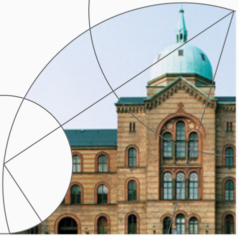
CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

BabyMAKRO

Spring 2023

Jeppe Druedahl



Plan

1. MAKRO
2. BabyMAKRO
3. BabyMAKRO
4. Solution method
5. Calibration
6. Government spending
7. Conclusion

Introduction

- **TBA**

Reminder: Consumption behavior (chapter 16)

1. **Maximize utility:**

   utility: $u(C_1) + \frac{u(C_2)}{1+\phi}$

   budget constraint: $C_1 + \frac{C_2}{1+r} = V_1 + Y_1^d + \frac{(1+g)Y_1^d}{1+r}$

   $\Rightarrow$ *derive properties of optimal micro-behavior*

2. **Aggregate consumption function:** $C_1 = C(\underset{+}{Y_1^d}, \underset{+}{g}, \underset{(-)}{r}, \underset{+}{V_1})$
3. **Estimate equation on aggregate data**
4. **Put equation into model**

Note: Similar for investment (chapter 15).

Classes of Macro Models

1. **Old-style Keynesian macro-models** (1950s-):

   Structure: Aggregate equations »similar« to those in micro-theory
   Estimation: Equation-by-equation on aggregate data
   In teaching: AS-AD models
   In practice: ADAM + MONA + SMEC
   (»Den økonomiske genopretning 1976-1993«, Jørgen Rosted, 2021)

2. **Micro-founded macro-models** (1970s-):

   Structure: Exactly the equations in micro-theory (in general equilibrium)
   Estimation: Calibration vs. moment-matching vs. full-system
   In teaching: *Dynamic Stochastic General Equilibrium Models* (DSGE)
   RBC: Real Business Cycle (1980s-)
   RANK: Representative Agent New Keynesian (1990s-)
   HANK: Heterogeneous Agent New Keynesian (2010s-)
   In practice: DREAM + DSGE at Nationalbanken + MAKRO

Blanchard: On the Need for (At Least) Five Classes of Macro Models

MAKRO

Structure of small open economy

- **Agents:**
  1. **Unconstrainted households** (»Ricardian«): One for each cohort
  2. **Hand-too-mouth households** (»HtM«): One for each cohort
  3. **Firms** (production, price setting, multiple sectors)
  4. **Central bank** (fixed exchange-rate)
  5. **Government**
  6. **Global foreign economy** (exogenous)
- **Expectations:** Perfect foresight
- **Market clearing:** Walras + sticky prices + search-and-match
- **Mathematically:** Non-linear equation system
- **Code:** https://github.com/DREAM-DK/MAKRO

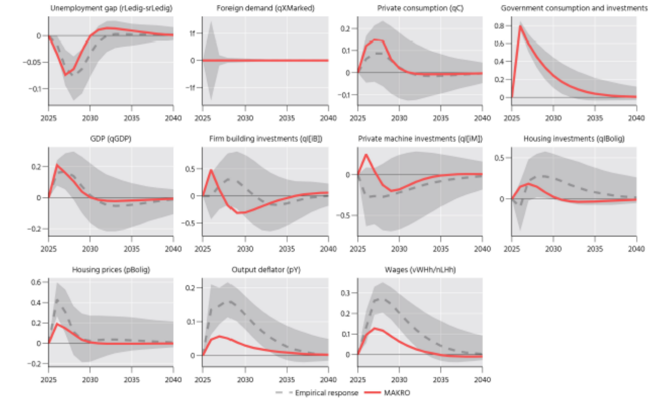
Empirical strategy

1. **Levels:** Weights in production and utility functions (directly observable in data, but changes over time...)
2. **Long-run relationships:** Substitution elasticities
3. **Short-run dynamics:** Adjustment cost parameters (especially focus on *convergence speed*)

Documentation: Matching af impuls responser og øvrige kortsigtsmomenter: MAKRO ift. empirien (2021)

Impulse-response functions (IRFs)

Figur 1
Stød til offentlige udgifter



Also: Foreign demand, foreign interest rate, labor supply, oil price

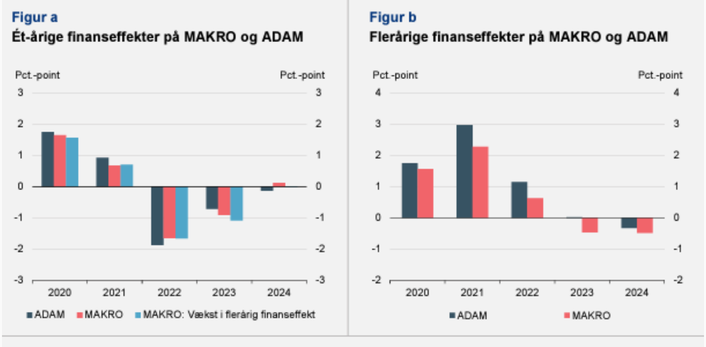
Micro-moments

Tabel 2

Yderligere relevant empiri til vurdering af MAKROs kortsigtsegenskaber

Analyse/moment	MAKRO og konsensus	Relevant litteratur
MPC ud af midlertidig/kortsigtet indkomst, første år	MAKRO: ca. 0,45 Litteratur: 0,4-0,6	Jørgensen & Kuchler (2017), Crawley & Kuchler (2020), Kreiner et al (2019), ADAM, SMEC
MPC ud af boligprisstigninger/formue, første år	MAKRO: ca. 0,05 Litteratur: 0,03-0,06	Hviid & Kuchler (2017), Andersen & Leth-Petersen (2021)
Fortrængning af tvungen pensionsopsparing for 30-55 årige, år 1 [år 10]	MAKRO: Ca. 0,35-0,55 [0,10-0,35] Litteratur: 0-0,5 [0-0,5]	Arnberg & Barslund (2012), Chetty m.fl. (2014), Andersen, Hansen & Kuchler (2021)
Rentefølsomhed, husholdningers boligværdi (stød til beskatning på aktie- og kapitalindkomst). Gns. 10 års-effekt.	MAKRO: knap -0,1 Litteratur: (-)0,25 – (-)0,18	Gruber, Jensen & Kleven (2021)*
Rentefølsomhed, husholdningers formue (stød til beskatning på aktie- og kapitalindkomst). 8-års effekt. [Langsigtet elasticitet]	MAKRO: ca. 0,2 [0,5] Litteratur: 0,2 – 0,4 [0,5 - 1]	Jakobsen, Jakobsen, Kleven & Zucman (2020)**

»Finanseffekt«: Is fiscal policy expansive or contractive wrt. GDP?



Kilde: Økonomisk Redegørelse, Marts 2023

BabyMAKRO

Verbal overview

- **TBA**

BabyMAKRO

Notation

- **Small open economy** with a *fixed exchange rate* and *overlapping generations*.
- **Households:** Unconstrained or hands-too-mouth wrt. consumption-saving + supply labor exogenously
- **Foreign economy:** Fixed nominal rate of return + import goods at fixed prices + demand curve for the domestic export good.
- **Production:**
  1. *Production firms* rent *capital* and *labor* to produce the domestic output good.
  2. Price adjustments for domestic good is infrequent
  3. *Repacking firms* combine imported goods with the domestic output good to produce a consumption good, an investment good, and an export good.
  4. Capital is rented from a *capital agency*, which purchases the investment good to accumulate capital subject to adjustment costs.
  5. Labor is rented from a *labor agency*, which post vacancies a search-and-match labor market to purchase labor from the

Notation

- **TBA**
- Notation: a denotes age, t denotes time
- The aggregate job-separation rate incl. mortality is

$$\delta_t^L = \frac{L_{t-1} - \underline{L}_t}{L_{t-1}}.$$

Foreign economy

- **Nominal interest rate:** r
- **Armington demand of the domestic exported good:**

$$X_t = \gamma^X X_{t-1} + (1-\gamma^X)\chi_t \left(\frac{P_t^X}{P_t^F}\right)^{-\sigma^F}.$$

- **Import goods:** $\bullet_t^M$ at prices $P_t^\bullet$ for $\bullet \in \{C, G, I, X\}$

Demographic structure and population

- **Life-span:** $\#$, hereof working, $\#_{\text{work}}$
- **Number of households:** N_a
- **Mortality rate:** ζ_a (controlled by ζ)
- **Demographic structure and population:**

$$N_a = \begin{cases} 1 & \text{if } a = 0 \\ (1-\zeta_{a-1})N_{a-1} & \text{if } a > 0 \end{cases}$$

$$\zeta_a = \begin{cases} 0 & \text{if } a < \#_{\text{work}} \\ \left(\frac{a+1-\#_{\text{work}}}{\#-\#_{\text{work}}}\right)^{\zeta} & \text{if } a < \# - 1 \\ 1 & \text{if } a = \# - 1 \end{cases}$$

$$N = \sum_{a=0}^{\#-1} N_a$$

Labor market flows

- **Employed:** $L_{a,t}$
- **Unemployed:** $U_{a,t} = N_a - L_{a,t}$
- **Job-separation rate:** δ_a^L
- **Job-finding rate:** m_t^s
- **Searchers** (everybody search = exogenous labor supply):

$$S_{a,t} = \begin{cases} 1 & \text{if } a = 0 \\ (1-\zeta_{a-1})\left[U_{a-1,t-1} + \delta_a^L L_{a-1,t-1}\right] & \text{if } a < \#_{\text{work}} \\ 0 & \text{if } a \geq \#_{\text{work}} \end{cases}$$

- **Employed** (before and after matching):

$$\underline{L}_{a,t} = \begin{cases} 0 & \text{if } a = 0 \\ (1-\zeta_{a-1})(1-\delta_a^L)L_{a-1,t-1} & \text{if } a < \#_{\text{work}} \\ 0 & \text{if } a \geq \#_{\text{work}} \end{cases}$$

$$L_{a,t} = \underline{L}_{a,t} + m_t^s S_{a,t}.$$

Search and matching

- **Vacancies:** v_t
- **Searchers:** $\sum_a S_{a,t}$
- **Matches**:

$$\mathcal{M}_t = \frac{S_t v_t}{\left(S_t^{\frac{1}{\sigma^m}} + v_t^{\frac{1}{\sigma^m}}\right)^{\sigma^m}}$$

- **Job-filling rate:** $m_t^v = \frac{\mathcal{M}_t}{v_t}$
- **Job-finding rate:** $m_t^s = \frac{\mathcal{M}_t}{S_t}$.

Wage bargaining

- The wage, W_t, is determined by an unmodeled bargaining mechanism, and it is set such that it is increasing in the labor demand:

$$W_t = W_{ss} \left(\frac{L_t}{L_{ss}} \right)^{\epsilon_w} .$$

Income

- The model has two types of households. A share of λ of households is hands-to-mouth and a share of $1-\lambda$ households is unconstrained (Ricardian). All households have four sources of income:

1. **Post-tax labor income:** $(1-\tau_t)\,W_t\frac{L_{a,t}}{N_a}$
2. **Post-tax unemployment benefits:** $(1-\tau_t)\,W^U W_{ss}\frac{U_{a,t}}{N_a}$
3. **Post-tax retirement benefits**: $(1-\tau_t)\,W^R W_{ss}\frac{N_a-(L_{a,t}+U_{a,t})}{N_a}$
4. **Equally divided inheritance**: $\frac{A_t^q}{N}$

- The age specific income is

$$\text{inc}_{a,t} = (1-\tau_t)\,W_t\frac{L_{a,t}}{N_a} + (1-\tau_t)\,W^U W_{ss}\frac{U_{a,t}}{N_a} + (1-\tau_t)\,W^R W_{ss}1_{\{a\geq\#_{\text{work}}\}} + \frac{A_t^q}{N},$$

and the price of consumption goods is P_t^C.

Hand-to-mouth households (HtM)

- **Consumer all income:**

$$C_{a,t}^{\text{HtM}} = \frac{\text{inc}_{a,t}}{P_t^C}$$

- **No savings:**

$$A_{a,t}^{\text{HtM}} = 0$$

Unconstrained household (Ricardian) I

- **Utility from consumption:**

$$\frac{\left(C^R_{a,t}\right)^{1-\sigma}}{1-\sigma}$$

- **Utility from wealth:**

$$\zeta_a \mu^{A^q} \frac{\left(\frac{A^R_{a,t}}{P^C_t}\right)^{1-\sigma}}{1-\sigma}$$

- **Discounting:**

$$\beta(1-\zeta_a)$$

- **Budget constraint:**

$$A^R_{-1,t} = 0$$
$$A^R_{a,t} = (1+r^{hh}_t)A^R_{a-1,t-1} + \text{inc}_{a,t} - P^C_t C^R_{a,t}.$$

Unconstrained household (Ricardian) II

- **Utility from consumption:**

$$\frac{\left(C^R_{a,t}\right)^{1-\sigma}}{1-\sigma}$$

- **Utility from wealth:**

$$\zeta_a \mu^{A^q} \frac{\left(\frac{A^R_{a,t}}{P^C_t}\right)^{1-\sigma}}{1-\sigma}$$

- **Discounting:**

$$\beta(1-\zeta_a)$$

- **Budget constraint:**

$$\begin{aligned} A^R_{-1,t} &= 0 \\ A^R_{a,t} &= (1+r^{hh}_t)A^R_{a-1,t-1} + \text{inc}_{a,t} - P^C_t C^R_{a,t}. \end{aligned}$$

Unconstrained household (Ricardian) II

- **Cohort:** t_0
- **Full problem**

$$V_{t_0} = \max_{\left\{C^R_{a,t}\right\}_{a=0}^{\#-1}} \sum_{a=0}^{\#-1} \left(\Pi_{j=0}^{a-1}\beta(1-\zeta_j)\right) \left[\frac{\left(C^R_{a,t}\right)^{1-\sigma}}{1-\sigma} + \zeta_a \mu^{A^q} \frac{\left(\frac{A^R_{a,t}}{P^C_t}\right)^{1-\sigma}}{1-\sigma} \right]$$

s.t.

$$t = t_0 + a$$

$$A^R_{-1,t} = 0$$

$$A^R_{a,t} = (1+r^{hh}_t)A^R_{a-1,t-1} + \mathrm{inc}_{a,t} - P^C_t C^R_{a,t}.$$

Unconstrained household (Ricardian) III

- **First order condition:**

$$C_{a,t}^{R}=\begin{cases}\left(\zeta_a\mu^{A^q}\left(\frac{A^R_{\#-1,t}}{P^C_t}\right)^{-\sigma}\right)^{-\frac{1}{\sigma}} & \text{if } a=\#-1\\ \left(\beta(1-\zeta_a)\frac{1+r^{hh}_{ss}}{1+\pi^{hh}_{ss}}\left(C^{R,}_{a+1,ss}\right)^{-\sigma}+\zeta_a\mu^{A^q}\left(\frac{A^R_{a,ss}}{P^C_{ss}}\right)^{-\sigma}\right)^{-\frac{1}{\sigma}} & \text{elif } t=T-1\\ \left(\beta(1-\zeta_a)\frac{1+r^{hh}_{t+1}}{1+\pi^{hh}_{t+1}}\left(C^{R,}_{a+1,t+1}\right)^{-\sigma}+\zeta_a\mu^{A^q}\left(\frac{A^R_{a,t}}{P^C_t}\right)^{-\sigma}\right)^{-\frac{1}{\sigma}} & \text{else}\end{cases}$$

- **Bequests:**

$$A_t^q=\left(1+r^{hh}\right)\sum_{a=0}^{\#-1}\zeta_a N_a A_{a,t}.$$

Production firms I

- **Capital:** K_{t-1}, at rental price r_t^K
- **Labor:** ℓ_t, at rental price r_t^ℓ
- **Output:** Y_t, with a CES technology, sold at $P_t^{Y,0}$
- **Profit maximization** with prices taken as given

$$\Pi_t = \max_{X_i, X_j} P_t^{Y,0} Y_t - r_t^K K_{t-1} - r_t^\ell \ell_t$$

s.t.

$$Y_t = \Gamma \left(\left(\mu^K\right)^{\frac{1}{\sigma^Y}} K_{t-1}^{\frac{\sigma^Y - 1}{\sigma^Y}} + \left(1 - \mu^K\right)^{\frac{1}{\sigma^Y}} \ell_t^{\frac{\sigma^Y - 1}{\sigma^Y}} \right)^{\frac{\sigma^Y}{\sigma^Y - 1}}$$

where $\mu^K, \sigma^Y, \Gamma > 0$, $\sigma^Y \neq 1$.

Production firms

- **Free entry implies zero profit:**

$$P_t^{Y,0} = \frac{1}{\Gamma}\left(\mu^K\left(r_t^K\right)^{1-\sigma^Y} + \left(1-\mu^K\right)\left(r_t^\ell\right)^{1-\sigma^Y}\right)^{\frac{1}{1-\sigma^Y}}.$$

- **First order condition for capital-labor ratio:**

$$\frac{K_{t-1}}{\ell_t} = \frac{\mu_K}{1-\mu_K}\left(\frac{r_t^\ell}{r_t^K}\right)^{\sigma^Y}$$

Capital agency I

- **Investment good:** I_t, at price, P_t^I
- Capital: K_t, rented out at rental rate r_{t+1}^K in the following period.
- Adjustment costs: Effective investment is ι_t.
- Required internal rate of return: r^{firm}.
- **Profit maximization:**

$$V_0^{\text{capital}}\left(K_{t-1}\right) = \max_{\{K_t\}} \sum_{t=0}^{\infty} \left(1 + r^{\text{firm}}\right)^{-t} \left[r_t^K K_{t-1} - P_t^I \left(\iota_t + \Psi(\iota_t, K_{t-1})\right)\right]$$

s.t.

$$I_t = \iota_t + \Psi(\iota_t, K_{t-1})$$

$$K_t = (1 - \delta^K)K_{t-1} + \iota_t.$$

Capital agency II

- **Functional form:**

$$\Psi(\iota_t, K_{t-1}) = \frac{\Psi_0}{2}\left(\frac{\iota_t}{K_{t-1}} - \delta^K\right)^2 K_{t-1}.$$

- **First order condition:**

$$\begin{aligned} 0 = &- P_t^I\left(1 + \Psi_\iota\left(\iota_t, K_{t-1}\right)\right) \\ &+ \frac{r_{t+1}^k + P_{t+1}^I(1-\delta^K)(1+\Psi_\iota(\iota_{t+1}, K_t)) - P_{t+1}^I \Psi_K\left(\iota_{t+1}, K_t\right)}{1 + r^{\text{firm}}} \end{aligned}$$

Labor agency I

- **Post vacancies**: v_t at cost κ^L (in units of labor).
- **Labor:** Hires L_t and rent out labor at rental price r_t^ℓ
- **Exogenous match destruction:** δ_t^L (implied by $\delta_{a,t}^L$ and $L_{a,t-1}$)
- Exogenous wage: W_t
- **Profit maximization:**

$$V_0^{\text{labor}}(L_{t-1}) = \max_{\{v_t\}} \sum_{t=0}^{\infty} \left(1 + r^{\text{firm}}\right)^{-t} \left[r_t^\ell \ell_t - W_t L_t\right]$$

s.t.

$$L_t = m_t^v v_t + \left(1 - \delta_t^L\right) L_{t-1}$$

$$\ell_t = L_t - \kappa^L v_t.$$

Labor agency II

- **First order condition:**

$$r_t^{\ell} = \frac{1}{1 - \frac{\kappa^L}{m_t^v}} \left[W_t - r_{t+1}^{\ell} \frac{1 - \delta_{t+1}^L}{1 + r^{\text{firm}}} \frac{\kappa^L}{m_{t+1}^v} \right]$$

Phillips curve

- **Input price:** $P_t^{Y,0}$
- **Output price:** p_t^Y for differentiated goods
- **Demand schedule:** $y_t = \left(\frac{p_t^Y}{P_t^Y}\right)^{-\sigma_D} Y_t$, where P_t^Y and Y_t are aggregates
- **Profit maximization:**

$$V_t^{\text{intermediary}} = \max_{\{p_t^Y\}} \left(p_t^Y - P_t^{Y,0}\right) y_t - g_t + \frac{1}{1 + r^{\text{firm}}} V_{t+1}^{\text{intermediary}}$$

s.t.

$$g_t = \frac{\gamma}{2} \left[\frac{p_t^Y / p_{t-1}^Y}{p_{t-1}^Y / p_{t-2}^Y} - 1\right]^2 P_t^Y Y_t$$

$$y_t = \left(\frac{p_t^Y}{P_t^Y}\right)^{-\sigma_D} Y_t.$$

Phillips curve

- **Assumption:** Symmetric firms
- **First order condition:**

$$
\begin{aligned}
P_t^Y =& (1+\theta)P_t^{Y,0} - \eta\left(\frac{P_t^Y/P_{t-1}^Y}{P_{t-1}^Y/P_{t-2}^Y} - 1\right)\frac{P_t^Y/P_{t-1}^Y}{P_{t-1}^Y/P_{t-2}^Y}P_t^Y \\
&+ \frac{2\eta}{1+r^{\textbf{firm}}}\frac{Y_{t+1}}{Y_t}\left(\frac{P_{t+1}^Y/P_t^Y}{P_t^Y/P_{t-1}^Y} - 1\right)\frac{P_{t+1}^Y/P_t^Y}{P_t^Y/P_{t-1}^Y}P_{t+1}^Y \\
\theta \equiv& \frac{1}{\sigma_D - 1} \\
\eta \equiv& \theta\gamma.
\end{aligned}
$$

Repacking firms

- **Output goods:** $\bullet_t^Y$ at prices $P_t^\bullet$ for $\bullet \in \{C, G, I, X\}$
  private consumption, C_t, public consumption, G_t, investment, I_t, or exports, X_t.
- **Domestic input good:** Y_t at price P_t^Y
- **Foreign input goods:** $\bullet_t^M$ at prices $P_t^\bullet$ for $\bullet \in \{C, G, I, X\}$
- **Profit maximization with CES** production techonology implies

$$P_t^\bullet = \left(\mu^{M,\bullet}\left(P_t^{M,\bullet}\right)^{1-\sigma^\bullet} + \left(1-\mu^{M,\bullet}\right)\left(P_t^Y\right)^{1-\sigma^\bullet}\right)^{\frac{1}{1-\sigma^\bullet}}$$

$$\bullet_t^M = \mu^{M,\bullet}\left(\frac{P_t^\bullet}{P_t^{M,\bullet}}\right)^{\sigma^\bullet}\bullet_t$$

$$\bullet_t^Y = \left(1-\mu^{M,\bullet}\right)\left(\frac{P_t^\bullet}{P_t^Y}\right)^{\sigma^\bullet}\bullet_t\ .$$

for $\bullet \in \{C, G, I, X\}$

Government

- **Interest rate:** r^B
- **Government consumption:** G_t
- **Unemployment insurance:** $E_t^U = W_U W_{ss} U_t$
- **Retirement benefits:** $E^R = W_R W_{ss} 1_{\{a \geq \#_{\text{work}}\}}$
- **Tax base:** $T_t = W_t L_t + E_t^U + E^R$
- **Budget constraint:**

$$B_t = (1 + r^B) B_{t-1} + P_t^G G_t + E_t^U + E^R - \tau_t T_t.$$

- **Tax policy**

$$\tau_t = \tau_{ss} + \varepsilon_B \frac{\tilde{B}_t - B_{ss}}{T_t},$$
$$\tilde{B}_t = (1 + r^B) B_{t-1} + P_t^G G_t + E_t^U + E^R - \tau_{ss} T_t$$

Goods market clearing

1. **Demand for domestically produced goods:**

$$Y_t = \sum_{\bullet \in \{C,G,I,X\}} \bullet_t^Y.$$

1. **Imports add up:**

$$M_t = \sum_{\bullet \in \{C,G,I,X\}} \bullet_t^M.$$

Current account and net foreign position

- **Not specified yet**

Solution method

Targets and unknowns

- **Goal:** Find the *equilibrium path* in the economy.
- **Equilibrium path:** A set of paths for all variables, which satisfies
  1. Optimal firm and household behavior in terms of FOCs.
  2. All accounting identities,
  3. Implies market clearing,
- **Target equations:** Must be zero on the equilibrium path.
- **Unknown variables:**
  1. Chosen by model-builder
  2. All other variables must be derived from these
  3. Target equations can be evaluated
- **Truncation:** Assume back in steady state after T periods

Exogenous variables

1. Γ_t, technology
2. G_t, public spending
3. χ_t, *foreign* demand shifter (»market size«)
4. $P_t^{M,C}$, import price of *private consumption* component good
5. $P_t^{M,G}$, import price of *public consumption* component good
6. $P_t^{M,I}$, import price of *investment* component good
7. $P_t^{M,X}$, import price of *export* component good
8. P_t^F, *foreign* price level
9. r_t^{hh}, *foreign* interest rate

Unknowns in practice

1. A_t^q, inheritance flow (T unknowns)
2. A_t^{death}, wealth of households at $a = \# - 1$ (T unknowns)
3. K_t, capital (T unknowns)
4. L_t, labor supply (T unknowns)
5. r_t^K, rental price for capital (T unknowns)
6. P_t^Y, price of domestic output (T unknowns)

Solving numerically

- **Solve with Newton's method**: Successive approximations of the root.
  - x is a $6 \times T$ vector containing all 6 unknown in all T periods.
  - f is a $6 \times T$ vector containing all 6 target in all T periods.
  - $\mathcal{J}$ is the Jacobian of f (the derivative of f).
  - with x_n being the n'th guess, compute next guess, x_{n+1}, as

$$x_{n+1} = x_n - \frac{f(x_n)}{\mathcal{J}_n}.$$

  - Converges to solution, $f(x^*) = 0$, (if it exists) as n grows.

Calibration

Steady state

- Steady state: When all variables are constant over time, the equilibrium path is a *steady state*.
- To solve for steady state:
  - Choose values for a selection of the endogenous variables.
  - Derive the rest from closed form expressions, or solve sub-systems numerically.

Dynamics

- **TBA**

Government spending

Impulse-responses

- An *impulse response*:
  - The economy starts at steady state.
  - Some exogenous variables *temporarily* deviate from steady state.
  - The impulse responses: How variables respond to the shock.
- Shock to government spending, G_t:

$$G_t = G_{ss} + Shock_t$$

$$Shock_t = \begin{cases} G_{ss} \cdot Size \cdot Persistence^{t-T_{start}} & \text{if}\, T_{start} \leq t < T_{end} \\ 0 & \text{else} \end{cases}$$

- $Size = 1.01$: Initial deviation from steady state at 1 pct.
- Shocks starts in $T_{start} = 0$ and ends in $T_{end} = 50$.
- $Persistence = 0.8$.
  - Shock fades as t grows.
  - Higher values $\rightarrow$ longer convergence.

Initial effects I

- **Repacking firms:** Demand for domestic goods $Y\uparrow$ and imports $M\uparrow$.
- **Production firms:** Increases inputs to increase production $Y\uparrow$:
  - Capital $K\uparrow$ (limited by adjustment costs) and labor $\ell\uparrow$.
- **Households:** More income, greater consumption $C\uparrow$:
  - Real wage $W\uparrow$ due to increased labor demand (indexed to P^C).
  - Hand-to-mouth $C^{HtM}\uparrow$: Increase proportional to increase in W.
  - Ricardian $C^R\downarrow$: Due to consumption smoothing.
- **Prices:** Higher input prices causes higher prices $P\uparrow$:
  - $W\uparrow$ and $r^K\uparrow$ drives up marginal costs $P^{Y,0}\uparrow$.
  - Output prices $P^Y\uparrow$ (limited by adjustment costs).
  - Causes higher repacking prices $P^\bullet\uparrow$ for $\bullet\in\{C,I,G,X\}$.
- **Foreign economy:** Exports $X\downarrow$ due to increasing prices $P^X\uparrow$.

Initial effects II

- **Labor agency:** Employs more $L\uparrow$ and rents $\ell\uparrow$ to production firms.
  - Job vacancies $v\uparrow$ to meet higher labor demand.
  - Number of matches $\mathcal{M}\uparrow$, »gross« labor $L\uparrow$.
  - Labor $\ell\uparrow$ (limited by adjustment costs).
- **Capital agency:** Investments $I\uparrow$ to accumulate capital $K\uparrow$.
  - Expensive investments: $P^I\uparrow$
  - Greater return: $r^K\uparrow$

Transition path

- **Government:**
  - Government spending $G \downarrow$ by assumption.
  - Tax rate $\tau \uparrow$ to finance growing government debt $B \uparrow$.
- **Repacking firms:**
  - Demand for domestic goods $Y \downarrow$ and imports $M \downarrow$.
  - Prices $P \downarrow$.
- **Production firms:**
  - Drop in production inputs, labor $\ell \downarrow$ and capital $K \downarrow$.
- **Households:**
  - $\ell \downarrow$ causes wages $W \downarrow$.
  - Higher taxes from $\tau \uparrow$.
  - Leads to less disposable income and thus $C \downarrow$.
- **Foreign economy:**
  - Exports $X \uparrow$ due to falling prices $P^X \downarrow$.

Conclusion

Insights and takeaways

- **TBA**