The Interaction between Household and Firm Dynamics and the Amplification of Financial Shocks*

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- Household credit constraints: Household deleveraging main force behind depth and length of downturn (Mian, Rao, and Sufi (2013), Mian and Sufi (2014))

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- **Answer to both questions: yes**

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  - Collateralized long term debt fixed in nominal terms: key nominal rigidity for demand shocks to matter.
  - Price fluctuations have real effects. Expected decline in nominal revenues reduce job creation and increase job destruction (both because of bankruptcies and voluntary liquidations).

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  - The Bad effect slightly prevails but only for 6 quarters; unemployment increases by a maximum of 0.3% in the short term, and then decreases below the steady state in the medium term.

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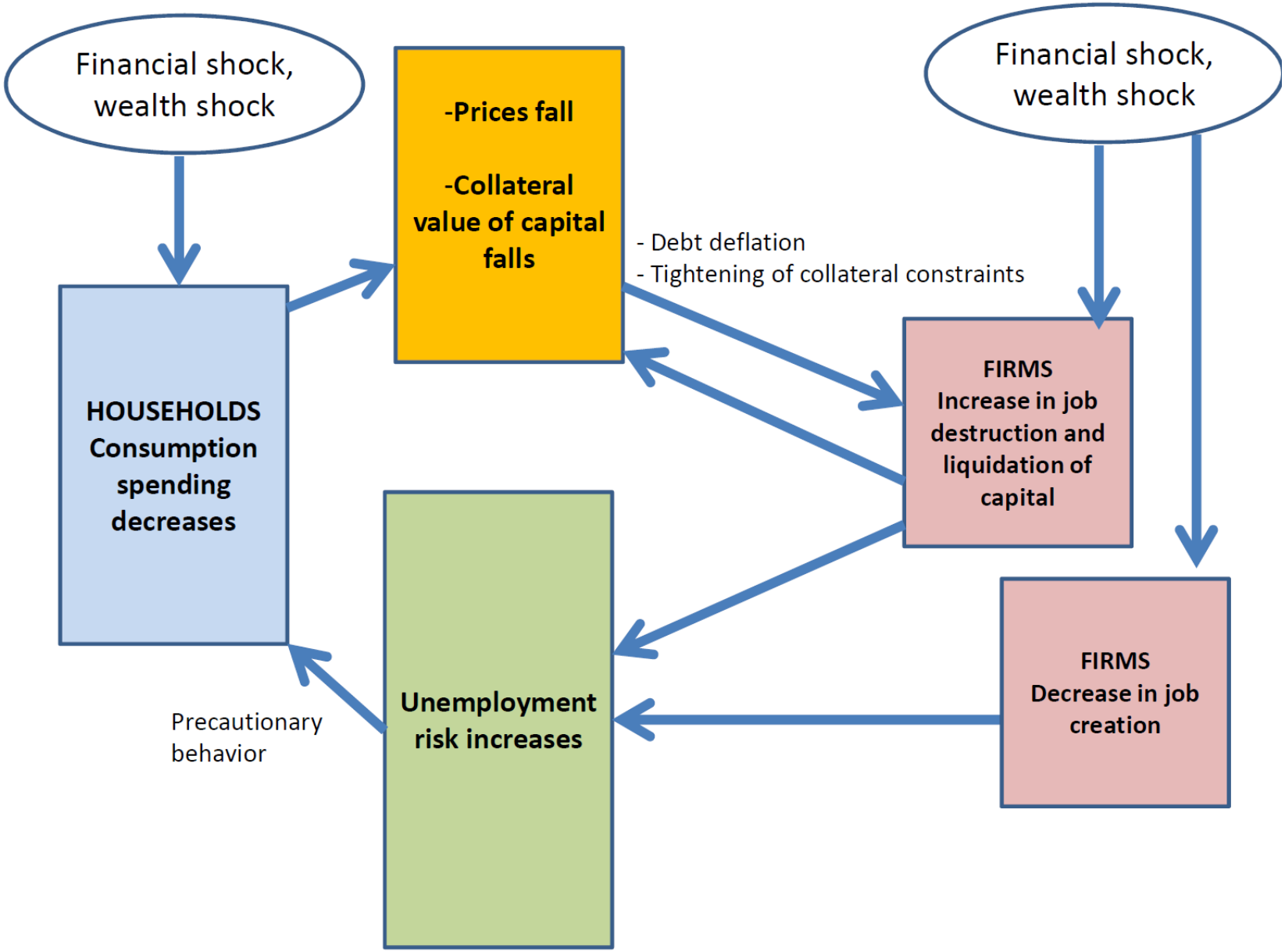
  - Households want to precautionary save more.
  - On average it takes them longer to deleverage .
  - The liquidated capital needs to be reabsorbed and prolongs the price decline further.


Financial shock, wealth shock
-Prices fall
-Collateral value of capital falls
Financial shock, wealth shock
- Debt deflation
- Tightening of collateral constraints
HOUSEHOLDS Consumption spending decreases
FIRMS Increase in job destruction and liquidation of capital
Unemployment risk increases
FIRMS Decrease in job creation
Precautionary behavior

Related Literature

- Precautionary savings and endogenous unemployment risk
  - Krusell, Mukoyama and Sahin (2010), Ravn and Sterk (2013), Challe, Matheron, Ragot, Rubio-Ramirez (2014), and Bayer, Lütticke, Pham-Daoz and Tjadenz (2014)).
- Household behavior and financial shocks
  - Hall (2011), Eggertsson and Krugman (2012), Guerrieri and Lorenzoni (2012)
- Firm financing frictions and labor market frictions
  - Chug (2009) and Petrosky-Nadeau (2009): no precautionary behavior in households or firms
  - Monacelli, Quadrini and Trigari (2012); transmission channel through wage bargaining process
- Firms' credit tightening and balance-sheet effects:
  - Kiyotaki and Moore (1997), Bernanke, Gertler and Gilchrist (1999), Jermann and Quadrini (2009)

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- **Industrial conglomerates**
  - Each owns multiple firms
  - Shares in conglomerates:
    - Only means of saving: used by households and firms to self-insure
    - Medium of exchange and numeraire (P = price of consumption good)
    - In fixed aggregate supply M
    - Dividend payout rule determines interest rate

Model Ingredients (2)

Frictions

1. Uninsurable idiosyncratic shocks
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2. Labor market frictions (Diamond-Mortensen-Pissarides)
3. Borrowing constraints
   - Households cannot borrow
   - Firms can only borrow nominal long term debt to finance initial investment in equipment
     - Need enough financial assets to guarantee debt, otherwise costly bankruptcy

The Firms

Operating firms generate profits:

$$\pi_{i,t}(\varepsilon_{i,t}) \equiv P_t \left(z + \varepsilon_{i,t}\right) - w_t, \tag{1}$$

$$w_t = \varphi P_t z, \tag{2}$$

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The budget constraint is:

$$n_{t+1}^F = n_t^F\left(1 + r_t\right) + \pi_t(\varepsilon_t) - d_t. \tag{3}$$

$n_t^F = a_t^F - D$ is net financial wealth, where D is long term nominal debt contracted when the firm is created. d_t =dividends.

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rearranging:

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Note 2: the expected path of prices affects the probability that condition 4 will bind in the future.

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   Voluntary exit is an equilibrium outcome if bankruptcy costs $(1-\chi)\, P_t k$ are relatively large.
3. **Exogenous** exit: probability η

Value function of firms

The value function of a firm with net asset holdings n_t^F in period t, which we denote by $J_t(n_t^F)$, is derived conditional on not exiting for voluntary reasons in period t, but before suffering the possibility of a collateral constraint examination, and is given by:

$$J_t(n_t^F) = \max_{d_t} \varphi_t(n_t^F) d_t^{exit}(n_t^F) + \left(1 - \varphi_t(n_t^F)\right) d_t + \frac{\left(1 - \varphi_t(n_t^F)\right)}{1 + r_{t+1}} E_{\varepsilon_t}\left[\overline{J}_{t+1}(n_{t+1}^F)\right] \tag{6}$$

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The voluntary exit decision is taken by the firm in order to maximize the beginning of period value $\overline{J}_t(n_t^F)$:

$$\overline{J_t}(n_t^F) = \max_{I_{vol,t} \in \{0,1\}} I_{vol,t} d_t^{exit}(n_t^F) + (1 - I_{vol,t}) J_t(n_t^F) \tag{8}$$

Industrial Conglomerates, Household Sector, Labor Market and Goods Market Equilibrium

- *Industrial conglomerates*:
  - Post vacancies, own firms, lend to firms in other conglomerates
  - Collect dividends from firms and pay them as return on shares owners. nominal interest rate r satisfies:

$$1 + r = 1 + \frac{DIV}{M}.$$

  - Where DIV is total dividends distributed by conglomerates to households and M is the number of shares

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- *Household* sector modeled as in Bewley-Huggett-Aiyagari framework

- *Labor market*: vacancies and unemployed matched randomly each period

- Goods market equilibrium condition

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- The probability that this vacancy is filled in the current period is $\lambda_{f,t} = M(N_{u,t}, N_{v,t})/N_{v,t}$
- The probability that an unemployed worker finds a job is $\lambda_{w,t} = M(N_{u,t}, N_{v,t})/N_{u,t}$.
- The optimal number of vacancies solves:

$$\left[J_t(n^F = -P_t k) - \overbrace{P_t k \frac{\partial \Omega(I,K)}{\partial I}}^{\text{marg. capital adj. costs}} \right] \frac{\partial M(N_{u,t}, N_{v,t})}{\partial N_{v,t}} = P_t \xi, \tag{9}$$

The model

- Employed households:

$$W_t(a_t, n_t^F) = \max_{c_t, a_{t+1}} \left\{ u(c_t) + \beta E_{\varepsilon_t} \left[\begin{array}{c} \sigma_{t+1}(n_{t+1}^F) U_{t+1}(a_{t+1}) \\ + \left(1 - \sigma_{t+1}(n_{t+1}^F)\right) W_{t+1}(a_{t+1}, n_{t+1}^F) \end{array} \right] \right\} \tag{10}$$

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- Unemployed households

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Borrowing penalty function (for both employed and unemployed):

$$u(c_t, a_{t+1}) = \frac{c_t^{1-\gamma}}{1-\gamma} - \frac{\tau}{a_{t+1}^2}.$$

Calibration 1

Panel A: Main Calibration Targets

	Model	Data
Workers' job finding rate	0.37	0.33-0.54
Vacancy-unemployment ratio	0.62	0.50-0.72
Operating income/Sales: mean (median)	0.09 (0.20)	0.02 (0.08)
Probability of negative profits	30.2%	6.2%
Aggregate adj. costs over total stock of capital	0.91%	0.91%
Annual rate of firm bankruptcies	0.19%	0.48%
Average maturity of firm debt	8.69	8.68
Costs of bankruptcy as a share of firm assets	26%	20-36%
Annual job destruction	9.2%	8-11%
Households' net worth as a % of total net worth	84%	80%

Value function

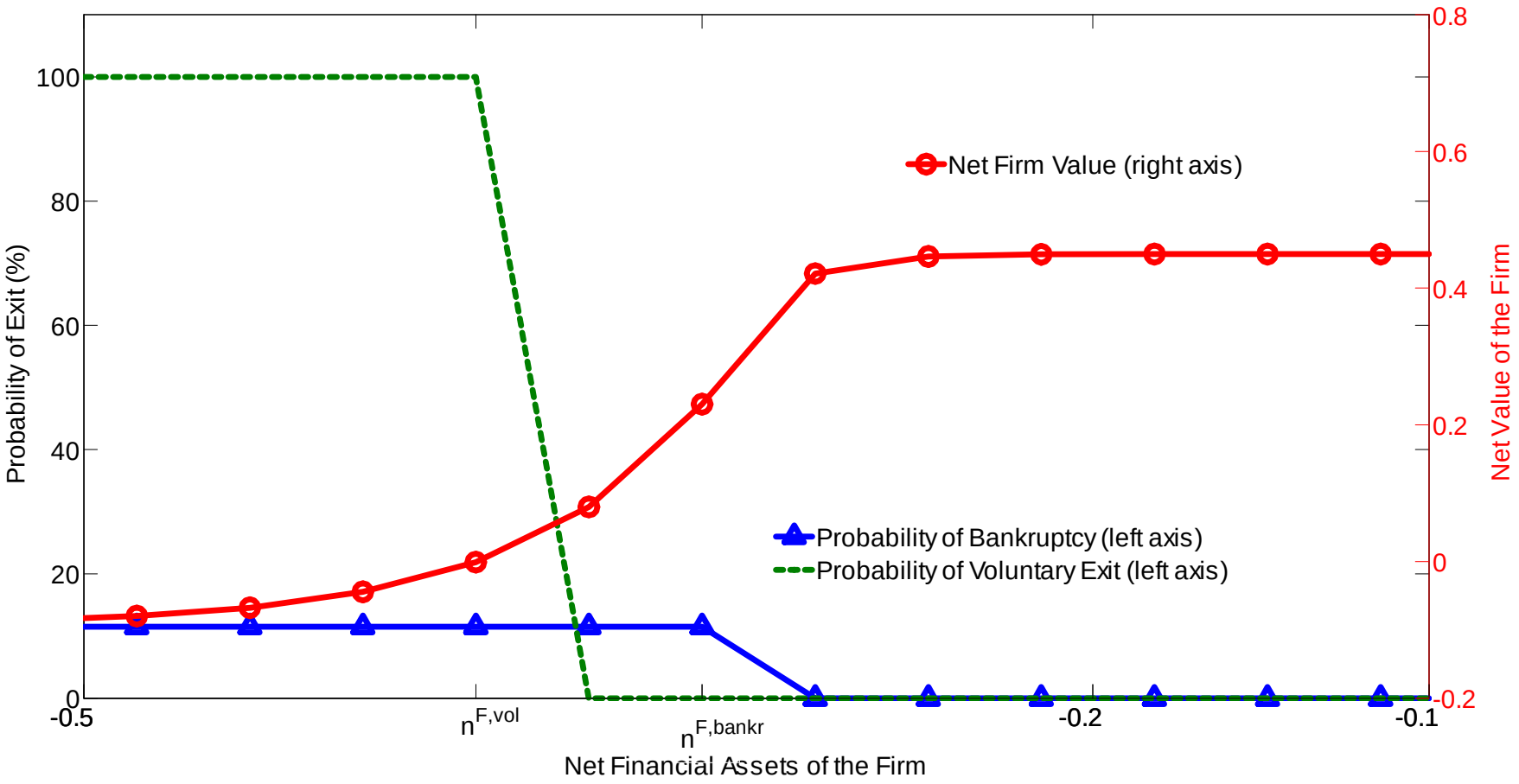

Figure: Firm's Optimal Voluntary Exit Decision

Steady state distributions

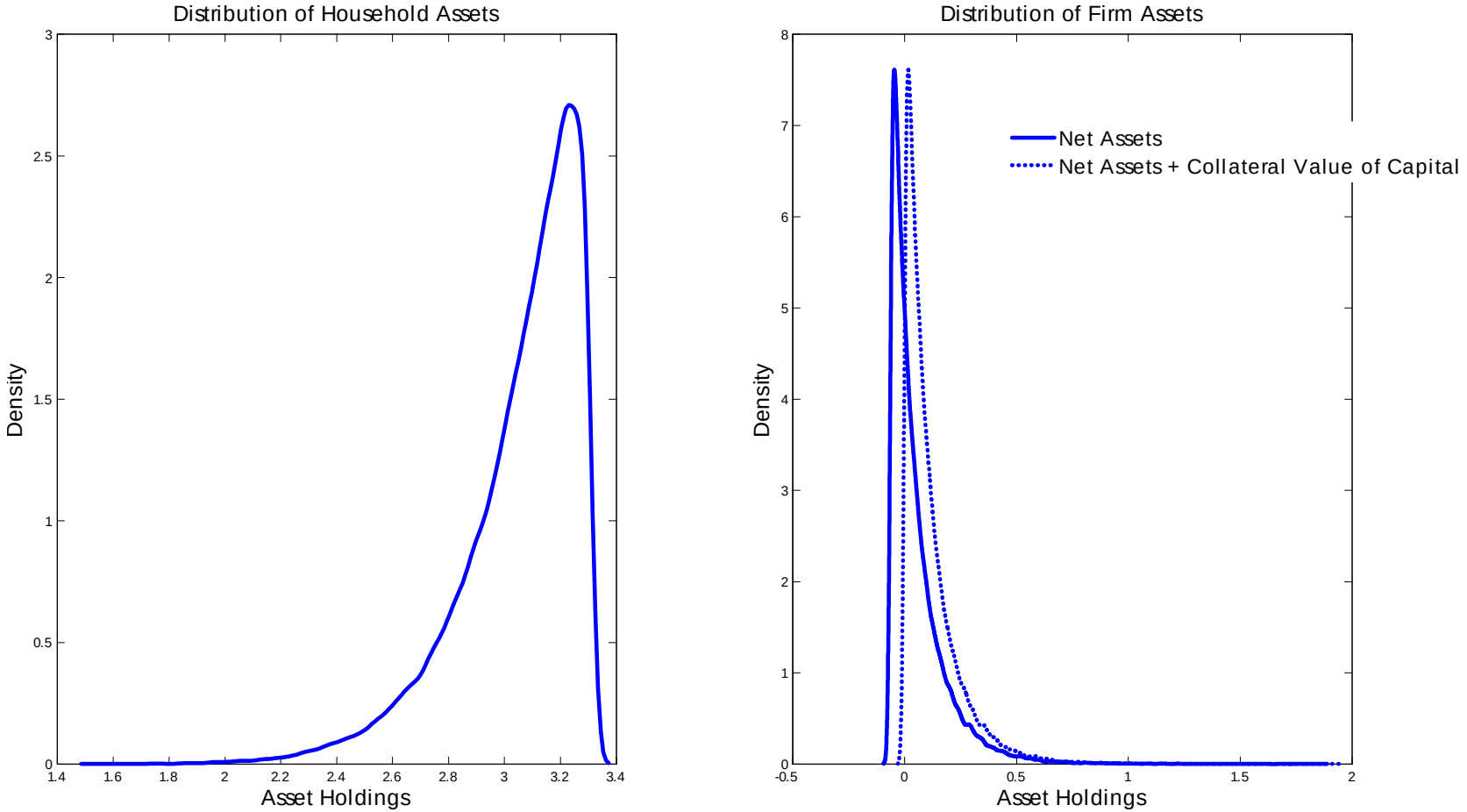

Figure: Household and Firm Real Net Asset Distributions

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- **Shock to firms:** probability to face a "roll over" shock α increases to 50% for periods $t = 1, ..., 8$.

Transition dynamics (2)

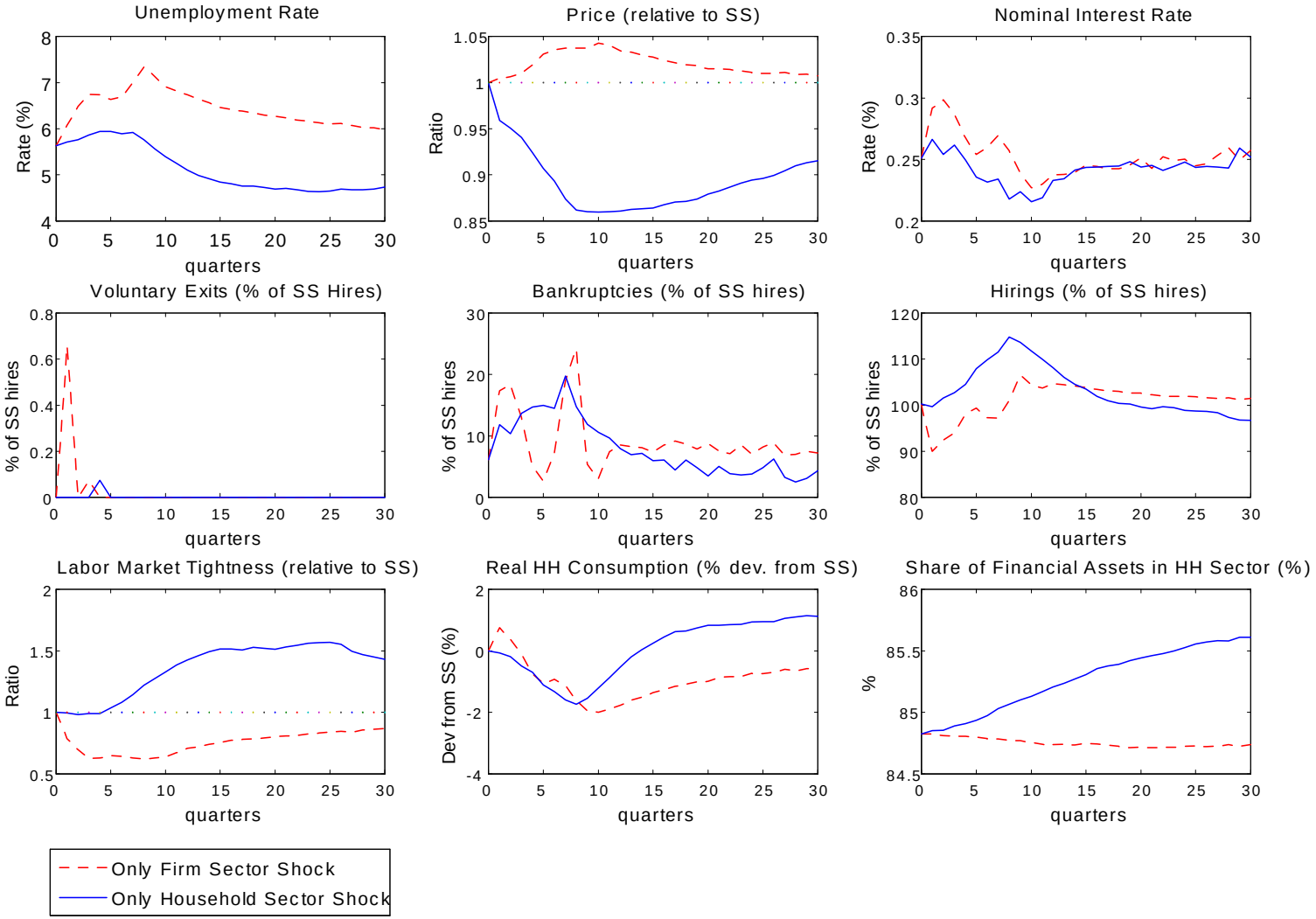
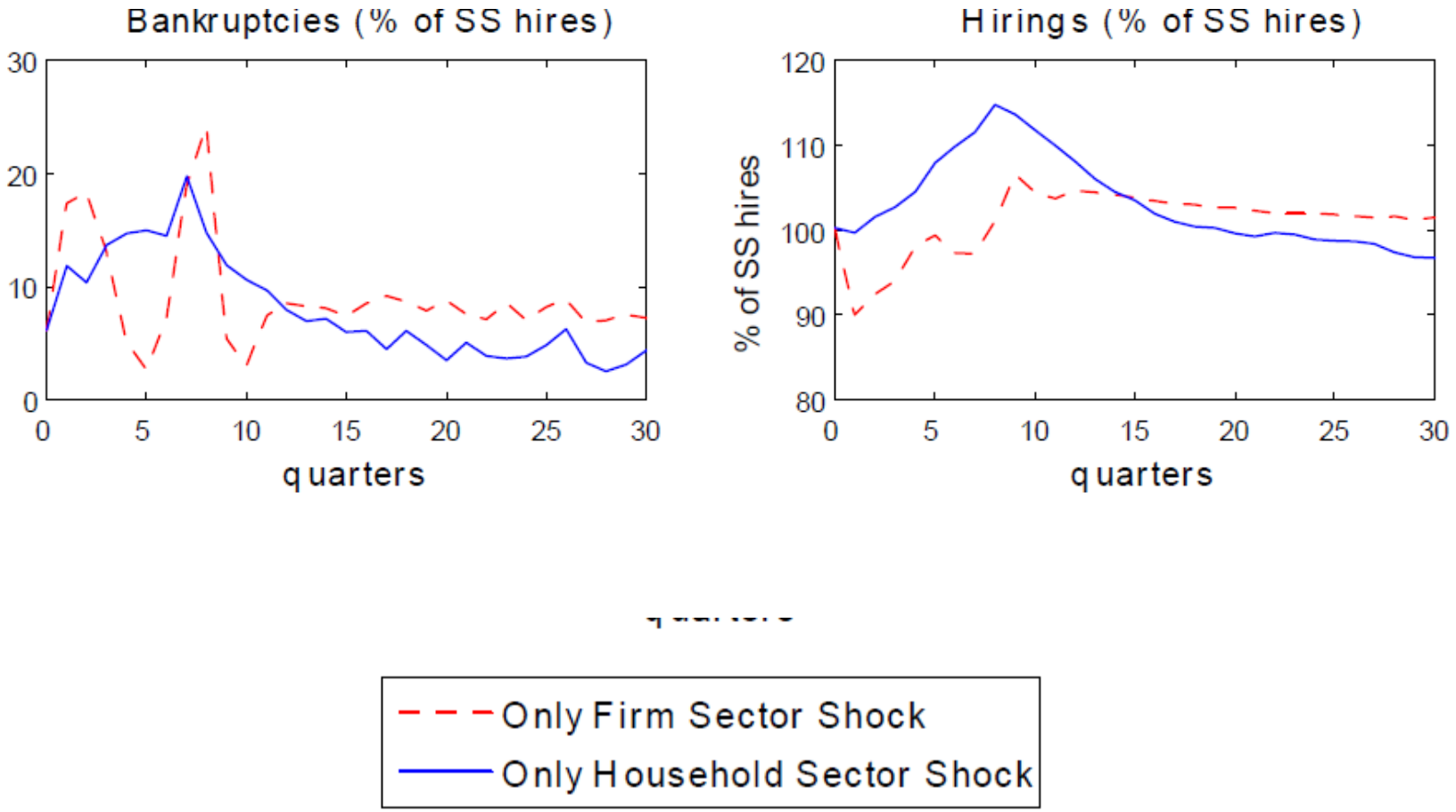


Figure: Transition Dynamics - Individual Shocks to Households and Firms

Transition dynamics (2a)

Transition dynamics (2b)



Transition dynamics (3)

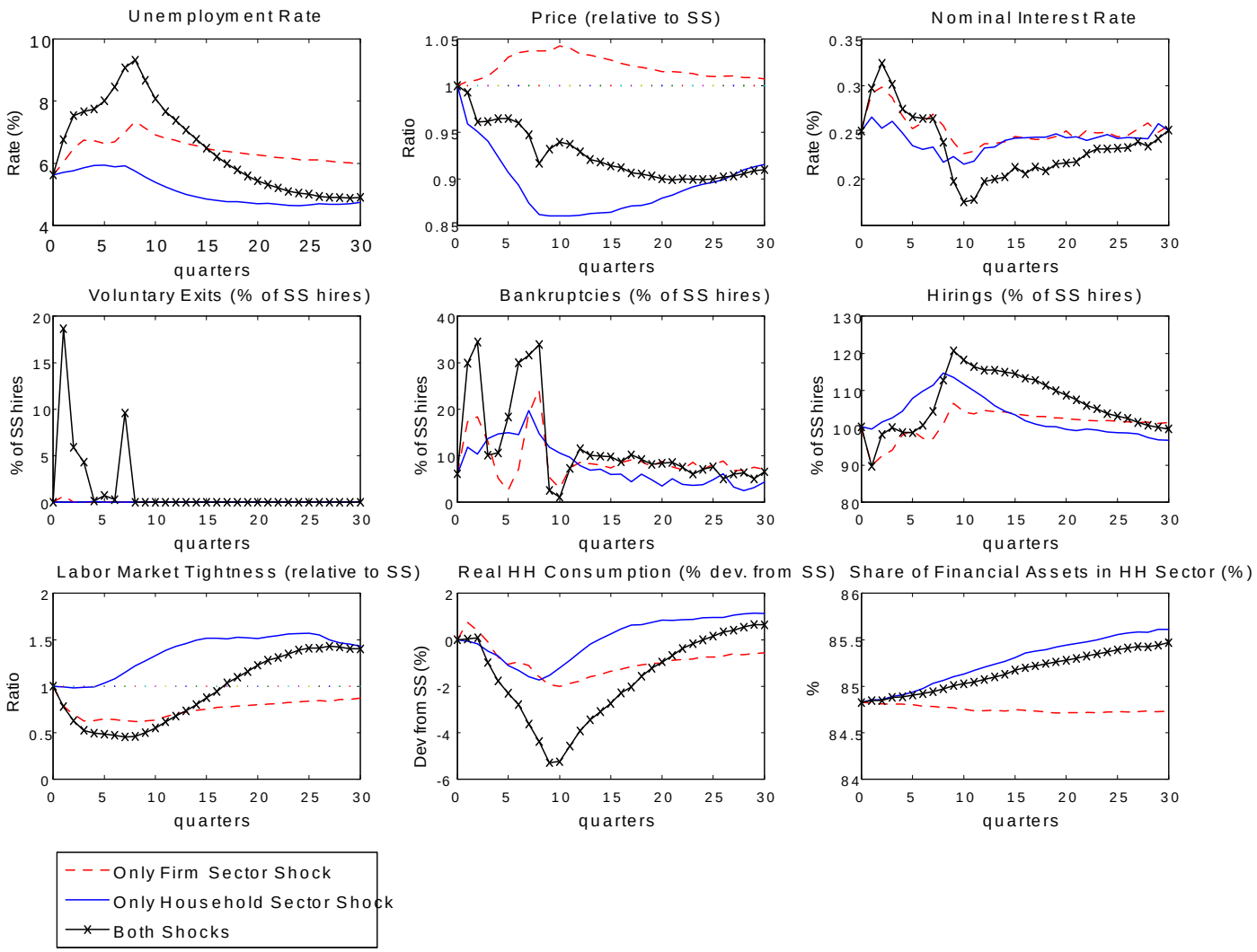
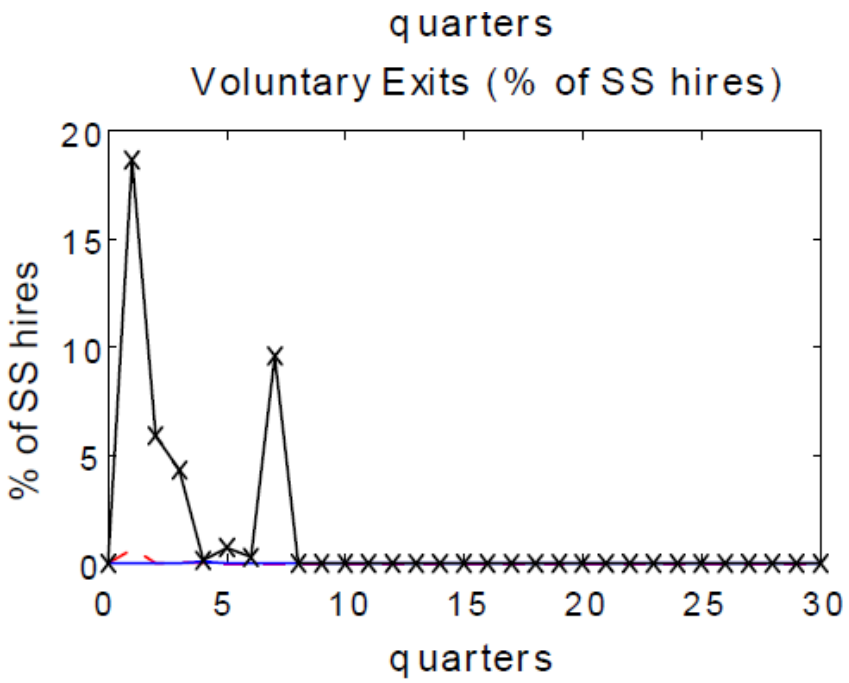
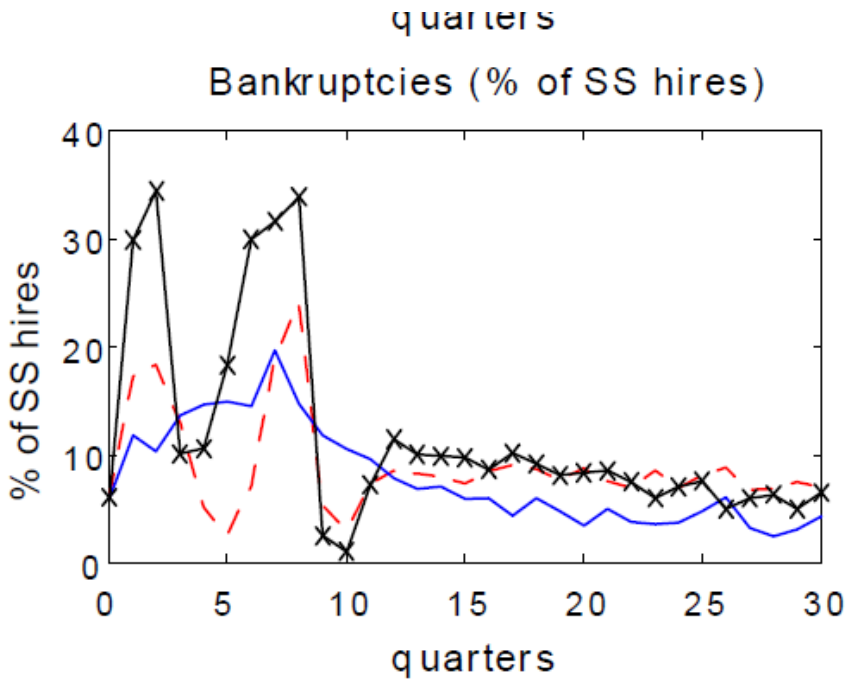


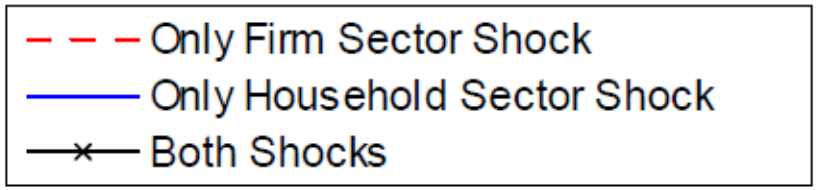
Figure: Transition Dynamics - Joint and Individual Shocks to Households and Firms

Transition dynamics (3b)

Transition dynamics (3c)







Intuition

Negative feedback effect:

- Household "deleveraging" generates future expected declines in revenues and collateral value of assets.
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  - $\rightarrow$It takes longer on average for households to reach their desired savings
  - $\rightarrow$Higher unemployment risk increases ex ante precautionary saving (but this channel is weak for our calibration).

Transition dynamics (4)
Small shocks (50% of benchmark)

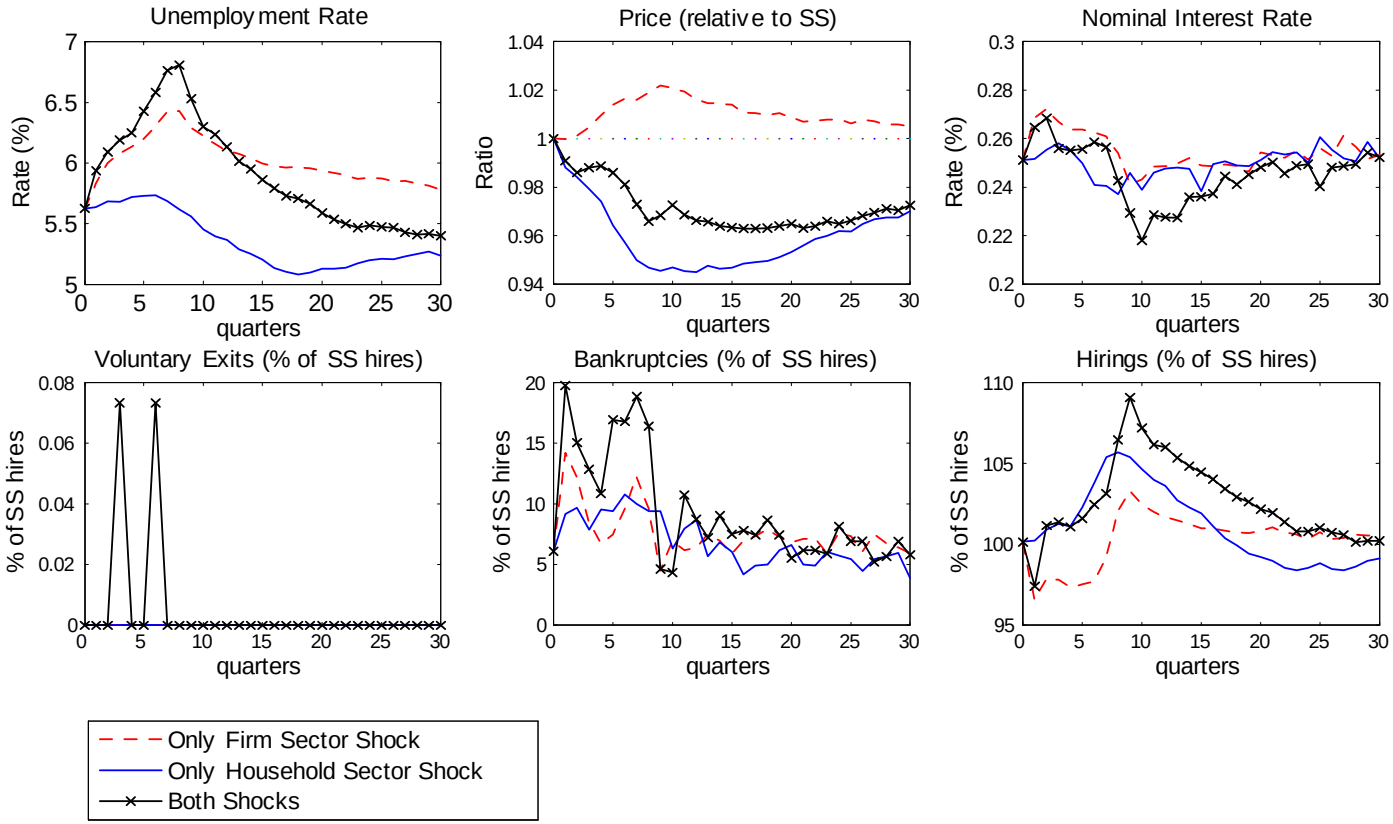

Figure: Transition Dynamics - Joint Shocks to Households and Firms of a Small Magnitude

Transition dynamics (5)
Large shocks

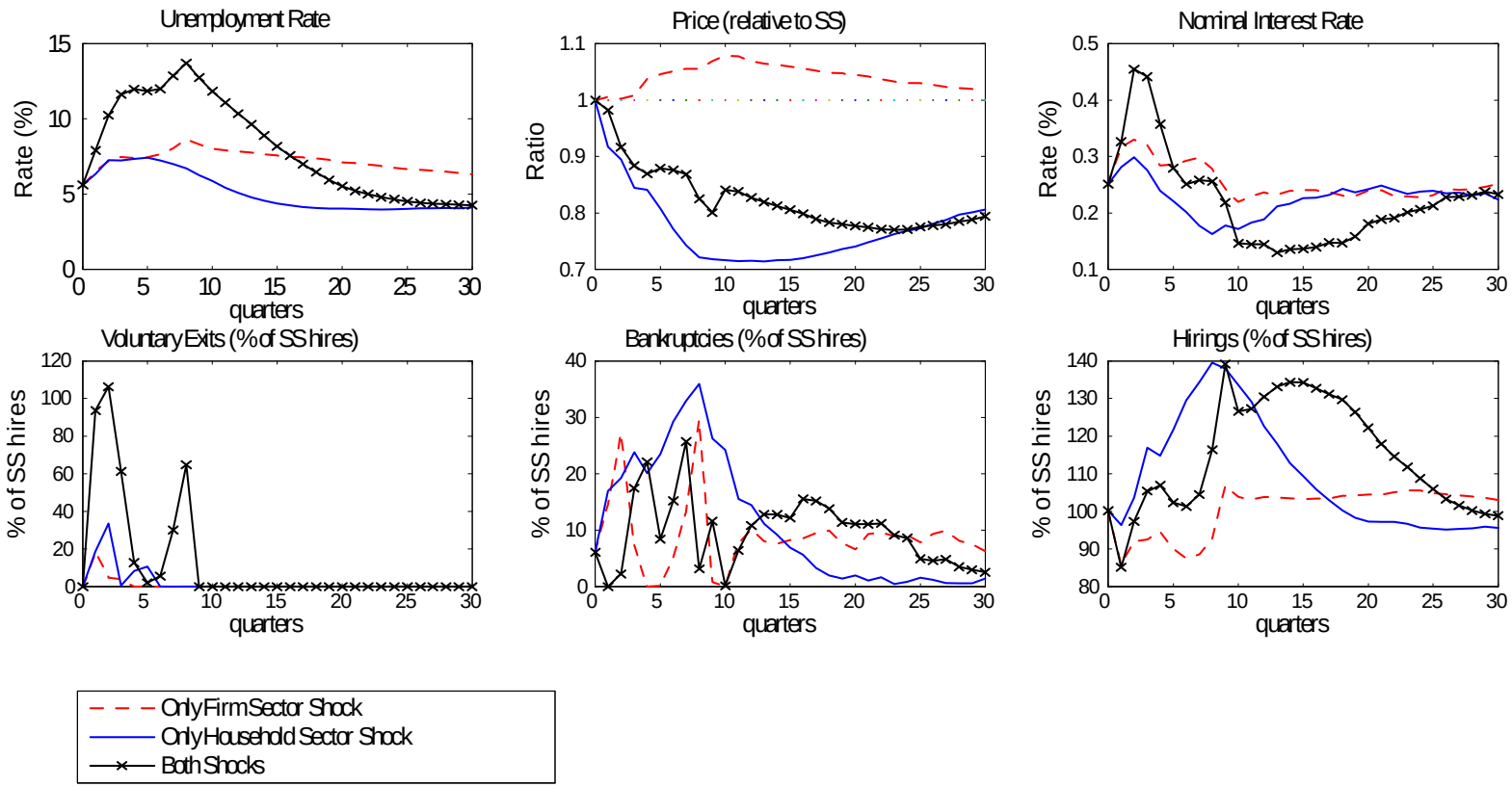

Figure: Transition Dynamics - Joint Shocks to Households and Firms of a Large Magnitude

Precautionary saving feedback effect

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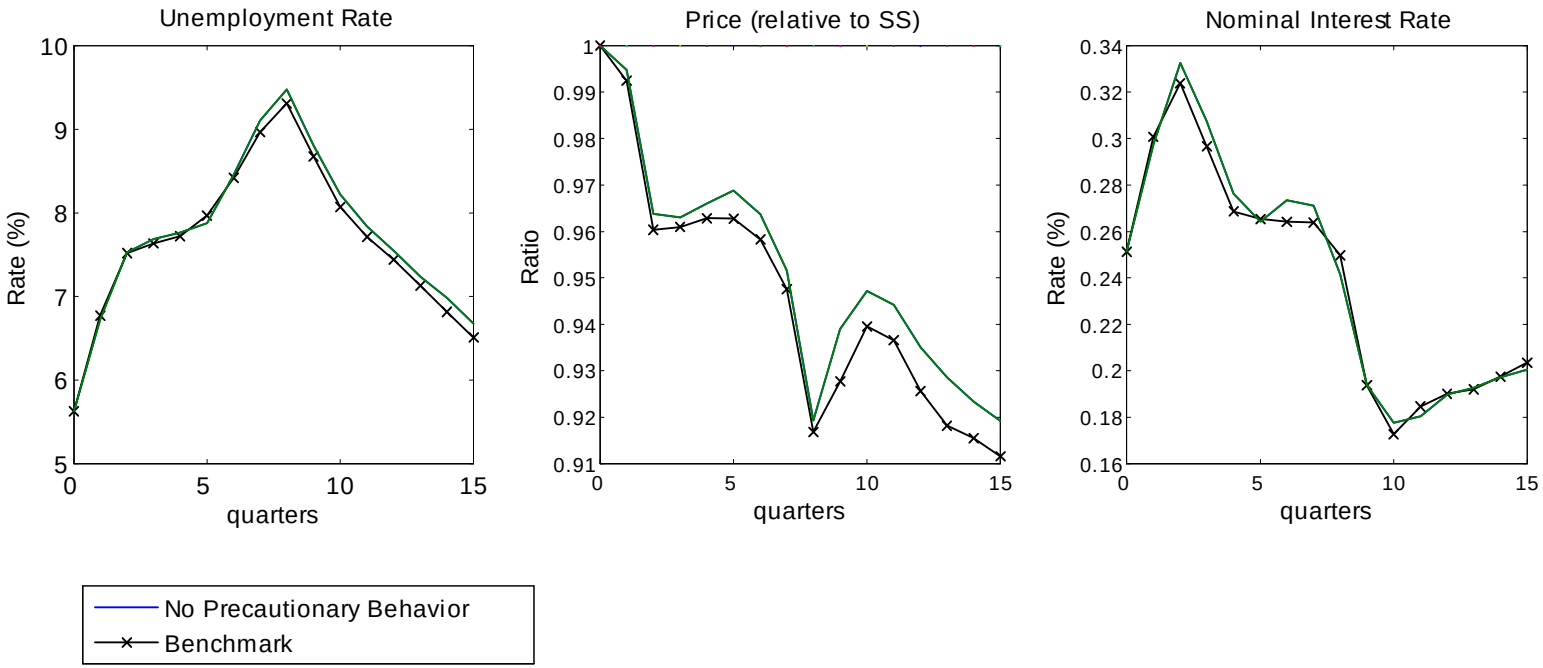
- Following a shock that increases unemployment risk, households might react by reducing consumption and increasing savings, which would in turn depress goods prices and induce more job destruction
- This effect is not strong in our base calibration:



Precautionary saving feedback effect (2)

It becomes strong if we increase the financing frictions of the unemployed

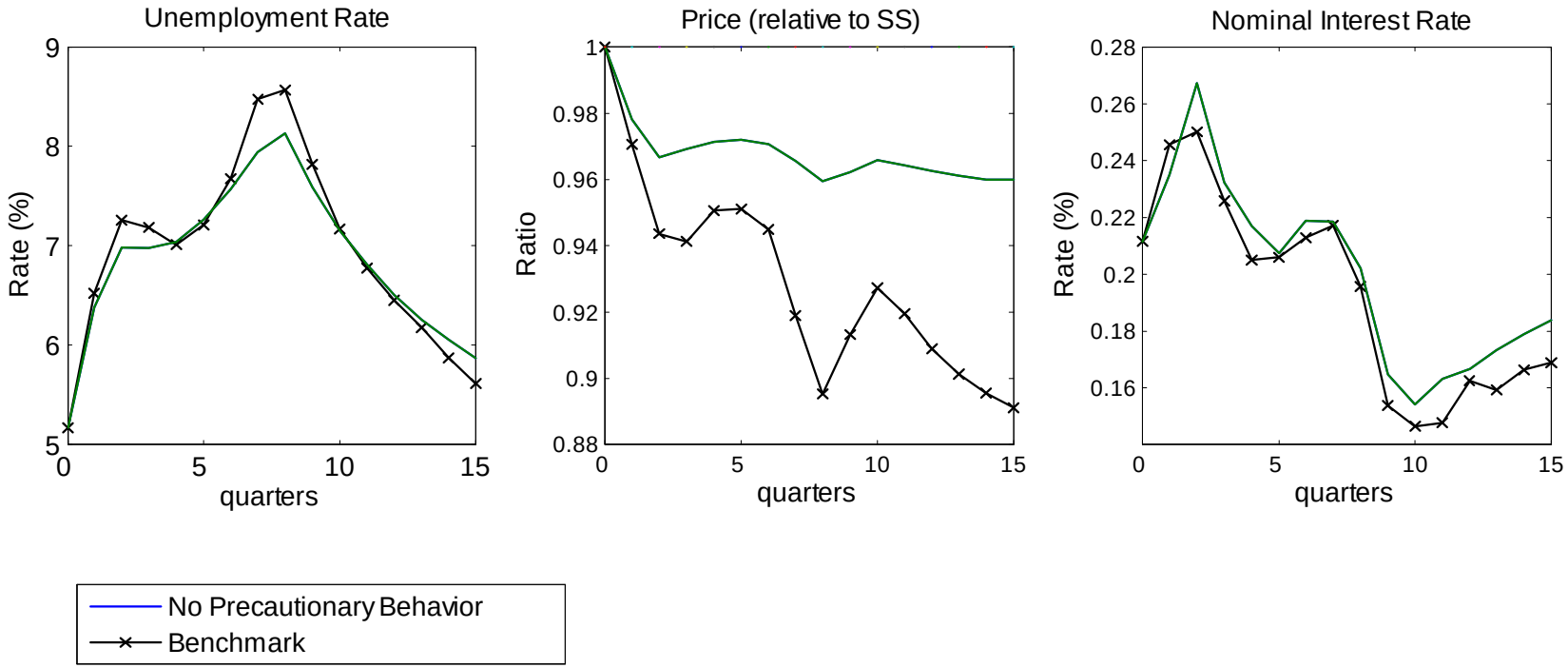


Figure: Transition Dynamics in Models with Tighter Credit Constraints for Unemployed Households - Joint Shocks to Households and Firms With and Without Household Precautionary Motives

Nominal wage rigidity

We consider fully rigid nominal wages, fixed at the steady state level.

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Instead we find very little difference with respect to the benchmark case:

- Price declines hurt firms profits and reduce job creation, but:
- Higher real wages sustain consumption and prevent price declines in the first place.

Nominal wage rigidity

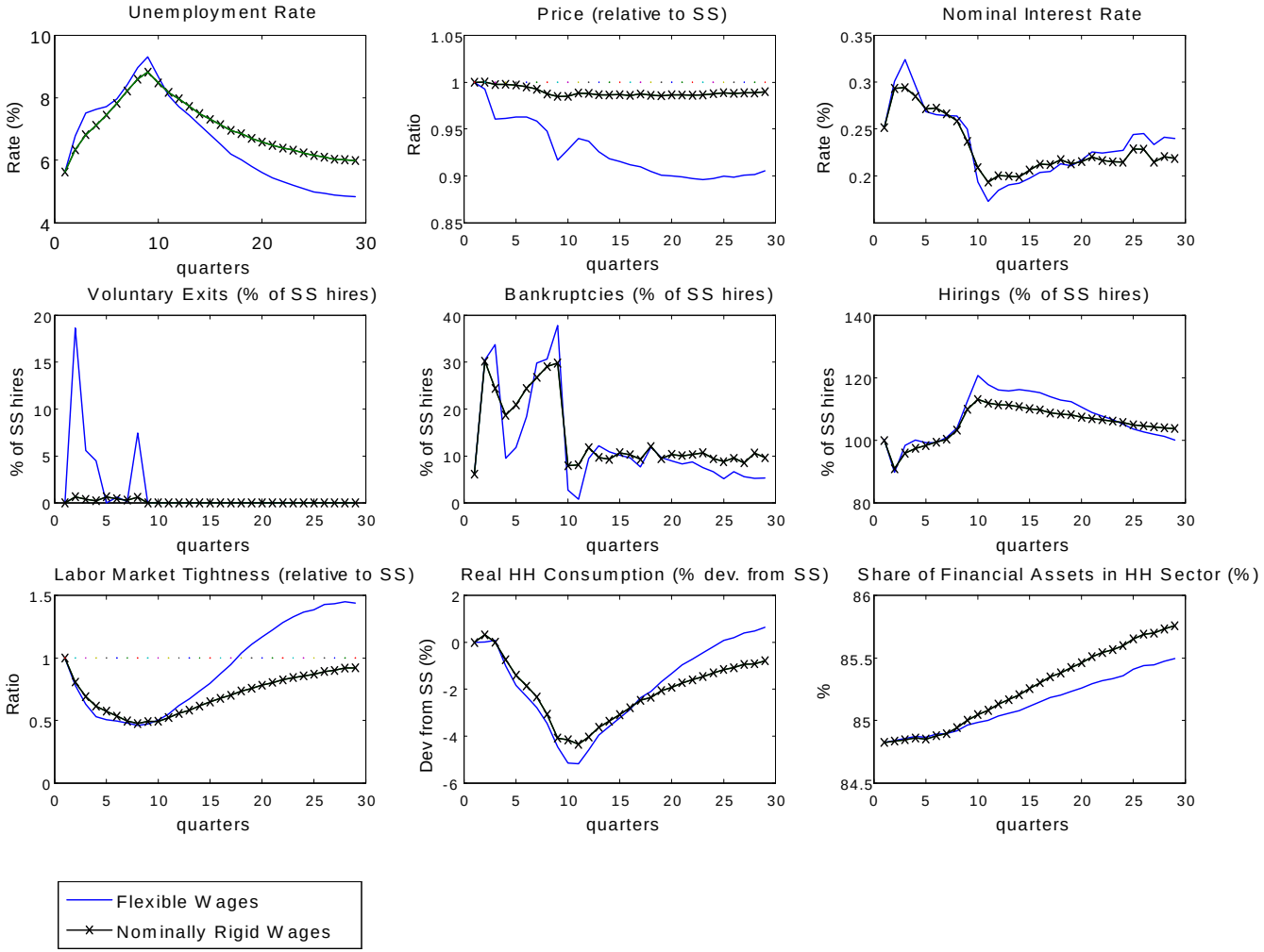

Figure: Transition Dynamics - Joint Shocks to Households and Firms in the Benchmark Model and in a Model With Nominally Rigid Wages

Conclusions

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- Results obtained in the absence of wage and price rigidities - Emphasize the role of nominal debt rigidity.
- Framework can be used to study effects of different policies
  - Fiscal/Monetary policy
  - labor market reform (firing costs,...)
  - unemployment benefits
  - subsidies to firms