The Dynamic Consequences of Technology and Discount Factor Shocks in Medium-Scale RANK vs TANK Models

Andreas Koundouros

Presentation for the Research Module Macroeconomics at the University of Bonn

24th January 2023

Roadmap

Introduction

Go to related literature

- aim: contrast a representative-agent to a two-agent framework
  $\Rightarrow$ RANK vs TANK
- two household types in TANK: standard agents and **hand-to-mouth** agents
- analyse how dynamics after aggregate shocks are altered
- two shocks: to technology and to the **discount factor**

Key Findings

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2. underlying heterogeneity of individual-level responses is interesting feature of TANK

3. two parameters are key in shaping the quantitative differences between RANK and TANK

The Models

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- crucial difference RANK vs TANK: household sector
- RANK: representative, consumption-smoothing agent with access to investment, bonds, profits, etc. resulting in standard labour supply and Euler equation:

$$w_t = \chi n_t^{\eta}(c_t - hc_{t-1}) \tag{2.1}$$

$$1 = \beta_{t+1} \frac{R_t}{\pi_{t+1}} \frac{(c_t - hc_{t-1})}{(c_{t+1} - hc_t)} \tag{2.2}$$

plus standard budget constraint Go to budget constraint

The TANK Model (I)

- unit-mass population, of which a share $(1-\lambda)$ are standard, consumption-smoothing households
- these **unconstrained** agents behave just as RANK agents $\Rightarrow$ identical equations (2.1), (2.2), budget constraint

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- unit-mass population, of which a share $(1-\lambda)$ are standard, consumption-smoothing households
- these **unconstrained** agents behave just as RANK agents
  $\Rightarrow$ identical equations (2.1), (2.2), budget constraint
- a share λ is **hand-to-mouth** and consume only current-period labour income with no access to consumption-smoothing tools

The TANK Model (II)

– hand-to-mouth households are characterised by labour supply and budget constraint:

$$w_t = \chi(n_t^H)^\eta(c_t^H - hc_{t-1}^H) \tag{2.3}$$

$$c_t^H = w_t n_t^H \tag{2.4}$$

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$$c_t^H = w_t n_t^H \quad (2.4)$$

– thus, hand-to-mouth cannot save or dissave in the face of shocks

– consumption of hand-to-mouth tied exclusively to labour market
$\Rightarrow$ labour market of great importance when analysing dynamics in the TANK model

The TANK Model (III)

– final step for TANK model is economy-wide aggregation:

$$c_t = (1-\lambda)c_t^U + \lambda c_t^H \tag{2.5}$$

$$n_t = (1-\lambda)n_t^U + \lambda n_t^H, \tag{2.6}$$

where:

c_t, n_t: aggregate consumption and employment

c_t^U, n_t^U: unconstrained agents' consumption and employment

c_t^H, n_t^H: hand-to-mouth agents' consumption and employment

The Discount Factor Shock

– the discount factor evolves according to:

$$\beta_t = \beta_{ss} \left(\frac{\beta_{t-1}}{\beta_{ss}} \right)^{\rho_\beta} \exp(\varepsilon_{\beta,t}) \tag{3.1}$$

– in $t = 1$: $\varepsilon_{\beta,t} = 0.02$ (contractionary demand shock)

Results

– calibration: mostly used the given values, but following Kaplan et al. (2018) and Debortoli and Galí (2018): $\lambda = 0.3$ and $\eta = 1$

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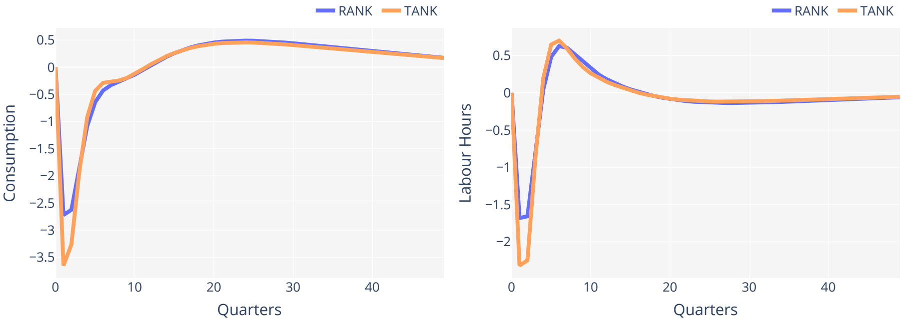
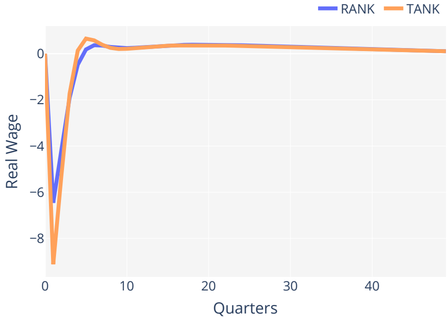
- roadmap for the results:
  1. responses to a discount factor shock
     Go to technology shock
  2. influence of λ and η on quantitative differences

Figure: Aggregate Responses to a Discount Factor Shock

(a) Consumption　　(b) Labour Hours



(c) Wage



(d) Nominal Interest Rate

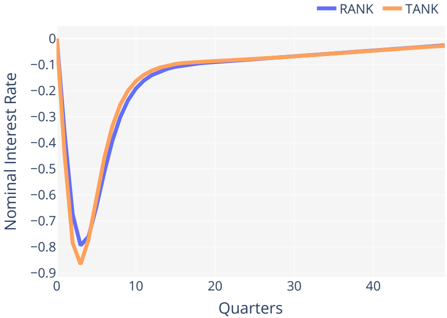
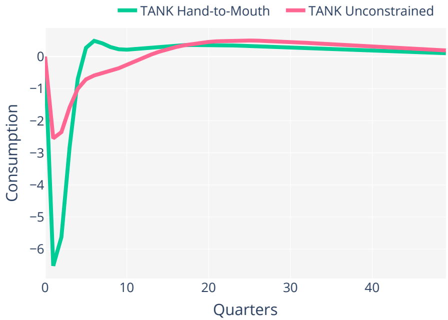
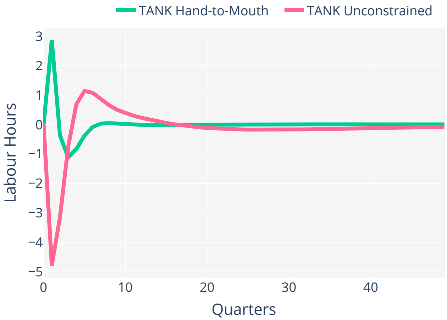


Figure: Individual-Level Responses to a Discount Factor Shock (TANK)

(a) Consumption



(b) Labour Hours

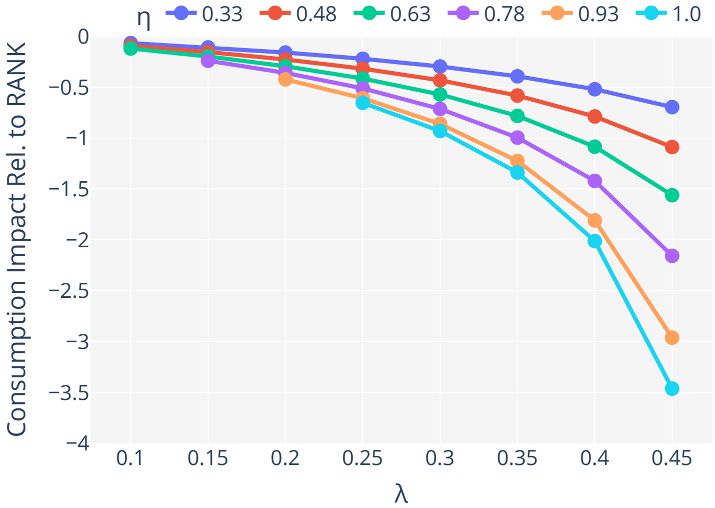


Sensitivity Analysis (I)

– check how the quantitative **relative differences** between RANK and TANK depend on choices of λ and η

– focus on aggregate consumption effects **on impact**

Figure: Aggregate Consumption Response on Impact to a Discount Factor Shock as a Function of λ and η



Sensitivity Analysis (II)

- higher $\lambda \Rightarrow$ stronger impact in TANK relative to RANK for given η
- higher $\eta \Rightarrow$ stronger impact in TANK relative to RANK for given λ

Sensitivity Analysis (II)

- higher $\lambda \Rightarrow$ stronger impact in TANK relative to RANK for given η
- higher $\eta \Rightarrow$ stronger impact in TANK relative to RANK for given λ
- **interaction** of high η and λ leads to most pronounced difference
- intuition: together, high λ and high η, imply:
  - labour market developments matter substantially (many hand-to-mouth)
  - **and** wage changes do not translate as much into changes in hours worked (low elasticity of labour to wages)

Conclusion

– results of simple RANK vs TANK comparison:
  1. qualitative differences are rare
  2. not too large quantitative differences for baseline calibration
  3. differences crucially depend on choices of λ and η

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- results of simple RANK vs TANK comparison:
  1. qualitative differences are rare
  2. not too large quantitative differences for baseline calibration
  3. differences crucially depend on choices of λ and η
- myriad of possible extensions:
  - include HANK and compare it to RANK & TANK
  - consider fiscal policy and redistribution
  - estimation of key parameters (especially λ and η)

Thank you very much for your attention!

Any questions?

References

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Gust, C., Herbst, E., López-Salido, D., & Smith, M. E. (2012). The Empirical Implications of the Interest-Rate Lower Bound. https://www.federalreserve.gov/econresdata/feds/2012/files/201283r1pap.pdf

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Appendix A: Related Literature ▸ Back

- one of the first papers to do TANK similar to the present model is by Galí et al. (2007)

- seminal paper by Kaplan et al. (2018) on monetary policy transmission in fully-fledged HANK models: direct vs indirect effects of a real interest rate shock

- Debortoli and Galí (2018): prototypical HANK model features three key aspects of heterogeneity; the most important one is the gap in consumption between unconstrained and constrained agents; TANK can replicate this and its aggregate responses are thus close to HANK

Appendix B: Household Budget Constraint ‣ Back

– this is the budget budget constraint of RANK households as well as of unconstrained TANK agents:[1]

$$dd_t + c_t + \tau_t + \frac{\Phi}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2 i_t = w_t n_t + \frac{R_{t-1}}{\pi_t} dd_{t-1} + \ldots \tag{6.1}$$

$$\ldots\left(1 - mc_t - \frac{\psi}{2}\left(\frac{\pi_t}{\tilde{\pi}_{t-1}} - 1\right)^2\right) y_t + \ldots$$

$$\ldots\left(q_t\left(1 - \frac{\Phi}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2 - 1\right) i_t + bprof_t\right.$$

[1] In the latter case, c_t^U and n_t^U replace c_t and n_t, respectively.

Appendix C: The Technology Shock ▸ Back

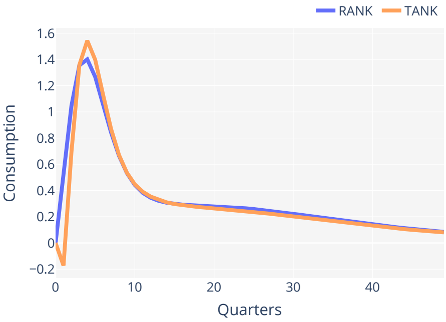
– technology adheres to this process:

$$z_t = z_{ss} \left(\frac{z_{t-1}}{z_{ss}} \right)^{\rho_z} \exp(\varepsilon_{z,t}) \tag{6.2}$$

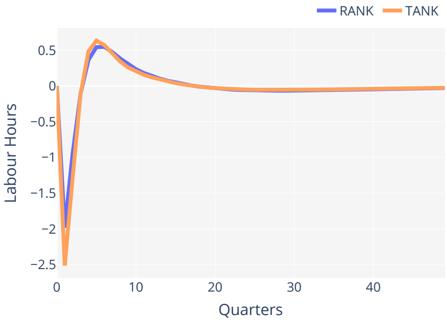
– in $t = 1$: $\varepsilon_{z,t} = 0.02$ (positive supply shock)

Figure: Aggregate Responses to a Technology Shock

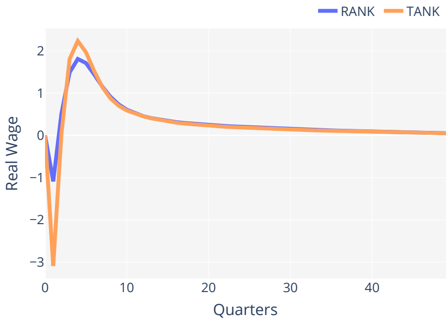
(a) Consumption



(b) Labour Hours



(c) Wage



(d) Nominal Interest Rate

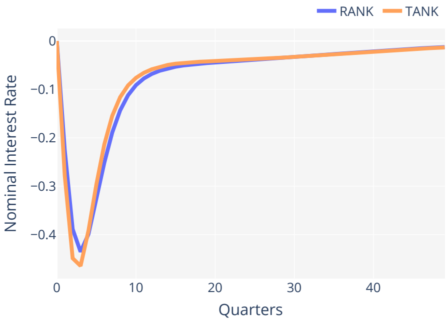


Figure: Individual-Level Responses to a Technology Shock (TANK)

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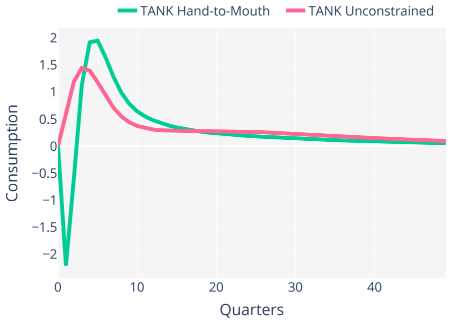

(b) Labour Hours

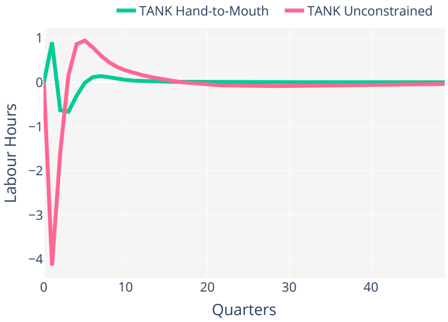

Figure: Aggregate Consumption Response on Impact to a Technology Shock as a Function of λ and η