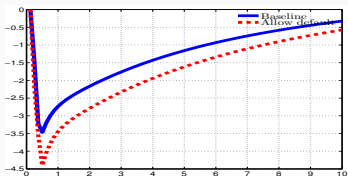
Unemployment rate



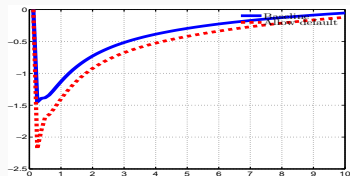
Consumption



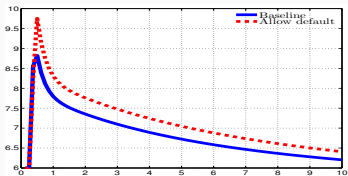
Investment



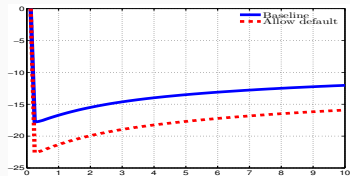
Output



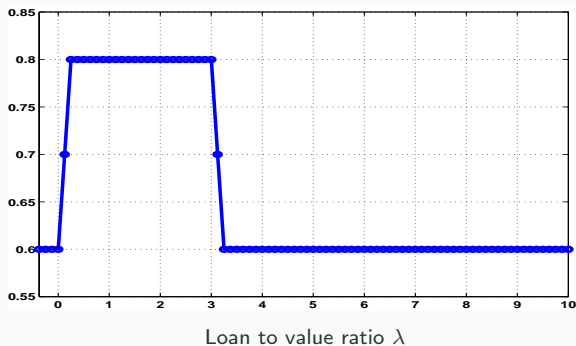
TFP



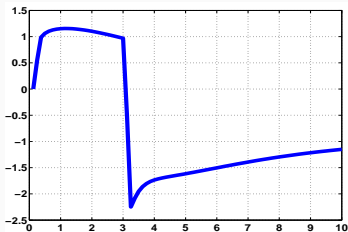
Unemployment rate



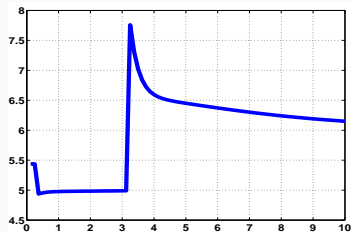
Housing Prices



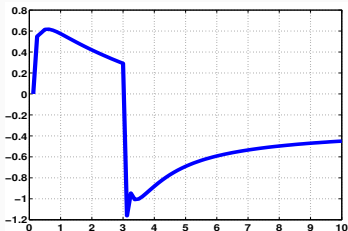
ANOTHER EXPERIMENT A CREDIT CYCLE



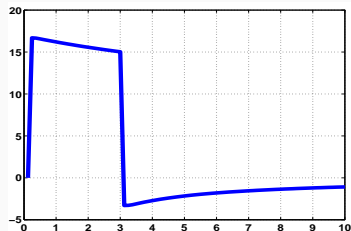
Real output



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 (97,98)) interesting really happens. There are modern linearization versions based on Reiter such as Ahn et al. (17) and Childers (17).
- 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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- Adding more shocks is linearly more costly



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



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



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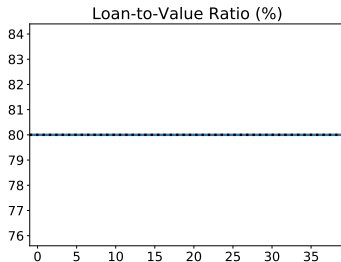
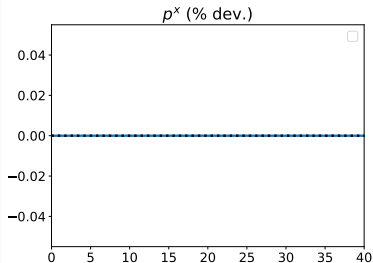
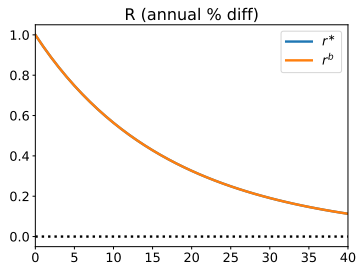
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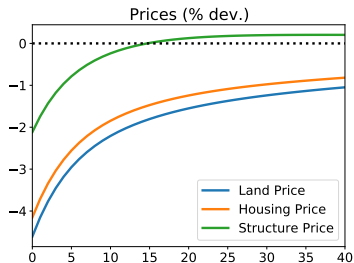
- Import Elasticity .8

1- EXOGENOUS SHIFTER: (ONLY r MOVES)

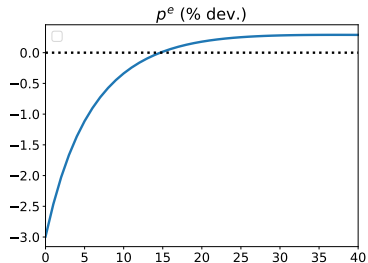
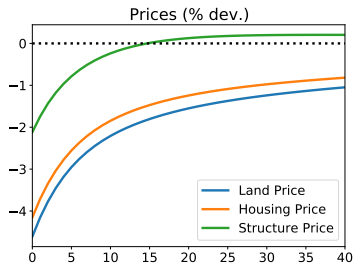


p^x BECAUSE OF DEVALUATION LTV DOES NOT





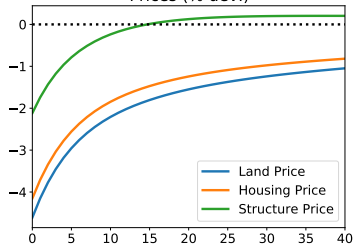
1- ASSET PRICES & QUANTITIES (FINANCIAL AND TOTAL WEALTH)



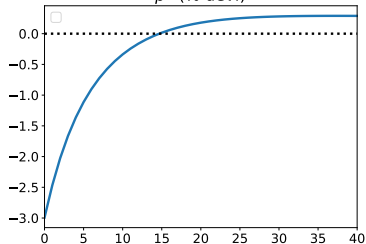
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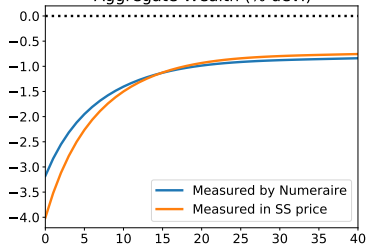
Prices (% dev.)



p^e (% dev.)



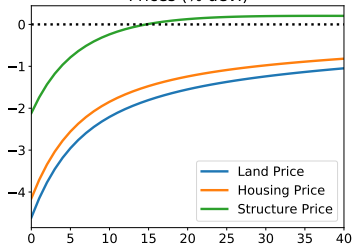
Aggregate Wealth (% dev.)



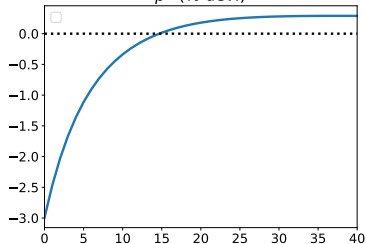
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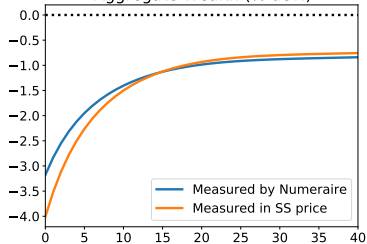
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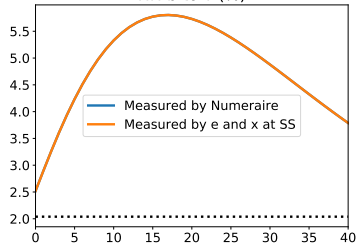
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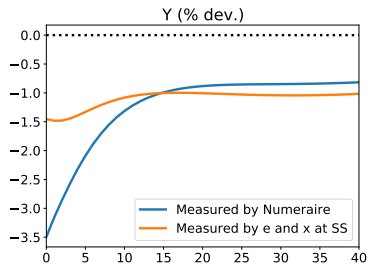
Aggregate Wealth (% dev.)



HH b to Y (%)



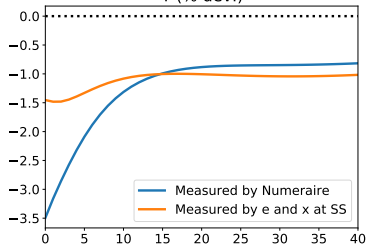
1- MAIN BUSINESS CYCLE OBJECTS



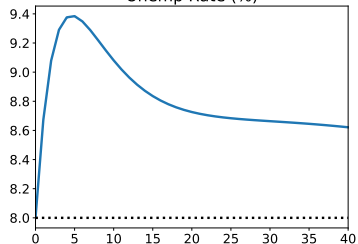
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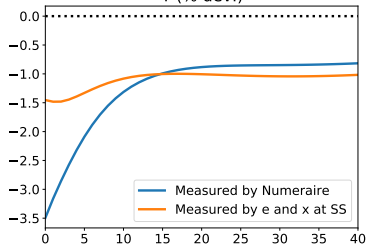
Unemp Rate (%)



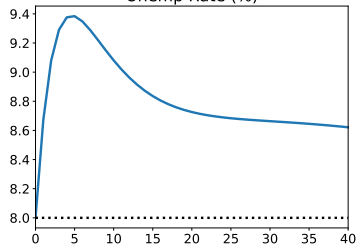
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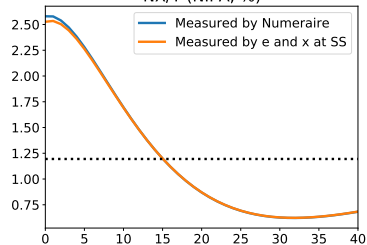
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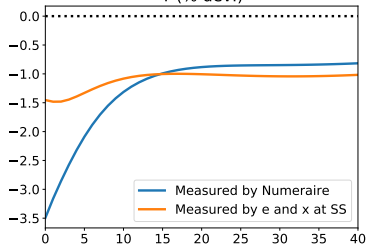
NX/Y (NIPA, %)



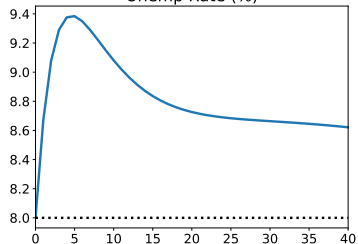
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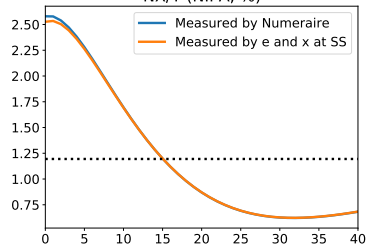
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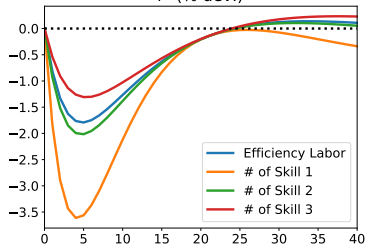
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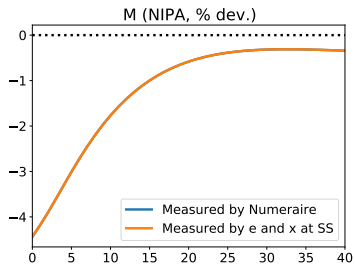


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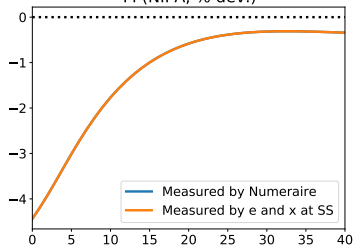
I^e (% dev.)



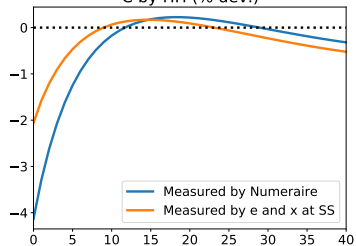




M (NIPA, % dev.)

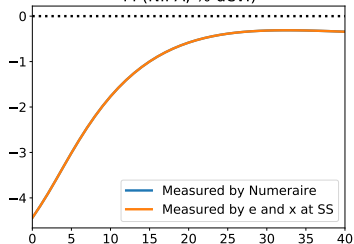


C by HH (% dev.)

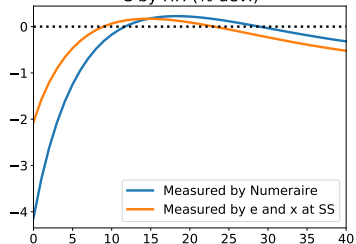




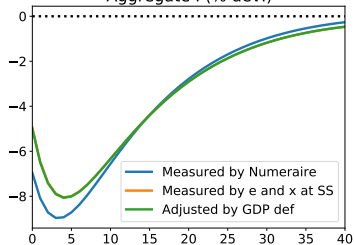
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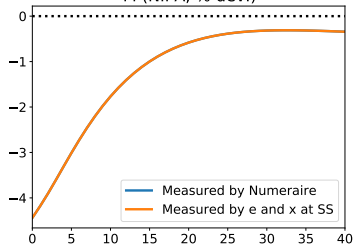
Aggregate I (% dev.)



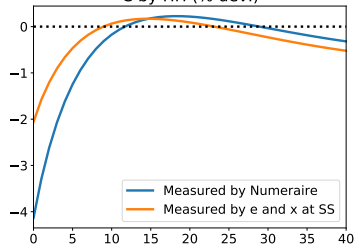
1- GDP COMPONENTS



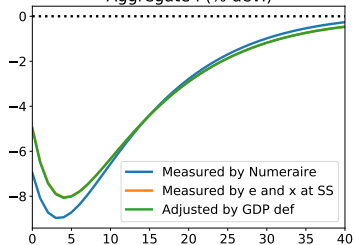
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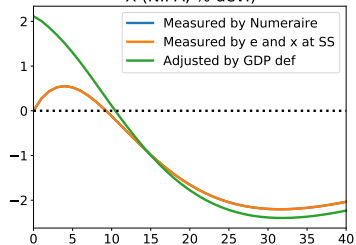
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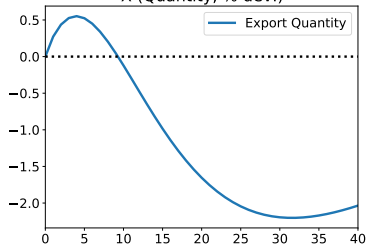


X (NIPA, % dev.)



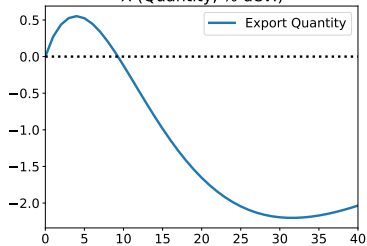
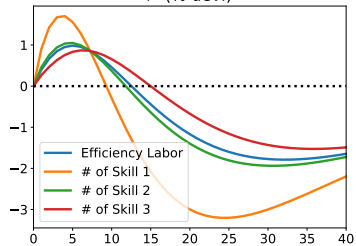


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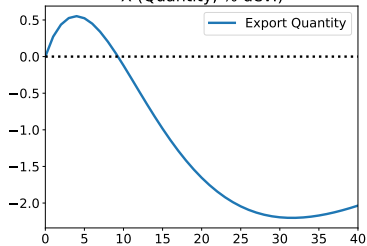
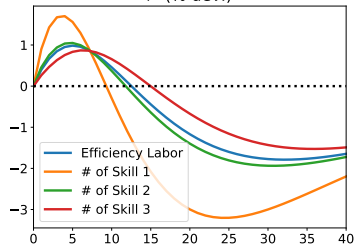
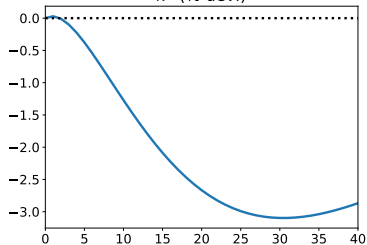


X (Quantity, % dev.)

 I^x (% dev.)

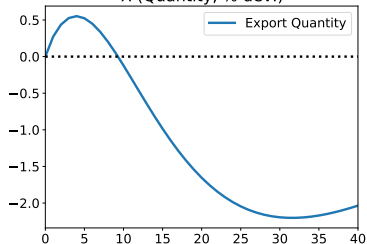
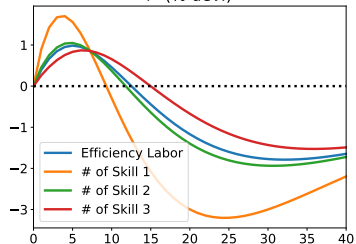
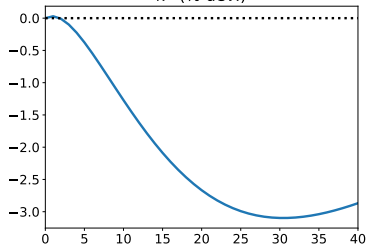


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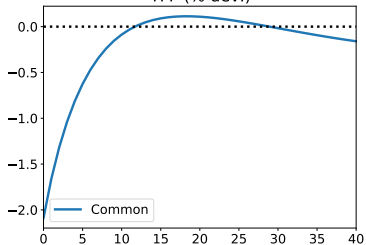
 I^X (% dev.) k^X (% dev.)

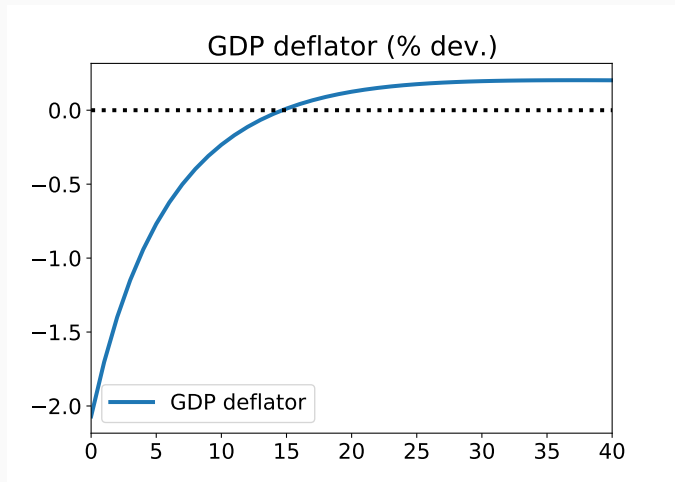


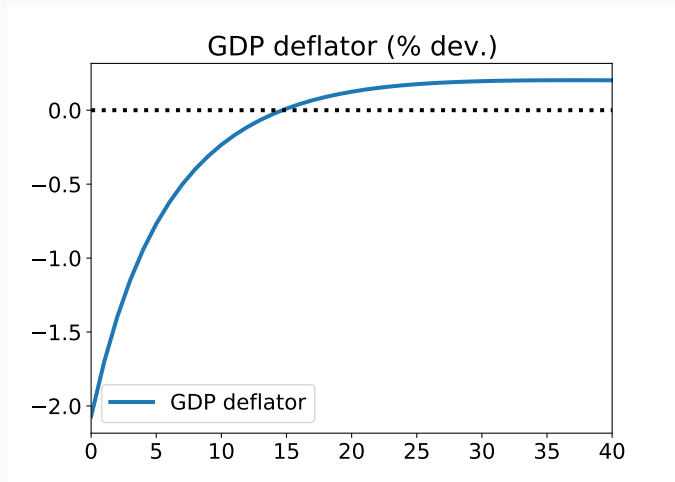
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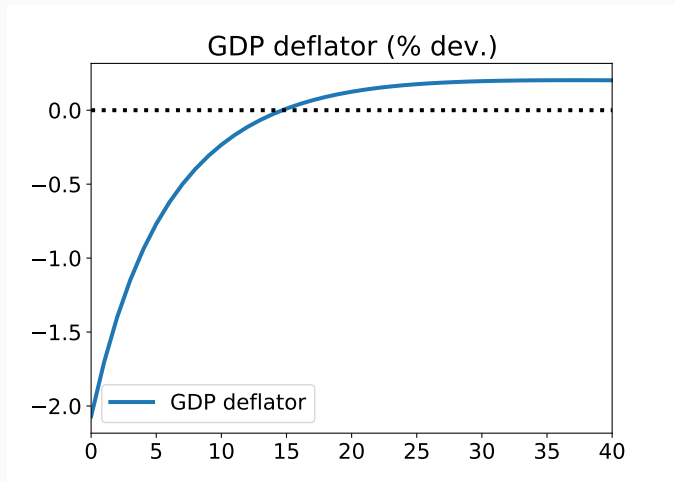
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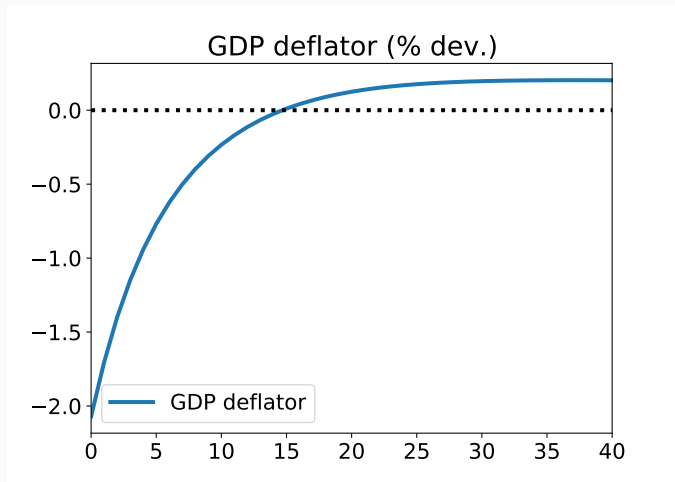
TFP (% dev.)

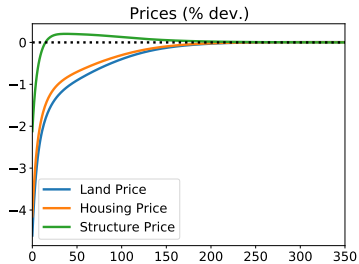


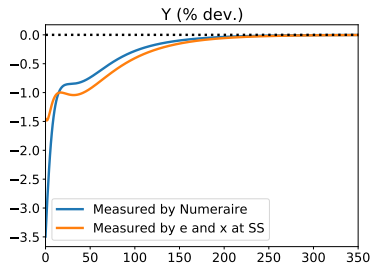
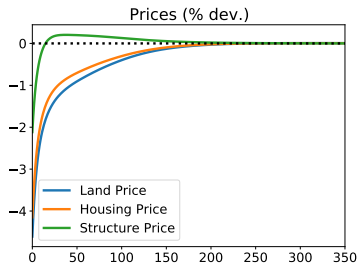




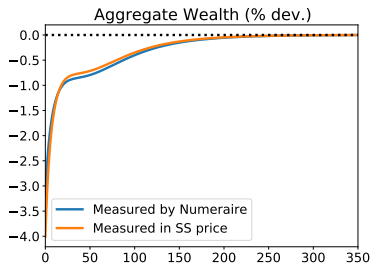
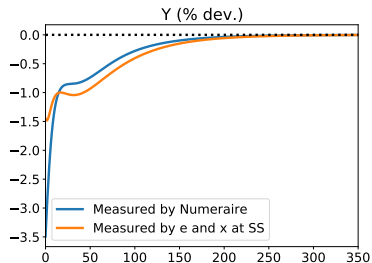
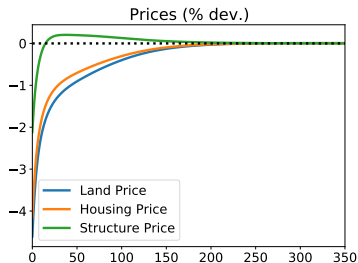








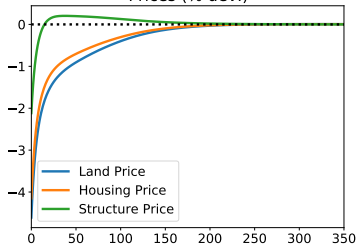
1- THE LONGER VIEW: 87 YEARS



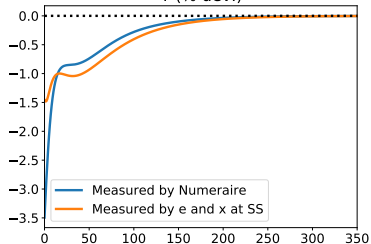
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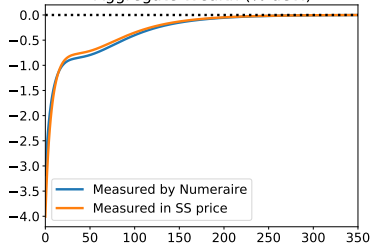
Prices (% dev.)



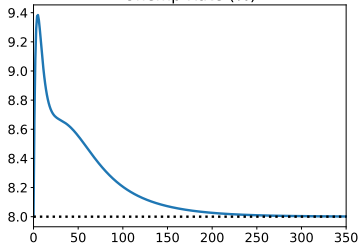
Y (% dev.)



Aggregate Wealth (% dev.)



Unemp Rate (%)





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- Large Drop of Consumption.



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- Large Reduction in Employment



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- Recessions are Long ([Aguiar and Gopinath \(2007\)](#))



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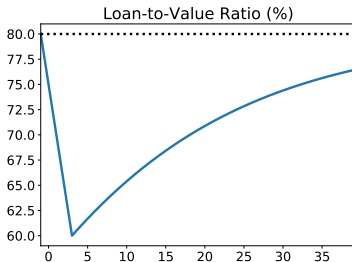
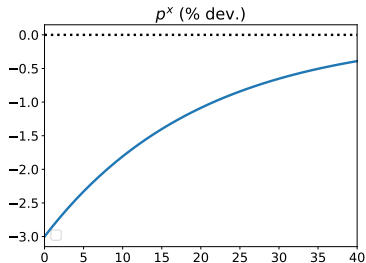
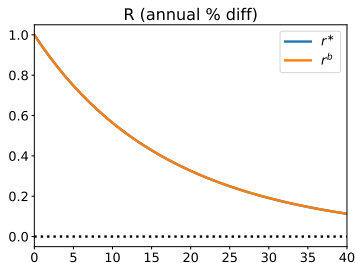


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 - Import Elasticity .8

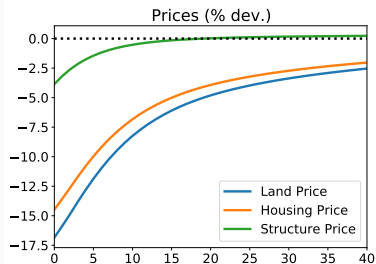
2. EXOGENOUS SHIFTERS: r MOVES 1% AND p^x 5%



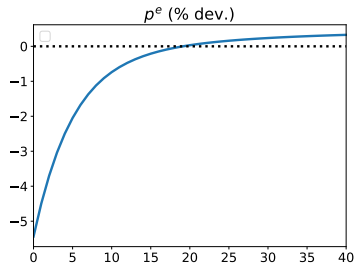
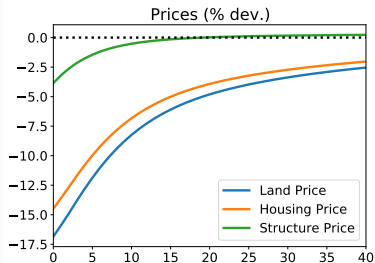
p^x MUCH MORE BECAUSE OF DEVALUATION; LTV DOES NOT



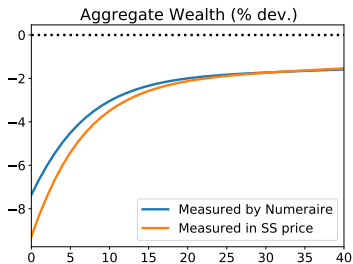
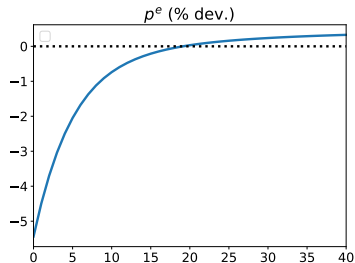
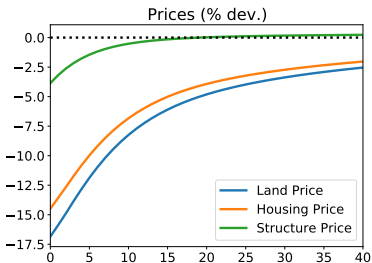
2. ASSET PRICES & QUANTITIES (FINANCIAL AND TOTAL WEALTH)



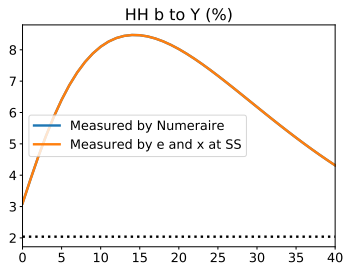
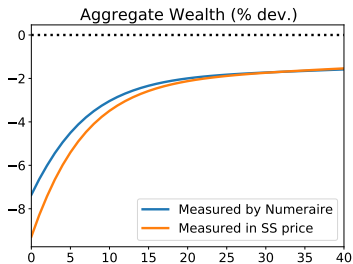
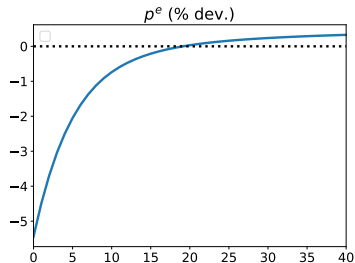
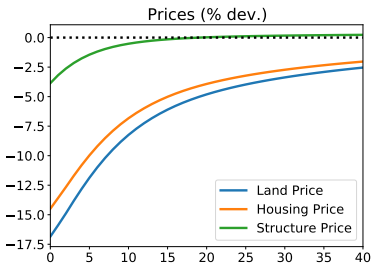
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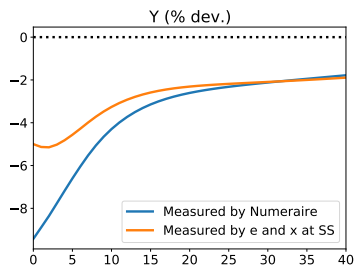
2. ASSET PRICES & QUANTITIES (FINANCIAL AND TOTAL WEALTH)



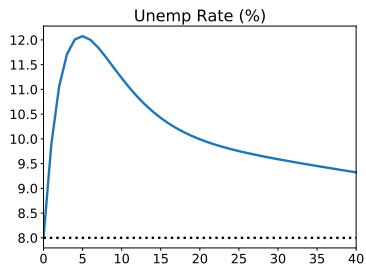
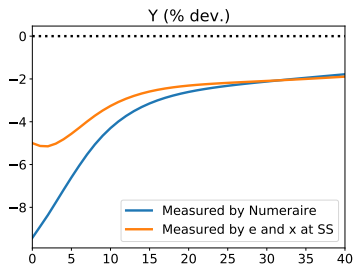
2. ASSET PRICES & QUANTITIES (FINANCIAL AND TOTAL WEALTH)



2. MAIN BUSINESS CYCLE OBJECTS



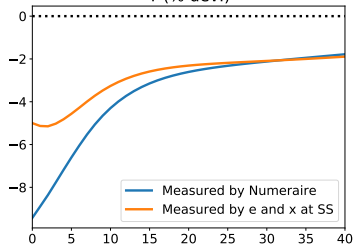
2. MAIN BUSINESS CYCLE OBJECTS



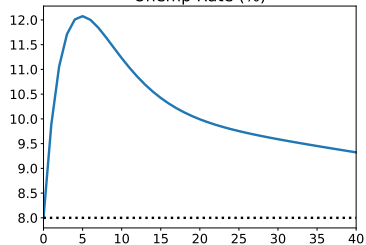
2. MAIN BUSINESS CYCLE OBJECTS



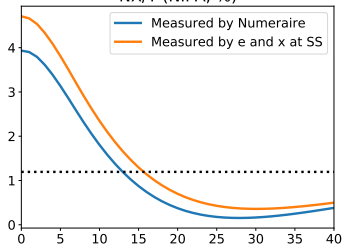
Y (% dev.)



Unemp Rate (%)



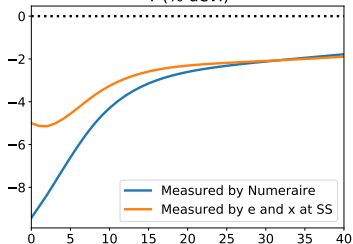
NX/Y (NIPA, %)



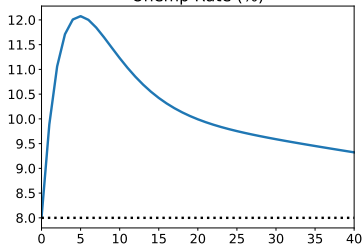
2. MAIN BUSINESS CYCLE OBJECTS



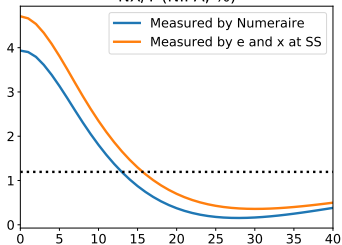
Y (% dev.)



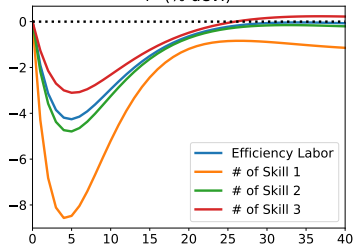
Unemp Rate (%)



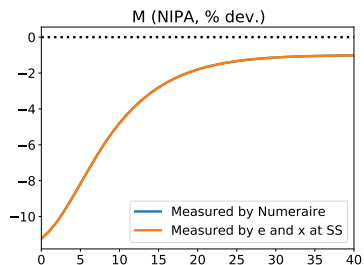
NX/Y (NIPA, %)



I^e (% dev.)



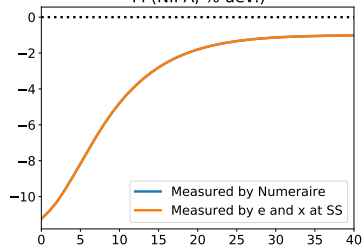
2. GDP COMPONENTS



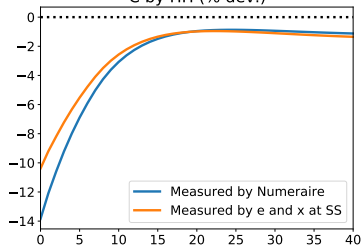
2. GDP COMPONENTS



M (NIPA, % dev.)



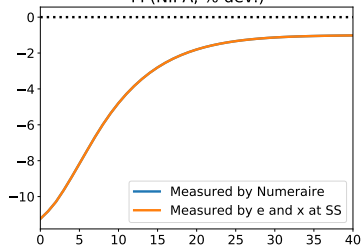
C by HH (% dev.)



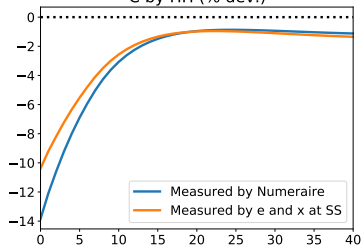
2. GDP COMPONENTS



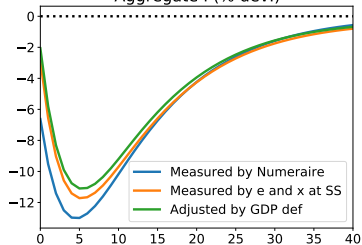
M (NIPA, % dev.)



C by HH (% dev.)



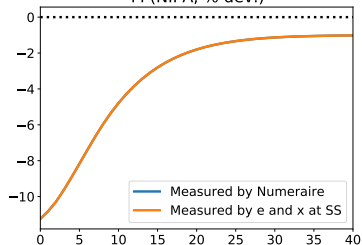
Aggregate I (% dev.)



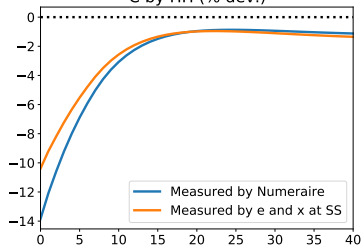
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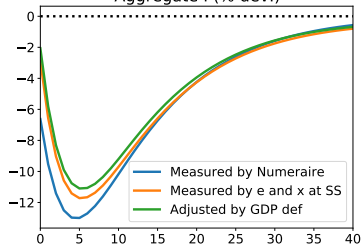
M (NIPA, % dev.)



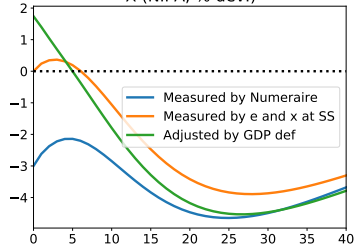
C by HH (% dev.)



Aggregate I (% dev.)



X (NIPA, % dev.)





- Everything Larger



- Everything Larger
- Very Large Devaluation relative to price decrease



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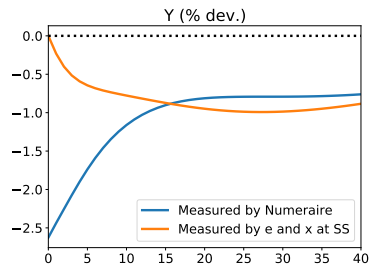


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- Humongous reduction of imports: Sizeable Improvement in Balance of Payments.



- Everything Larger
- 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.

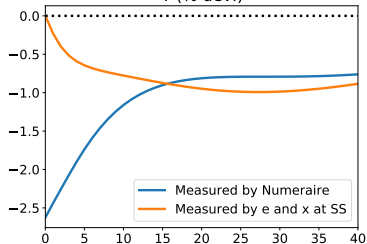
3- No AMPLIFICATION VIA EXPENDITURE EXTERNALITY



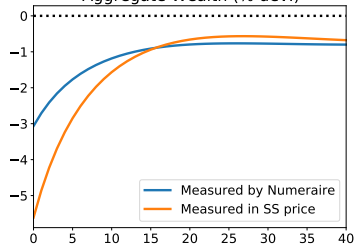
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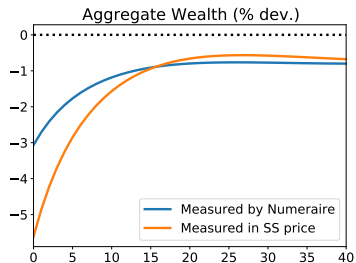
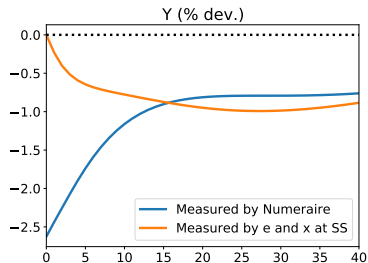
Y (% dev.)



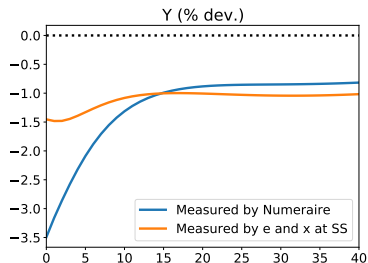
Aggregate Wealth (% dev.)



3- No AMPLIFICATION VIA EXPENDITURE EXTERNALITY



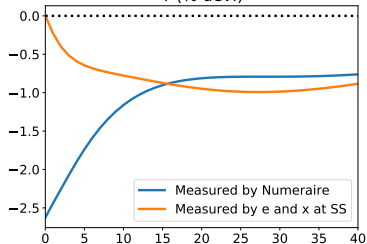
Comparing with Baseline



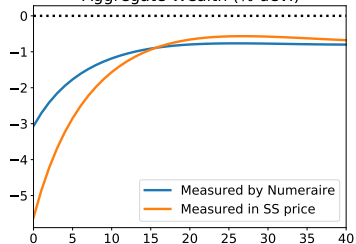
3- No AMPLIFICATION VIA EXPENDITURE EXTERNALITY



Y (% dev.)

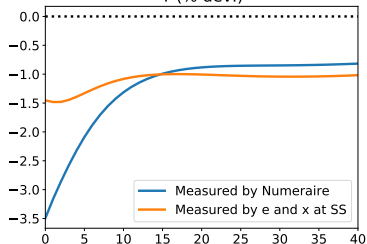


Aggregate Wealth (% dev.)

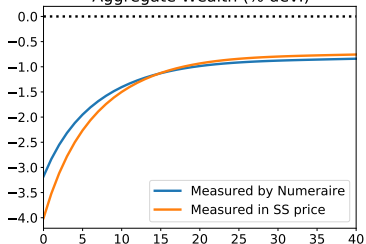


Comparing with Baseline

Y (% dev.)



Aggregate Wealth (% dev.)





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



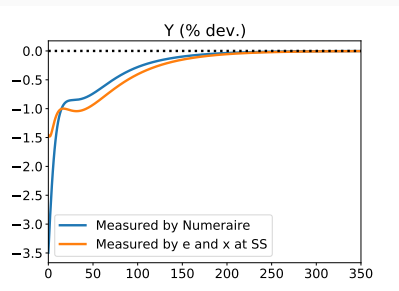
- A Temporary but persistent Increase in Interest Rates
- Elastic Non-tradable price no market clearing on non-tradables, demand determined quantities
- Reduction in Max LTV from 80% to 60%
- With TFP Externality
 - TFP Elasticity wrt expenditures .5
 - Wage Adjustments ($\psi^w = .5$)
$$\log w_t - \log w^{ss} = \psi^w (\log Y_t - \log Y^{ss})$$
 - Import Elasticity .8

COMPARING WITH OUTPUT ACROSS HORIZONS BETWEEN BASE AND PARTIAL DEVALUATION



Baseline

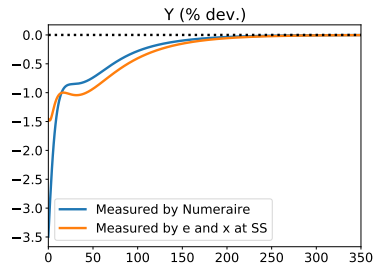
Partial Devaluation



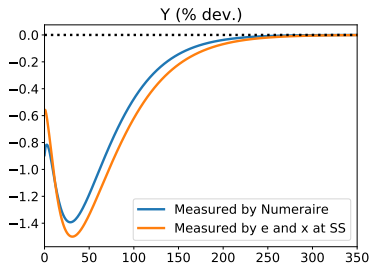
COMPARING WITH OUTPUT ACROSS HORIZONS BETWEEN BASE AND PARTIAL DEVALUATION



Baseline



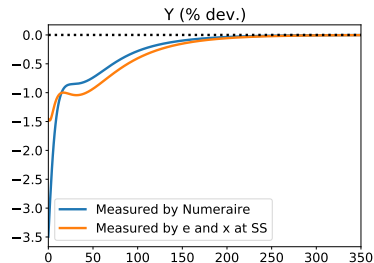
Partial Devaluation



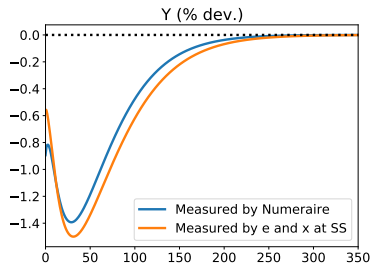
COMPARING WITH OUTPUT ACROSS HORIZONS BETWEEN BASE AND PARTIAL DEVALUATION



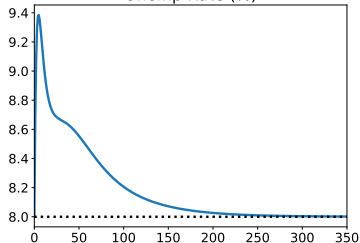
Baseline



Partial Devaluation



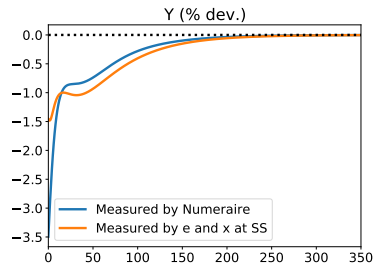
Unemp Rate (%)



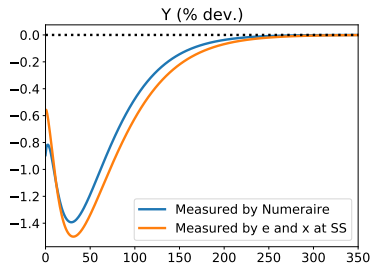
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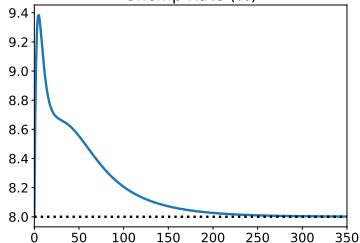
Baseline



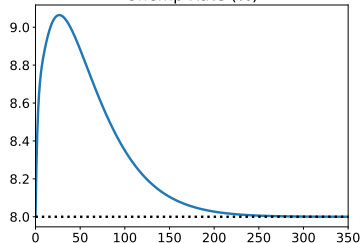
Partial Devaluation



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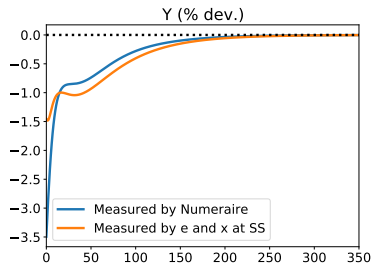
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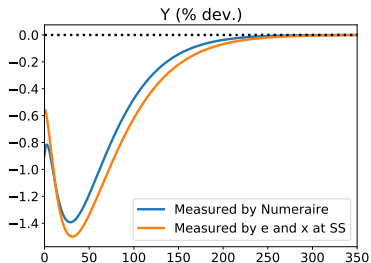
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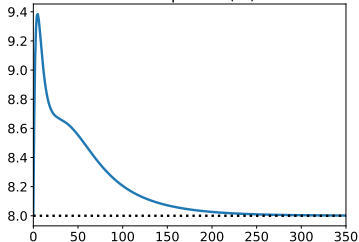
Baseline



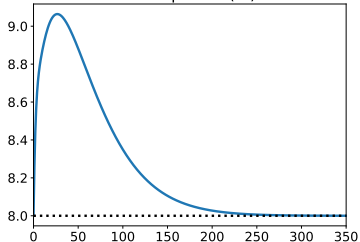
Partial Devaluation



Unemp Rate (%)



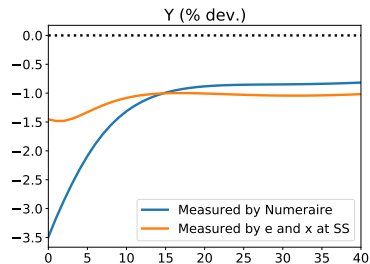
Unemp Rate (%)





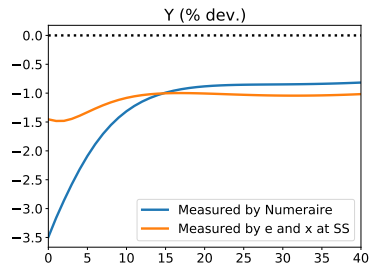
Baseline

Perfect Storm

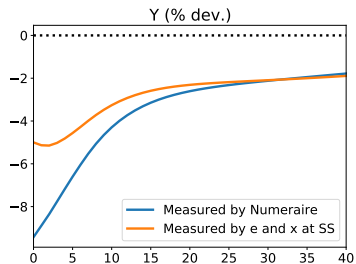




Baseline

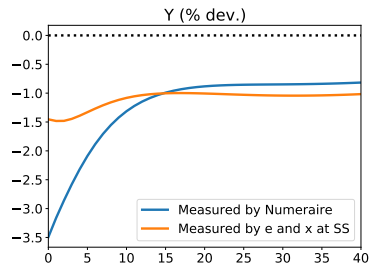


Perfect Storm

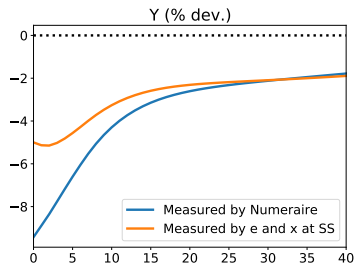




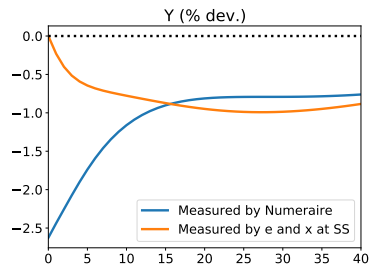
Baseline



Perfect Storm



No TFP Externality

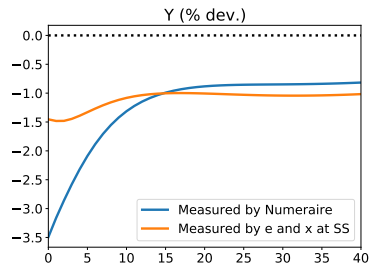


Insufficient Devaluation

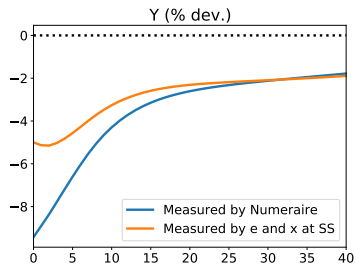
COMPARISON BETWEEN ALL ECONOMIES: OUTPUT



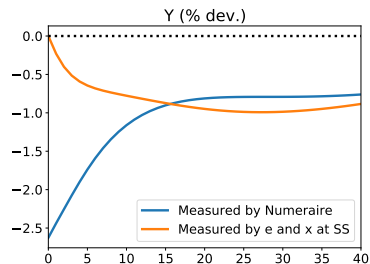
Baseline



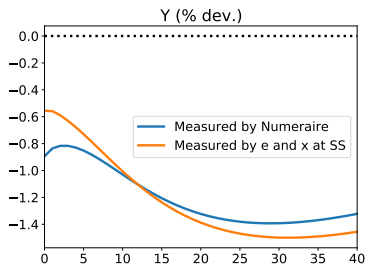
Perfect Storm



No TFP Externality



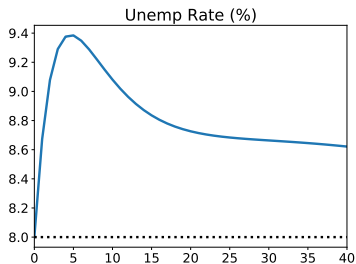
Insufficient Devaluation



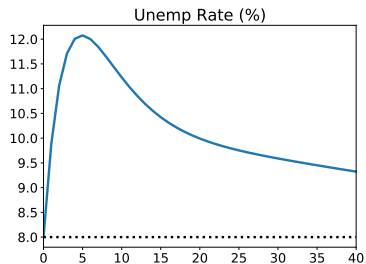
COMPARISON BETWEEN ALL ECONOMIES: UNEMPLOYMENT



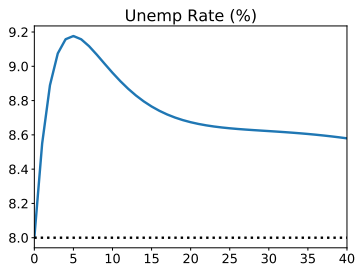
Baseline



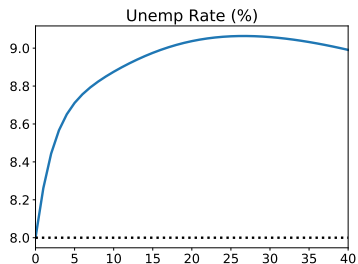
Perfect Storm



No TFP Externality



Insufficient Devaluation





- Some Technical Things



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 - Incorporate Financial Restrictions ONLY on newly born



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 - Loan to Value Restrictions ONLY to New Loans



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 - Loan to Value Restrictions ONLY to New Loans
- Build this into a World Economy
 - So Interest Rates are Endogenous
 - So Crisis are Simultaneous and Devaluations are Not Helpful
- Have a modern New Keynesian structure to model the link between nominal and real interest rates



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- Wider mechanisms than just through intertemporal substitution as in Rep Agent models.
- They incorporate some wealth and redistribution effects.
- Build more Asset prices and productivity propagation into those models.



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- But also because Households are affected, especially in Europe where mortgages are NOT indexed.



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- Not only because financial firms are affected
- But also because Households are affected, especially in Europe where mortgages are NOT indexed.
- 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

- Aguiar, M. and G. Gopinath (2007): "Emerging Market Business Cycles: The Cycle Is the Trend," *Journal of Political Economy*, 115, 69–102.
- Aiyagari, S. R. (1994): "Uninsured Idiosyncratic Risk and Aggregate Saving," *Quarterly Journal of Economics*, 109, 659–684.
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