Demographic Aging and the New Keynesian Phillips Curve

Gene Ambrocio

August 2023

Motivation

"While higher interest rates, slower growth, and softer labor market conditions will bring down inflation, they will also bring some pain to households and businesses. These are the unfortunate costs of reducing inflation."

- Jerome Powell (Jackson Hole, Aug. 26, 2022)

- Post-pandemic surge in inflation and consequent monetary tightening highlights the disinflation costs faced by a monetary authority
- Slope of the Phillips Curve (NKPC) an important indicator for this trade-off
  - Many have argued that the slope has flattened (Del Negro et al., 2020, Stock and Watson, 2020, Hazell et al., 2022) thereby increasing the costs of disinflation

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- Reasons for flattening NKPC slope: anchoring of inflation expectations (Barnichon and Mesters, 2021), optimal monetary policy (McLeay and Tenreyro, 2020), state dependence at low inflation (Forbes et al., 2021; Costain et al., 2021), evolving production networks , (Hoeynck, 2020; Rubbo 2023), and **Competition (Fujiwara and Matsuyama, 2022)**
- Competition (market power) hypothesis also accounts for rise in markups (De Loecker et al., 2020, Autor et al., 2020)
  - Declining price sensitivities an important factor (Brand, 2021; Doepper et al., 2022; Atalay et al., 2023)
- There may also be a link to a third trend: demographic aging

▸ Trends

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- Shift in consumption towards services among elderly: Aging leads to shift in demand and production towards services sector (Cravino et al., 2022) with stickier prices (Mangiante, 2023).
- However, average price sensitivities may also decline as one ages

> *"Old people's spending patterns may be dominated by strong habit patterns that make them less sensitive to price changes. Teenagers may be affected by peer pressures that explain their insensitivity to prices when compared with working-age adults; however they seem to show higher sensitivity when compared with old people."*
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This Paper: Monetary policy implications of aging and consumption

Focus on the relation between aging and market power and develop a model to derive implications for monetary policy.

- Document a correlation between demographic factors and average markups
  - Larger old-age population $\Rightarrow$ higher markups (market power)
  - Not due to common trends or structural changes
- Embed age-dependent deep habits in a New Keynesian model
  - Markups (market power) increase with aging as in the data
  - Flattens the *slope* of the Phillips curve and raises the cost of disinflation

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Markups and demographic factors

$$MU_{c,t} = \alpha_c + \alpha_t + \sum \beta_f Demog_{c,t}(f) + \sum \beta_k X_{c,t}(k) + \beta_l MU_{c,t-1} + \epsilon_{c,t}$$

Dep. var.: Markups	(1)	(2)	(3)	(4)	(5)	(6)
Sample	FULL	FULL	FULL	FULL	OECD	non-OECD
Age dependency ratio (total)	0.009**	0.009**	0.004*			
Share young to total pop.				0.008*	0.002	0.003
Share old to total pop.				0.015*	0.011*	-0.008
L.Markups			0.489***	0.492***	0.814***	0.397***
Additional controls	NO	YES	YES	YES	YES	YES
Model	PFE	PFE	DP	DP	DP	DP
Observations	1356	628	628	628	591	393

Panel Fixed Effects and Dynamic Panel methods: Country and Year fixed effects included. Additional control variables are Real GDP, current account and total trade to GDP, government spending to GDP, savings to GDP, share of Services to GDP, unemployment and labor force participation rates, population density, life expectancy, population growth, share female, stock market capitalization and credit to GDP. Country-year panel of 40 countries over 1980-2016. Data from World Bank and De Loecker and Eeckhout (2020).

Increase in old-age dependency can account for 10% of markups for OECD

Data desc

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What are the implications?

- Association between aging and markups not due to common trends or structural changes - price sensitivities decline over lifetimes
- Hypothesis: Households develop tastes for specific products (deep habits) as they age and gain *consumption experience* - become more *niche consumers* as they grow older
- Implications for monetary policy: A New Keynesian Deep Habits model (Ravn et al., 2006) augmented with overlapping generations and age-specific deep habits
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New Keynesian Deep Habits and Aging: Key Features

- Households
  - Key assumption: Deep habits develop over lifetime ▸ Foundations
  - Tractability: Blanchard-Yaari overlapping generations with consumption risk sharing ▸ Details
- Firms
  - Demand- and supply-side sources of market power: Two layers of monopolistic competitive production (consumption goods and intermediate inputs) ▸ Details
  - Link from market power to the Phillips Curve: Rotemberg price rigidities

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New Keynesian Deep Habits and Aging: Log-linearized 3 equations

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\begin{aligned}
\hat{r}_t &= \rho_r \hat{r}_{t-1} + (1-\rho_r)[\alpha_\pi \hat{\pi}_t + \alpha_y \hat{y}_t] + \epsilon_{r,t} \\
\hat{y}_t &= \frac{1}{1+\tilde{\theta}} \mathbb{E}_t \hat{y}_{t+1} + \frac{\tilde{\theta}}{1+\tilde{\theta}} \hat{y}_{t-1} - \frac{1-\tilde{\theta}}{1+\tilde{\theta}} \frac{1}{\sigma} \left[\hat{r}_t - \mathbb{E}_t \hat{\pi}_{t+1} + \hat{\beta}_t \right] \\
\hat{\pi}_t &= \tilde{\beta} \mathbb{E}_t \hat{\pi}_{t+1} + \frac{\gamma - 1}{\delta} \left[\hat{\lambda}_{h,t} - \hat{\lambda}_{i,t} \right] + \tilde{\beta} \mathbb{E}_t \hat{\lambda}_{i,t+1} - (1+\tilde{\beta}) \hat{\lambda}_{i,t} + \hat{\lambda}_{i,t-1}
\end{aligned}
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- Cons. good marginal cost: $\hat{\lambda}_{i,t} = \Theta_1 \hat{y}_t - \Theta_2 \mathbb{E}_t \hat{y}_{t+1} - \Theta_3 \hat{y}_{t-1} + \Theta_4 \hat{\beta}_t$
- Interm. input marginal cost: $\hat{\lambda}_{h,t} = (\kappa + \frac{\sigma}{1-\tilde{\theta}}) \hat{y}_t - \Theta_5 \hat{y}_{t-1} - (1+\kappa) \hat{A}_t$
- Deep habits $\tilde{\theta} \in [0,1]$ is increasing in aging
  - $\tilde{\theta} = 0 \Rightarrow \Theta_i = 0 \; \forall i$, $\hat{\lambda}_{i,t} = 0$, and model collapses to Standard New Keynesian

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New Keynesian Deep Habits and Aging: Cost of (dis)inflation

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- Coefficients $\Theta_i \geq 0$ are increasing in aging and zero if no deep habits
  - Aging flattens the slope of the Phillips curve (coefficient on $\hat{y}_t$)
  - Slope is no longer a sufficient statistic for the relationship between inflation and output in the Phillips curve - simulate output response to a monetary policy

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& + \Theta_4\tilde{\beta}\mathbb{E}_t\hat{\beta}_{t+1} - (1+\tilde{\beta}+\frac{\gamma-1}{\delta})\Theta_5\hat{\beta}_t + \Theta_4\hat{\beta}_{t-1} - \frac{\gamma-1}{\delta}(1+\kappa)\hat{A}_t
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New Keynesian Deep Habits and Aging: Calibration

Demographics and markups for Japan in the 1980s and 2010s.

- Life expectancy and population growth give $\tilde{\theta}_s$ for $s \in \{1980s, 2010s\}$
- Markups

$$\mu_s = \left[\frac{\gamma_s}{(\gamma_s - 1)}\right]\left[\frac{\eta}{(\eta - 1)}\right]\left[\frac{1 - \tilde{\theta}_s}{1 - \tilde{\theta}_s\left(\frac{\eta - \tilde{\beta}_s}{\eta - 1}\right)}\right]$$

- Demographic change accounts for about 3.8% of markups (10% average in OECD data)
- ▸ Full Table

▸ Steady state changes

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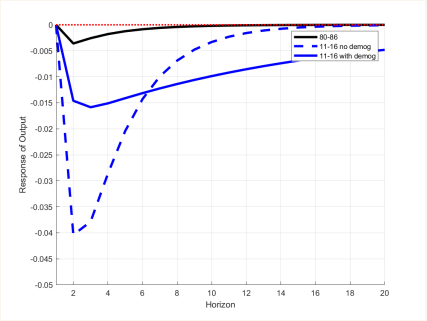
New Keynesian Deep Habits and Aging: Cost of (dis)inflation

Cumulated output response

Horizon	2 year	5 year	20 year
1980-1985 Baseline	-0.011	-0.012	-0.012
2011-2016 with no demog. change	-0.163	-0.174	-0.174
Share (%)	(157.5)	(91.3)	(68.8)
2011-2016 All changes	-0.108	-0.189	-0.247
Share (%)	(100.0)	(100.0)	(100.0)

- Cost of disinflation order of magnitude higher in the 2010s
- Aging adds persistence but dampens initial output response
- About one-third of long-run increase in disinflation cost is due to aging



Output IRF to monetary surprise

▸ w/o deep habits

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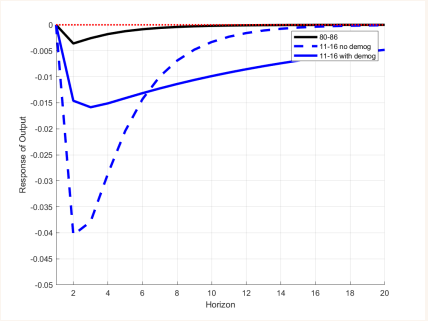

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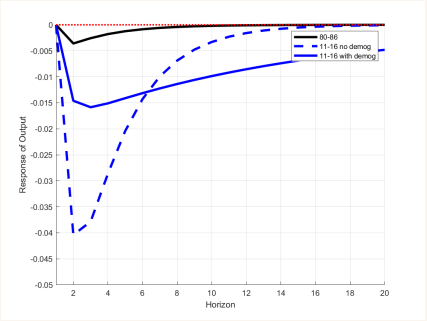

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Concluding remarks

- Stylized fact: Age-structure correlates well with average markups
  - Particularly for the share of old dependents in OECD countries
  - Declining price sensitivities over lifetimes may explain this relationship
- A New Keynesian Deep Habits model with age-specific deep habits can replicate these features of the data
  - Aging raises markups and flattens the New Keynesian Phillips Curve
  - More broadly, aging raises the cost of disinflation for monetary policy

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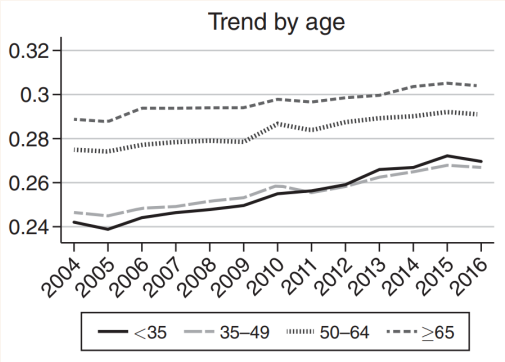
Motivation

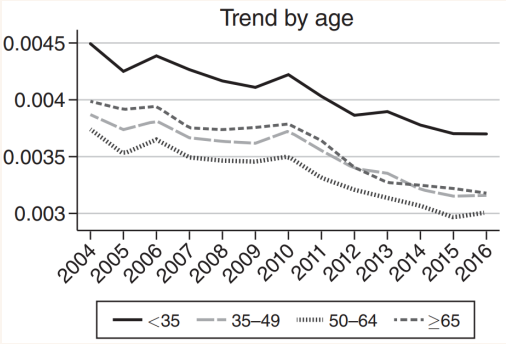
- Older households are more attached to specific brands (brand loyalty/capital)
  - Older households have more *niche* consumption (Neiman and Vavra, 2023) ▸ Figure
  - Consumption inertia more pronounced in older households (Bornstein, 2021) ▸ Figure
- 2012 Eurobarometer survey evidence that older households care less about prices and more about non-price qualities in food purchases ▸ Results

▸ Return

Niche consumption by age



Average HH concentration



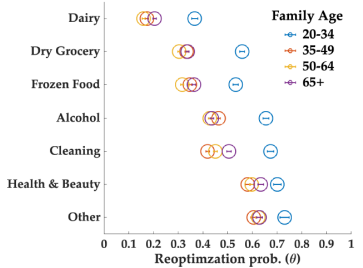
Aggregate concentration

Source: Figure 3 in Neiman and Vavra (2023)

Return

Consumer inertiaby age

Figure 5: Consumer Inertia by Household Age Across Departments



Notes: This figure displays the average estimated consumer inertia by age groups in each product department. The center of each circle represents the weighted average point estimates, and each confidence interval represent the weighted average confidence interval. Weights are proportional to the number of observations in the regression of each product category.

Source: Figure 5 in Bornstein (2021)

Return

Price sensitivities and age: EU household food purchases

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.:	PRICE		QUALITY		GEOGRAPHIC ORIGIN		BRAND	
25 - 34 years	0.018	0.020	-0.035*	-0.034*	-0.145***	-0.148***	-0.055*	-0.063**
35 - 44 years	0.023	0.024	-0.038	-0.038*	-0.238***	-0.245***	-0.058	-0.071**
45 - 54 years	0.016	0.016	-0.051**	-0.050**	-0.285***	-0.298***	-0.068	-0.082**
55 - 64 years	0.070**	0.071**	-0.081***	-0.081***	-0.342***	-0.349***	-0.062	-0.077*
65 years and older	0.135***	0.127***	-0.083***	-0.080***	-0.370***	-0.376***	-0.072	-0.093*
With children	-0.030**	-0.030**	0.022	0.023*	0.057***	0.056***	0.028*	0.026
Additional controls	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effects	CNTRY	NUTS2	CNTRY	NUTS2	CNTRY	NUTS2	CNTRY	NUTS2
Adj. R-squared	0.175	0.188	0.053	0.067	0.120	0.137	0.117	0.138
Observations	15977	15977	16092	16092	15946	15946	15759	15759

Dependent variables are survey responses regarding importance of feature (decreasing scale) for food purchases. Omitted age category is 15-24 years old. Additional controls are education, occupation, home ownership, difficulties paying bills, marital status, gender, community, social status, internet use and ability, online purchases, and food logo awareness. Data from the March 2012 Eurobarometer survey covering 26 thousand respondents from 27 European countries.

▸ Return

Related Literature

- Economic implications of aging on savings, real rates, and asset returns (Poterba, 2001; Krueger and Ludwig 2007; Ludwig et al., 2012; Carvalho et al., 2016; Lunsford and West, 2019), labor markets and productivity (Feyrer, 2007; Liang et al., 2018; Aksoy et al., 2019; Acemoglu and Restrepo, 2022), and inflation and monetary policy (Fujiwara and Teranishi, 2008; Goodhart and Pradhan, 2020; Katagiri et al., 2020; Juselius and Takats, 2021; Leahy and Thapar, 2022)
  - I focus on consumption behavior $\Rightarrow$ market power and monetary policy
- Decline in markups and price sensitivities (De Loecker et al., 2020, 2021; Autor et al., 2020; Brand, 2021; Liu et al., 2022; Doepper et al., 2022; Atalay et al., 2023) and demographic aging
  - Bornstein (2021) on formation of new firms and Cravino et al. (2022) and Mangiante (2023) on changing consumption baskets while I focus on changing price sensitivities via deep habits.

Return

Markups and demographic factors

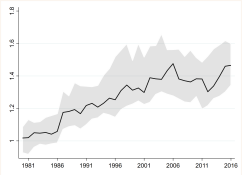
Country-year panel over 1980-2016. Data from the World Bank and De Loecker and Eeckhout (2020).

ARG	DEU	IRL	PER
AUS	DNK	ITA	PHL
AUT	ESP	JPN	PRT
BEL	FIN	KOR	SGP
BRA	FRA	MEX	SWE
CAN	GBR	MYS	THA
CHE	GRC	NLD	TUR
CHL	HKG	NOR	USA
CHN	IDN	NZL	VEN
COL	IND	PAK	ZAF

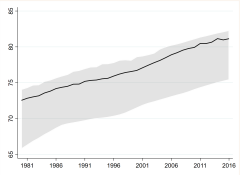
	Mean	St. dev.	Obs.	Description
Markups	1.34	0.31	1382	Average markups
Age dependency ratio (total)	54.57	10.81	1480	Share of young (0-14) and old (65+) to working age pop.
Share young to total pop.	24.37	8.22	1480	Share of young (0-14) to total pop.
Share old to total pop.	10.64	5.27	1480	Share of old (65+) to total pop.
Life exp. at birth (years)	74.22	6.24	1480	Life expectancy at birth, total (years)
Population growth(annual %)	1.08	0.82	1479	Population growth in annual %
Fertility rate	2.18	0.94	1480	Fertility rate (births per woman)
Share female to total pop.	50.42	0.90	1480	Share of felae to total pop.
Net migration (% of pop.)	0.97	1.88	280	Net migration to total pop.
...	...	...	...	...
Real GDP growth (annual %)	3.30	3.59	1478	Real GDP growth in annual %
CPI inflation	24.30	250.70	1404	Consumer price index (2010=100) inflation in annual %
Unemployment rate	6.96	4.77	1122	Unemployment rate as % of labor force
Labor force part. rate	60.65	7.50	1308	Labor force participation rate as % to population aged15+
Current Account to GDP	0.24	5.40	1339	Current account balance as % of GDP
Market cap of listed firms (% of GDP)	77.87	113.39	1147	Market cap. of listed dom. firms as % of GDP
Private domestic credit (% of GDP)	80.31	51.05	1221	Domestic credit to private sector as % of GDP
Services value-added (% of GDP)	57.13	9.70	1225	Services sector value added as % of GDP

Return

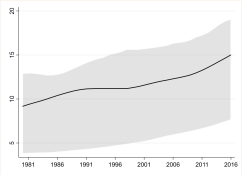
Markups and demographic factors



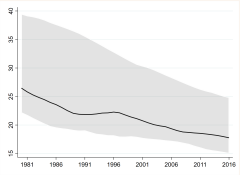
Average markups



Life expectancy



Share old dependents



Share young dependents

▸ Return motivation

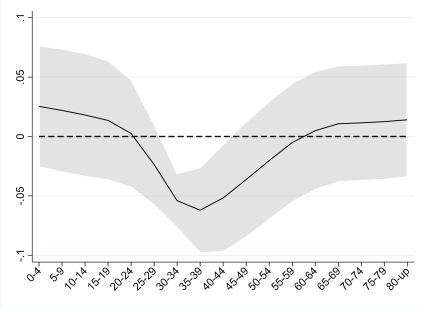
Median values and interquartile range.

▸ Return

Markups and demographic factors

- Difficult to add full age distribution as variables
- Factor shrinkage of age dist:

$$
\begin{aligned}
Age_{c,t}(a) &= \sum \gamma_{a,p} F_{c,t}(p) + \xi_{c,t,a} \\
MU_{c,t} &= \sum \beta_p F_{c,t}(p) + \sum \beta_k X_{c,t}(k) \\
&\quad + \beta_l MU_{c,t-1} + \alpha_c + \alpha_t + \epsilon_{c,t} \\
\frac{\partial MU_{c,t}}{\partial Age_{c,t}(a)} &= \sum \hat{\gamma}_{a,p} \hat{\beta}_p
\end{aligned}
$$



Return

Age-specific deep habits

- Suppose that a household j born at time $t - J$ consumes a product variety $k \in [0, 1]$ in sector $i \in [0, 1]$ and prefers to consume some subset of varieties $\Sigma_{j,i}$ of length $0 \leq s \leq 1$. Household obtains higher marginal utility from consuming the preferred good:

$$\frac{\partial U_{j,t}}{\partial c_{k,i,j,t}} = \begin{cases} \bar{x} \left[c_{k,i,j,t} \right]^{-1/\eta} & \text{if} \quad k \notin \Sigma_{j,i} \\ \bar{x} \left[c_{k,i,j,t} - \bar{c} \right]^{-1/\eta} & \text{if} \quad k \in \Sigma_{j,i} \end{cases}$$

- Every period, the household is matched with a store offering one random variety for each sector. The household can then choose to consume this variety or any one that she has previously encountered.

Return

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Return

Age-specific deep habits

- The likelihood that a household of age J has encounted (one of) a preferred variety is increasing over their lifetime:

$$Pr(\{k\}_{t-J}^{t} \cap \Sigma \neq \emptyset) = 1 - (1 - s)^{J}$$

- Random Σ across households $\Rightarrow$ above is also share of households of age J consuming their preferred variety.
  - Generates deep habits: $\theta_{i,j,t} = \theta Pr(\{k\}_{t-J}^{t} \cap \Sigma \neq \emptyset)$
- Aggregate deep habits depend on age distribution:

$$\tilde{\theta} = \sum_{J=1}^{\infty} \int_{j \in J} \theta_{i,j,t} dj \; f(J)$$

Return

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Return

New Keynesian Deep Habits: Households

- Blanchard-Yaari Overlapping Generations: Fraction g_b born and g_d exit each period. Ex-ante identical households with parsimonious age distribution,

$$f(J) = g(1-g)^{J-1} \quad \text{where} \quad g = g_b/(1+g_b-g_d)$$

- *Standard* deep habits household problem: max CRRA utility from consumption bundle $U(x_{j,t}, h_{j,t})$ where

$$x_{j,t} = \left[\int_0^1 \left(c_{i,j,t} - \theta_{i,j,t} c_{i,t-1}\right)^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}}$$

Return

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▸ Return

New Keynesian Deep Habits: Households

$$\max \quad \mathbb{E}_t \sum_{t'=0}^{\infty} [(1-g_d)\beta]^{t'} U(\{c_{i,j,t+t'}\}, h_{j,t+t'})$$

subject to:

$$U = \frac{x_{j,t}^{1-\sigma}}{1-\sigma} - \frac{h_{j,t}^{1+\kappa}}{1+\kappa}$$

$$x_{j,t} = \left[\int_0^1 \left(c_{i,j,t} - \theta_{i,j,t} c_{i,t-1}\right)^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}}$$

$$\int_0^1 P_{i,t} c_{i,j,t} di + B_{j,t} = R_{t-1} B_{j,t-1} + W_t h_{j,t} + \Phi_t \quad \forall t$$

Return

New Keynesian Deep Habits: Consumption good Firms

- Firms max profits given household stochastic discount factor and demand curve:

$$c_{i,t} = x_t \left[\frac{P_{i,t}}{P_t} \right]^{-\eta} + \tilde{\theta} c_{i,t-1}$$

- Produce using intermediate inputs $y_{m,t}$ at cost $P_{m,t}$:

$$y_{i,t} = \left[\int_{m=0}^{1} Y_{m,t}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

- Production elasticity of substitution γ captures supply side factors

Return

New Keynesian Deep Habits: Consumption good Firms

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- Production elasticity of substitution γ captures supply side factors

Return

New Keynesian Deep Habits: Intermediate input Firms

Firms use labor to meet demand for inputs and max profits subject to Rotemberg costs

- Profits: $\Phi_{m,t} = P_{m,t} Y_{m,t} - W_t h_{m,t} - \frac{\delta}{2} P_{M,t} c_t \left(\frac{P_{m,t}}{P_{m,t-1}} - \pi^* \right)^2$
- Demand: $Y_{m,t} = \int_{i=0}^{1} Y_{i,t} \lambda_{i,t}^{\gamma} \left[\frac{P_{m,t}}{P_t} \right]^{-\gamma} di$
- Production: $Y_{m,t} \leq A_t h_{m,t}$

Markups (consumption goods price over productivity-adjusted nominal wages):

$$\mu \equiv PA/W = \lambda_h^{-1} = \frac{\gamma}{\gamma - 1} \lambda_i^{-1} = \left[\frac{\gamma}{\gamma - 1} \right] \left[\frac{\eta}{\eta - 1} \frac{1 - \tilde{\theta}}{1 - \tilde{\theta} \left(\frac{\eta - \tilde{\beta}}{\eta - 1} \right)} \right]$$

Return

New Keynesian Deep Habits and Aging: Calibration

	1980-1985		2011-2016		Alt. 2011-16
	Data	Model	Data	Model	Model
Population growth	0.69	0.69	-0.14	-0.14	0.69
Life expectancy.	76.90	76.90	83.40	83.40	76.90
Average Deep habits		0.75		0.95	0.75
Consumption elasticity		56.91		56.91	56.91
Production elasticity		59.85		4.97	4.97
Markups	1.036	1.036	1.280	1.280	1.275

- Aging accounts for 3.8% of increase in markups
- ▸ Other parameters

▸ Return

Calibrated parameters

Model calibrated parameters

Parameter		Symbol	Value	Target
	Discount factor	β	0.99	Annual real rate of 4%
	Risk aversion	σ	3.0	Following Ravn et al. (2010)
	Inverse labor elasticity	κ	1.0	Following Fernandez-Villaverde et al. (2015)
	Demand elasticity	η	56.9	Match 1980s average markups
	Production elasticity	γ	59.9,4.9	Match 1980s-2010s average markups
	Price rigidity	δ	187	Equivalent to average Calvo parameter of 0.75
	Maximum habits	θ	1.02	Average deep habits of 0.85 as in Ravn et al. (2010)
	Deep habits rate	s	0.03	Deep habits flatten out at age 55 years
	Birth rate	gb	0.011-0.002	Population growth in Japan 1980s-2010s
	Death rate	gd	0.004-0.0037	Life expectancy in Japan 1980s-2010s
Monetary policy rule				
	Persistence	ρ_r	0.70	Following Fernandez-Villaverde et al. (2015)
	Inflation coefficient	α_π	1.5	Conventional values
	Output coefficient	α_y	0.0	Conventional values
	Inflation target	π^*	1.00	Conventional values

Return

New Keynesian Deep Habits and Aging: Steady state changes

- Aging raises average deep habits $\tilde{\theta}$ and raises markups,

$$\mu = \left[\frac{\gamma}{(\gamma-1)}\right]\left[\frac{\eta}{(\eta-1)}\right]\left[\frac{1-\tilde{\theta}}{1-\tilde{\theta}\left(\frac{\eta-\tilde{\beta}}{\eta-1}\right)}\right]$$

- Lowers labor share, $Wh/PY = \mu^{-1}$,
- and lowers output if $\tilde{\theta} \lessapprox \sigma/(\sigma+1)$:

$$Y = \left[A^{1+\kappa}\mu^{-1}(1-\tilde{\theta})^{-\sigma}\right]^{\frac{1}{\kappa+\sigma}}$$

Return

New Keynesian and Aging: No Deep habits

- Instead of deep habits, $\eta_j = \underline{\eta} + (\bar{\eta} - \underline{\eta})(1-s)^{j-1}$ and $\tilde{\eta} = \sum \eta_j f(j)$
- Rotemberg costs on consumer and intermediate goods producers
- SS markups : $\mu = \left[\frac{\gamma}{\gamma-1}\right]\left[\frac{\tilde{\eta}}{\tilde{\eta}-1}\right]$ where aging $\rightarrow\downarrow \tilde{\eta}$

$$
\begin{aligned}
\hat{y}_t &= \tilde{\beta}\mathbb{E}_t\hat{y}_{t+1} - \sigma^{-1}(\hat{r}_t - \mathbb{E}_t\hat{\pi}_{t+1}) \\
\hat{\pi}_t &= \tilde{\beta}\mathbb{E}_t\hat{\pi}_{t+1} + ((\tilde{\eta}-1)/\delta_c)\hat{\lambda}_{i,t} \\
\hat{\pi}_{m,t} &= \tilde{\beta}\mathbb{E}_t\hat{\pi}_{m,t+1} + ((\gamma-1)/\delta_m)\hat{\lambda}_{h,t} \\
\hat{\lambda}_{i,t} + \hat{\lambda}_{h,t} &= (\kappa+\sigma)\hat{y}_t - (1+\kappa)\hat{A}_t \\
\hat{\pi}_{m,t} - \hat{\pi}_t &= \hat{\lambda}_{i,t} - \hat{\lambda}_{i,t-1}
\end{aligned}
$$

Return

New Keynesian and Aging: No Deep habits

- Calibrate as before. This time, changes in $\tilde{\eta}$ account for 10% increase in markups
- Output cost of disinflation is about four times higher in 2010s relative to 1980s
- Contribution of aging to inflation output trade-off in line with contribution to change in markups

Cumulated output response

Horizon	2 year	5 year	20 year
1980-85 Baseline	-1.7460	-1.7399	-1.7399
2011-2016 with no demog. change	-5.9882	-5.7785	-5.7781
Share (%)	(85.4)	(89.8)	(89.8)
2011-2016 All changes	-6.7075	-6.2384	-6.2360
Share (%)	(100.0)	(100.0)	(100.0)

Return