Aggregate Implications of Financial and Labor Market Frictions

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Bank of Finland/CEPR/Philadelphia Fed conference SEARCH FRICTIONS AND AGGREGATE DYNAMICS

18-19 October 2012

(Caggese & Perez)

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Financing Frictions, Uncertainty and Precautionary Behavior

- Uncertainty increases precautionary behavior, especially in presence of financial frictions
 - Households reduce consumption and increase savings when unemployment risk increases.
 - Firms lay off workers or scale down if demand growth becomes more volatile.

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This paper:

- Do precautionary decisions of households and firms in the presence of labor and financial market frictions reinforce each other?
- Is this interaction a source of amplification of financial shocks?
- Does it influence the effects of policies such as firing costs and unemployment benefits?

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Motivation - Financing Frictions and the 2007-2009 Recession

- Financial crisis has had important real effects
 - Campello, Graham and Harvey (2011): firms declaring "difficulties in accessing credit markets" planned to cut 10.9% of their employees in 2009, compared to 2.7% at unconstrained firms".
 - During crisis, unemployment rate in US increased from around 5% to more than 10% in mid-2009.

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- Financial crisis has had important real effects
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 - During crisis, unemployment rate in US increased from around 5% to more than 10% in mid-2009.
- Were financial constraints binding on a large scale?
 - Monacelli, Quadrini and Trigari (2011): Liquidity of non financial businesses quickly rebounded after peak of crisis → enough resources to finance investment and hiring.
 - Khale and Stulz (2011): Corporate cash holdings ↑, equity issuance ↓, net debt =

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This paper

- GE model with heterogeneous firms(households) facing bankruptcy(unemployment) risk.
 - Financially constrained firms self-insure to reduce risk of costly bankruptcy
 - Financially constrained employed households self-insure against unemployment risk

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This paper

- GE model with heterogeneous firms(households) facing bankruptcy(unemployment) risk.
 - Financially constrained firms self-insure to reduce risk of costly bankruptcy
 - Financially constrained employed households self-insure against unemployment risk
- Interaction generates amplification after an unexpected increase in firm financing frictions:
 - ► higher firing → higher unemployment → higher household precautionary savings → lower interest rate → slower firm wealth accumulation → firms more financially fragile → higher firing → ...



- ▶ Workers, mass N
 - Risk averse and face uninsurable unemployment risk

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- Workers, mass N
 - Risk averse and face uninsurable unemployment risk

Firms

- Produce consumption good using labor
- Owned by capitalists (through industrial conglomerates)
 - capitalists are impatient, risk neutral and borrowing constrained
- A firm is created when a vacancy is matched with a worker.

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taxes capitalists to finance unemployment benefits

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Government

- taxes capitalists to finance unemployment benefits
- Two goods:
 - a **consumption good** *c* produced by the firm
 - an asset, which we call "**capital**", in fixed aggregate supply *K*.
 - medium of exchange and numeraire (P = price of consumption good)
 - only saving technology for workers and firms: 1 unit generates b units of consumption good each period

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Model Ingredients (2)

Frictions

1. <u>Labor</u> markets using Diamond-Mortensen-Pissarides matching framework.

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Frictions

- 1. <u>Labor</u> markets using Diamond-Mortensen-Pissarides matching framework.
- 2. Financial imperfections
 - Workers
 - cannot insure directly against unemployment risk
 - cannot borrow

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Frictions

- 1. <u>Labor</u> markets using Diamond-Mortensen-Pissarides matching framework.
- 2. Financial imperfections
 - Workers
 - cannot insure directly against unemployment risk
 - cannot borrow
 - Firms:
 - Limited initial endowment (equity) conglomerates can provide to firms
 - ► Once firms start producing, only internal finance (dividends≥ 0, no secondary equity offerings, no debt)
 - If financial wealth goes below lower bound, firm forced to close

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Worker and Firm Flows



(Caggese & Perez)

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Worker, Firm and Financial Flows



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Firms

- Maximize PV of dividends d distributed to capitalists
- Asset holding dynamics:

$$a'_F(s) = a_F(1+r) + \pi(s) - d(a_F)$$

where profits π are:

$$\pi(s) \equiv Pz - w + s$$

•
$$z =$$
productivity; $s = i.i.d.$ shock, $E(s) = 0$.

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Wage each period determined according to expected revenue sharing rule:

$$w = \varphi P z$$

•
$$0 < \varphi < 1$$

w cannot be made contingent on shock

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Wage each period determined according to expected revenue sharing rule:

$$w = \varphi P z$$

- ► $0 < \phi < 1$
- *w* cannot be made contingent on shock
- Borrowing constraints for firm:

$$a_F \geq \underline{a}_F, \ d \geq 0.$$

(Caggese & Perez)

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- At beginning of each period, a firm may cease to operate for 3 reasons:
- 1. Forced liquidation if:

 $a_F < \underline{a}_F$

loss of net worth, firm only able to distribute $d = \chi a_F$, $0 \le \chi \le 1$.

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2. **Exogenous** exit: probability η , and firm distributes $d = a_F$

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• Probability that a firm exits: $\sigma(a_F) \in \{\eta, 1\}$

(Caggese & Perez)

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Operating Firm

▶ Value of a firm with assets *a_F* immediately following continuation decision:

$$J(a_F) = \max_{d,\sigma(a'_F)} \left\{ d(a_F) + \sum_{s=0,1} \beta p_s \left[\sigma(a'_F(s)) d'_{exit}(a'_F(s), E) + [1 - \sigma(a'_F(s))] J(a'_F(s)) \right] \right\}$$

- where
 - $d_{exit}(a_F, E) = 1_{forced}(E)\chi a_F + (1_{exogenous}(E) + 1_{voluntary}(E))a_F$
 - ► *a_F* : current asset holdings of firm
 - $\sigma(a_F)$: probability of firm exit (firing) next period
 - ▶ *s* : occurrence of a liquidity shock in the firm
 - *p_s* : probability firm suffers liquidity shock
- Discount rate β of capitalists ►

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- Optimal firm behavior
 - ► Since in equilibrium $r < \frac{1}{\beta} 1$, firms distribute dividends only if a_F above a certain threshold.
 - ► Continue operations next period if $J(a'_F) \ge a'_F$ (and no forced/exogenous exit)

(Caggese & Perez)

Industrial Conglomerates, Capitalists, HH and Government

- ▶ Industrial conglomerates, continuum of mass 1, their role:
 - Collect dividends from firms
 - Create vacancies (cost ξ) and finance initial firm wealth $a_{F,start}$
 - Pay taxes (T), and pay residual (DIV) to capitalists

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- Capitalists
 - Receive DIV from conglomerates every period
- Household sector modeled as in Bewley-Huggett-Aiyagari framework:
 - ▶ risk-averse, face uninsurable idiosyncratic unemployment risk
 - unable to borrow ($a' \ge 0$), can only insure unemployment risk partially by accumulating capital
 - Unemployed households receive unemployment benefit h

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 - Unemployed households receive unemployment benefit h
- Government: $T = N_u h$

(Caggese & Perez)

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Firm Creation - Vacancies and Matching

- Industrial conglomerates post vacancies: matched vacancy assigned to a capitalist to manage
- Random matching each period according to:

$$M(N_u, N_v) = \frac{N_u N_v}{\left(N_u^L + N_v^L\right)^{\frac{1}{L}}}$$

Vacancy posting cost ξ

- ▶ Firms created with initial (equity) finance *a*_{*F*,start}
- Optimal number of <u>vacancies</u> solves:

$$(J(a_{F,start}) - a_{F,start}) rac{N_u}{\left(N_u^L + N_v^L
ight)^{rac{1+L}{L}}} - \xi = 0$$

- Where $J(a_{F,start}) a_{F,start} = NPV(\text{firm profits})$
- Matching rates: $\lambda_w = M(N_u, N_v)/N_u$ and $\lambda_f = M(N_u, N_v)/N_v$
- Unemployment dynamics:

$$u' = (1 - \lambda_w)u + (1 - u)\int \sigma(a_F)dF(a_F).$$

(Caggese & Perez)

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Goods and Capital Markets

Goods market equilibrium condition is:

$$(1-u')\int\int c_w(a,a_F)f_e(a,a_F)dada_F+u'\int c_u(a)f_u(a)da+DIV/P=zN_{1-u}$$

► Interest rate *r* satisfies:

$$1+r=1+Pb,$$

 Aggregating budget constraints also ensures that demand of capital is equal to supply of capital

(Caggese & Perez)

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Calibration: Parameters

In units of the consumption good

Parameter	Symbol	Value	Empirical moment	U.S.data	Model					
	Parameters matched to an empirical moment									
Firm starting wealth	a _{F,start}	2.9	$\frac{Median(a_F(age=1))}{median(a_F)}$	0.47 (1)	1.24					
Size of liquidity shock	ε	0.8	St.Dev(profits/sales)	0.35 (1)	2.28					
Prob. of liquidity shock	θ	0.2	Prob(profits < 0)	$0.25^{(1)}$	0.20					
Exog. prob of job destr.	η	0.025	Avg firm dur. (years, if age>5)	43 (1)	45					
Vacancy cost	ξ	1	Firm job finding rate (λ_f)	0.71 (2)	0.70					
Efficiency of matching	L	1.27	Worker job finding rate (λ_w)	0.45 (2)	0.45					
Productivity of firms	Z	0.2	Worker separation rate	0.08-0.11 (2)	0.039					
Productivity of capital	b	0.003	Interest rate	2%	1.3%					
	Parai	neters ta	aken from the literature							
Discount factor	β	0.99								
Lab. share of exp. profits	φ	0.5								

(1) Own calculations using Compustat and Capital IQ for U.S. listed firms.

(2) Den Haan, Ramey and Watson (2000)

(Caggese & Perez)

Calibration: Sensitivity Analysis

Parameter	Symbol	Value
Sensitivity	analysis	
Risk aversion param.	γ	0.5 - 4
Unemployment Benefit	ĥ	$2\% - 50\%^*$
Firing costs	ψ	$0 - 200\%^{*}$
Minimum firm wealth	\underline{a}_F	0 - 2
Bankr. recovery rate	χ	0 - 1

* In percentage of the equilibrium wage

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Steady State

• We **describe** the steady state

- optimal decisions of firms and households
- distributions of asset holdings of firms and households
- **Comparative statics**: steady state allocation for different values of γ , χ and \underline{a}_F
 - γ : degree of precautionary behavior by households
 - \underline{a}_F : the higher \underline{a}_F , the higher the risk of default for firms
 - χ : degree of inefficiency of bankruptcy (recovery rate)

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Steady State

Workers' Saving Decisions: Buffer Stock Behavior For $\underline{a}_F = 2$, $\chi = 0$, h = 2%.(in real terms)



Workers' Saving Policy Functions

(Caggese & Perez)

Aggregate Implications of Financial and Labor Market Frictions

Steady State

Asset Holdings Distributions of Workers and Firms For $\underline{a}_F = 2$, $\chi = 0$, h = 2%.(in real terms)



▶ Precautionary savings of workers ⇒ larger average asset accumulation

(Caggese & Perez)

Firms' Exit Decision For $\underline{a}_F = 2$, $\chi = 0$, h = 2%.(in real terms)



Increased precautionary exit of firms with high household precautionary behavior

(Caggese & Perez)

Feedback Mechanism with Costly Bankruptcy Variations in firms' financing frictions (\underline{a}_F) and HH precautionary behavior (γ)

				Average	Average	Forced exits	Voluntary
		Interest rate	Unemployment	worker	firm assets	(% over	exits (% over
χ=0	Price (P)	(<i>r</i>)	rate (u)	assets (a)	(a_F)	total firms)	total firms)
γ=0.5							
$\underline{a}_{F}=0$	2.05	0.610%	4.88%	0.39	2.68	0.04%	0.00%
<u>a</u> _F =0.85	1.33	0.400%	6.46%	1.61	3.10	0.07%	0.12%
<u>a</u> _F =1.14	1.28	0.380%	7.70%	1.62	3.36	0.05%	0.26%
γ=2							
<u>a</u> _F =0	1.10	0.330%	5.71%	3.48	2.09	0.20%	0.00%
$\underline{a}_{F}=0.85$	0.73	0.220%	8.64%	5.56	2.99	0.07%	0.25%
<u>a</u> _F =1.14	0.68	0.200%	12.63%	6.05	3.23	0.00%	0.60%
γ=4							
$\underline{a}_{F}=0$	0.54	0.160%	6.41%	9.33	1.91	0.31%	0.00%
<u>a</u> _F =0.85	0.45	0.140%	11.07%	10.97	2.85	0.08%	0.40%
<u>a</u> _F =1.14	0.42	0.130%	21.55%	11.92	3.13	0.00%	0.75%

Note: Wealth is measured in units of the consumption good

Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 0$)

(Caggese & Perez)

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Feedback Mechanism with Costly Bankruptcy LOW HH precautionary behavior (low γ)

					Average	Average	Forced exits	Voluntary	
			Interest rate	Unemployment	worker	firm assets	(% over	exits (% over	
	χ=0	Price (P)	(<i>r</i>)	rate (u)	assets (a)	(a _F)	total firms)	total firms)	
i	γ=0.5								1
i	$\underline{a}_{F}=0$	2.05	0.610%	4.88%	0.39	2.68	0.04%	0.00%	ł
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i									j
	v-2								
	$\frac{1-2}{a_{F}=0}$	1.10	0.330%	5.71%	3.48	2.09	0.20%	0.00%	
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Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 0$)

(Caggese & Perez)

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Feedback Mechanism with Costly Bankruptcy HIGH HH precautionary behavior (high γ)

				Average	Average	Forced exits	Voluntary
		Interest rate	Unemployment	worker	firm assets	(% over	exits (% over
χ=0	Price (P)	(<i>r</i>)	rate (u)	assets (a)	(a _F)	total firms)	total firms)
γ=0.5							
$\underline{a}_{F}=0$	2.05	0.610%	4.88%	0.39	2.68	0.04%	0.00%
<u>a</u> _F =0.85	1.33	0.400%	6.46%	1.61	3.10	0.07%	0.12%
$\underline{a}_{F}=1.14$	1.28	0.380%	7.70%	1.62	3.36	0.05%	0.26%
<u>γ=2</u>							
$\underline{a}_{F}=0$	1.10	0.330%	5.71%	3.48	2.09	0.20%	0.00%
<u>a</u> _F =0.85	0.73	0.220%	8.64%	5.56	2.99	0.07%	0.25%
<u>a</u> _F =1.14	0.68	0.200%	12.63%	6.05	3.23	0.00%	0.60%
γ=4							
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<u>a</u> _F =0.85	0.45	0.140%	11.07%	10.97	2.85	0.08%	0.40%
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Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 0$)

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Feedback Mechanism with Costless Bankruptcy Variations in firms' financing frictions (\underline{a}_F) and HH precautionary behavior (γ)

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Sector Sec.		Interest rate	Unemployment	worker	firm assets	(% over	exits (% over
χ=1	Price (P)	(<i>r</i>)	rate (u)	assets (a)	(a _F)	total firms)	total firms)
γ=0.5							
$\underline{a}_{F}=0$	2.07	0.620%	4.86%	0.40	2.64	0.05%	0.00%
<u>a</u> _F =1.71	1.72	0.520%	7.28%	0.11	3.66	0.46%	0.00%
<u>a</u> _F =2	1.68	0.500%	9.41%	0.12	3.81	0.82%	0.00%
$\gamma - 2$							
$\underline{a_F}=0$	1.13	0.340%	5.75%	3.50	1.94	0.29%	0.00%
<u>a</u> _F =1.71	1.64	0.490%	7.52%	0.35	3.60	0.49%	0.00%
<u>a</u> _F =2	1.58	0.470%	10.09%	0.42	3.78	0.86%	0.00%
γ=4							
$\underline{a}_{F}=0$	0.55	0.160%	6.39%	9.22	1.84	0.37%	0.00%
<u>a</u> _F =1.71	1.51	0.450%	7.99%	0.75	3.51	0.53%	0.00%
<u>a</u> _F =2	1.46	0.440%	10.89%	0.79	3.76	0.89%	0.00%

Note: Wealth is measured in units of the consumption good

Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 1$)

(Caggese & Perez)

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Policy experiments

- 1. Firing costs
 - Exogenous and precautionary exit: firm has to pay firing cost to worker equal to ψw , with $\psi > 0$
 - $d_{exogenous} = a_F \psi w$
 - Precautionary exit condition now: $J(a_F) < a_F \psi w$
 - With forced exit (bankruptcy), no firing cost
 - Comparative statics: $\psi \in \{0, 1, 2\}$
- 2. Unemployment benefits
 - ▶ Comparative statics: *h* ∈ {2%, 25%, 50%}

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Policy experiments Firing costs

				Average	Average	Forced exits	Voluntary
		Interest rate	Unemployme	worker	firm assets	(% over	exits (% over
	Price (P)	(<i>r</i>)	nt rate (u)	assets (a)	(a _F)	total firms)	total firms)
$\chi=0$, Min Wealth (<u>a</u>)=1	.14, γ=4: Ec	conomy with	high unemployn	nent because	of financing	frictions	
Firing costs=0	0.43	0.130%	21.66%	11.71	3.11	0.00%	0.78%
Firing costs=1	0.51	0.150%	25.30%	9.58	3.14	0.00%	0.74%
Firing costs=2	0.57	0.170%	29.30%	8.42	3.19	0.00%	0.63%
i							
Unemp. Benefit=2%	0.43	0.130%	21.66%	11.71	3.11	0.00%	0.78%
Unemp. Benefit=25%	0.64	0.190%	14.11%	6.77	3.15	0.00%	0.67%
Unemp. Benefit=50%	0.97	0.290%	9.54%	3.23	3.27	0.00%	0.45%
χ=1, Min Wealth (<u>a_F</u>)=0), γ=0.5, 1=0	.75: Econom	y with high uner	nployment b	ecause of lab	our market fri	ctions
Firing costs=0	1.94	0.580%	10.08%	0.86	2.50	0.07%	0.00%
Firing costs=1	2.02	0.610%	10.28%	0.66	2.59	0.05%	0.00%
Firing costs=2	2.10	0.630%	10.52%	0.48	2.67	0.04%	0.00%
Unemp. Benefit=2%	1.94	0.580%	10.08%	0.86	2.50	0.07%	0.00%
Unemp. Benefit=25%	2.09	0.630%	9.82%	0.48	2.67	0.04%	0.00%
Unemp. Benefit=50%	2.20	0.660%	9.66%	0.20	2.81	0.03%	0.00%

Note: Wealth is measured in units of the consumption good

Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 0$)

(Caggese & Perez)

Aggregate Implications of Financial and Labor Market Frictions

Policy experiments Unemployment benefits

					Average	Average	Forced exits	Voluntary
			Interest rate	Unemployme	worker	firm assets	(% over	exits (% over
		Price (P)	(<i>r</i>)	nt rate (u)	assets (a)	(a _F)	total firms)	total firms)
	$\chi=0$, Min Wealth (<u>a</u> _E)=1.	14, γ=4: Ec	conomy with	high unemployn	nent because	of financing	frictions	
	Firing costs=0	0.43	0.130%	21.66%	11.71	3.11	0.00%	0.78%
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٦								
	$\chi=1$, Min Wealth (<u>a</u>)=0,	γ=0.5, 1=0	.75: Economy	y with high uner	nployment b	ecause of lab	our market fri	ctions
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	Unemp. Benefit=50%	2.20	0.660%	9.66%	0.20	2.81	0.03%	0.00%

Note: Wealth is measured in units of the consumption good

Figure: Comparative Statics: Variations in γ and \underline{a}_F . (Case: $\chi = 0$)

(Caggese & Perez)

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Conclusions

- Main result: feedback between firms' and households' precautionary behavior, operating through precautionary firing and uninsurable unemployment risk.
 - Powerful amplification channel of financing frictions
 - persistently high unemployment
- Research in progress
 - Endogenise financing frictions <u>a_F</u>
 - Introduce aggregate shocks.

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Appendix

APPENDIX

(Caggese & Perez)

Aggregate Implications of Financial and Labor Market Frictions

Appendix

Related Literature

- Household precautionary behavior and labor market frictions
 - Krusell, Mukoyama & Sahin (2009): no firm financing frictions
- Firm financing frictions and labor market frictions
 - Chug (2009) and Petrosky-Nadeau (2009): no precautionary behavior in households or firms
 - Monacelli, Quadrini and Trigari (2011); transmission channel through wage bargaining process
- Household precautionary behavior and financial shocks
 - Guerrieri and Lorenzoni (2011): no distinction between firms and households and no labor market frictions

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