Incomplete Credit Markets and Monetary Policy with Heterogeneous Labor Supply

James Bullard (FRBSTL) **Aarti Singh** (U. Sydney)

The Canon Global Institute
Tokyo, Japan
May 29, 2017

Overview

THIS TALK

- This is an academic talk.
- In the model presented here, monetary policy has an important role to play, but not because of "sticky prices."
- Heterogeneous households will supply labor endogenously, and household labor supply will differ across households.
- Nevertheless, monetary policymakers will be able to carry out an optimal monetary policy without reference to household labor supply.
- I see this result as helping to inform the debate on whether U.S. monetary policy needs to worry about declining labor force participation.

Labor Force Participation and Monetary Policy

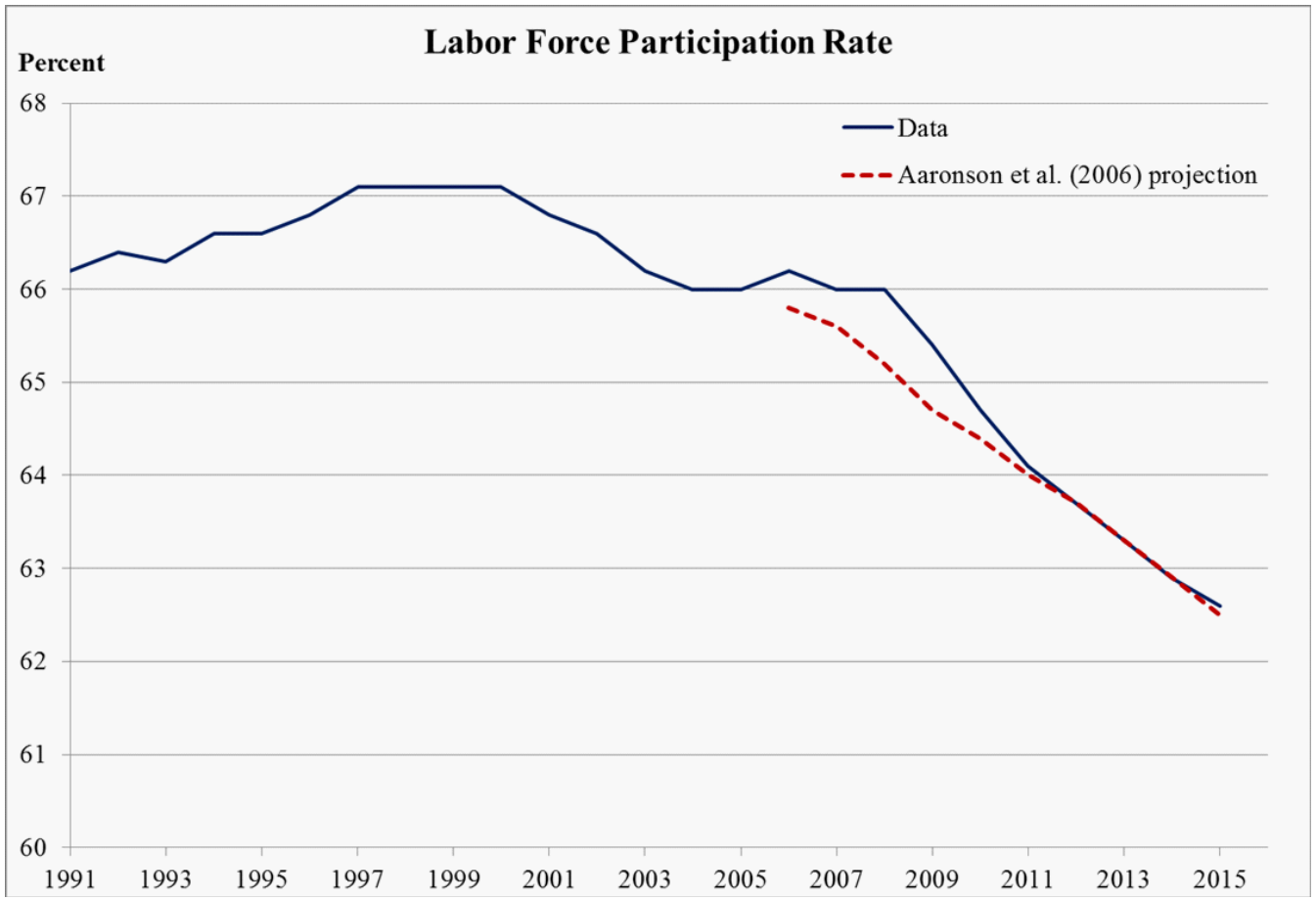
DEPRESSED U.S. LABOR FORCE PARTICIPATION

- U.S. labor force participation (LFP) has been depressed since the large 2007-2009 recession.
- Portions of the current U.S. monetary policy discussion have been focused on reviving labor force participation to higher levels.
- Key questions: Can monetary policy substantially affect labor force participation? If so, should it? How would an "aging workforce" affect labor force participation?
- Important: For this presentation, I will think of "labor force participation" and "household labor supply" interchangeably.

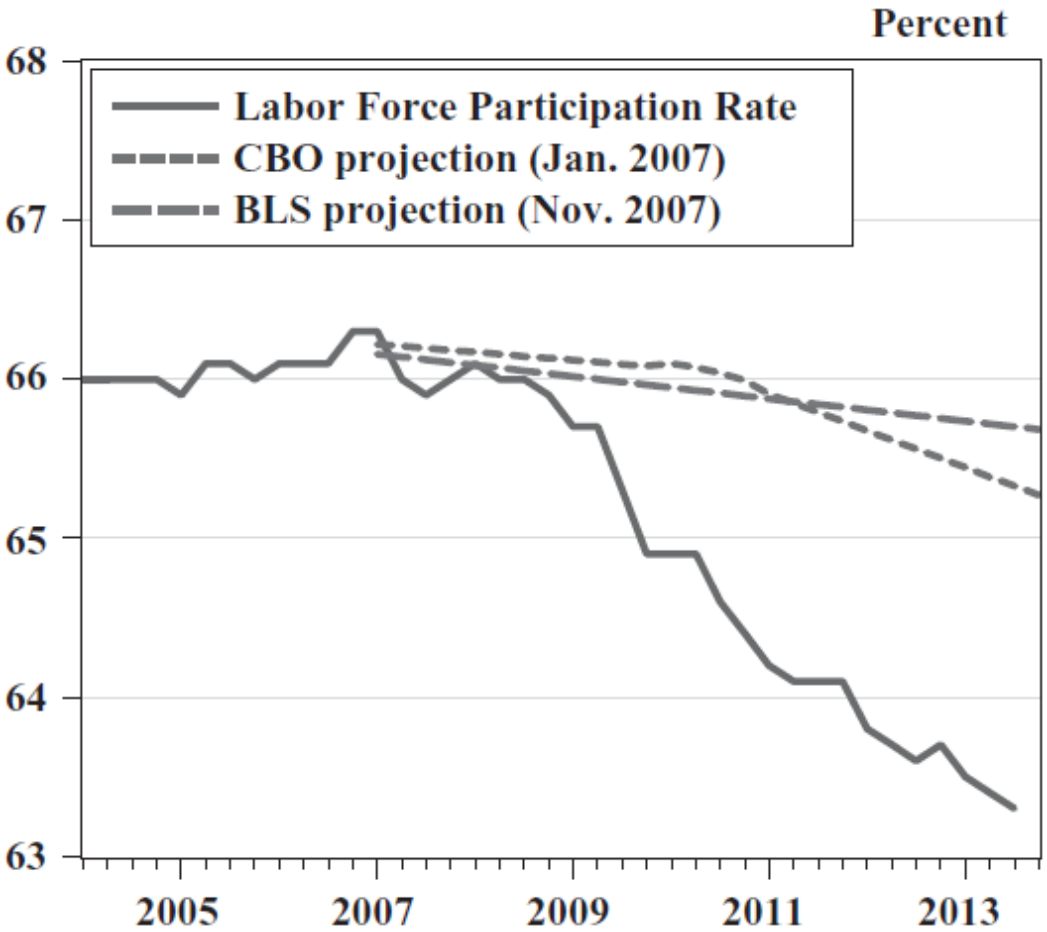
TWO VIEWS

- Traditional view: Aaronson et al. (*BPEA,* 2006) built a demographically-based LFP model and successfully predicted the post-crisis 2013 LFP rate.
- "Different demographic groups tend to have different LFP."
- Alternative view: Erceg and Levin (*JMCB,* 2014) argued that a large portion of the post-crisis fall in LFP was cyclical, and built a New Keynesian model in which an "LFP gap" becomes a component of optimal monetary policy after large recessions.

THE TRADITIONAL VIEW: AARONSON ET AL. (2006)



THE ERCEG AND LEVIN (2014) VIEW



THIS PAPER

- The argument in this paper is that the traditional view is more nearly correct.
- The model economy includes heterogeneous households that will supply different amounts of labor at every date.
- Monetary policy will be conducted optimally to repair a friction in household credit markets.
- The optimal monetary policy can be conducted independently of household labor supply decisions.
- Demographic factors—time-varying population growth—will affect measured labor supply of households.

Credit Market Friction

THE RETURN OF HOUSEHOLD CREDIT MARKETS

- The 2007-2009 financial crisis increased attention on household credit markets.
- Could monetary policy be used to help keep household credit markets working well?

HOUSEHOLD CREDIT IN A DSGE MODEL

- We study an economy with a large private credit market *essential* to good macroeconomic performance.
  - This market has an important friction: Non-state contingent nominal contracting (NSCNC).
- The role of monetary policy will be to keep this large credit market functioning properly (i.e., complete).
- When large and persistent negative shocks hit the economy, the zero lower bound (ZLB) will threaten.
- The monetary authority can maintain a smoothly operating credit market even when the ZLB threatens.
- I will not emphasize ZLB issues in this talk.

INCOME AND WEALTH INEQUALITY

- There is a lot of income and wealth inequality in this stylized model.
- The role of credit markets, if they work correctly, will be to reallocate uneven income across the life cycle into perfectly equal per capita consumption.
- The model equilibrium will naturally rank the wealth Gini coefficient as the highest, the income Gini coefficient as somewhat lower, and the consumption Gini coefficient as the lowest.

HOW LARGE ARE THESE MARKETS?

- According to Mian and Sufi (*AER*, 2011), the ratio of household debt to GDP in the U.S. was about 1.15 before it ballooned to 1.65 during the 2000s.
- In today's dollars, that would be about $19.5 trillion to about $28 trillion, comprised mostly of mortgage debt.
- Disrupting these markets might be quite costly for the economy, so the NSCNC friction could be quite important.

What We Do

WHAT WE DO

- Simple, stylized, endowment DSGE T-periods (quarterly) life-cycle model of *privately-issued along with publicly-issued* debt, real interest rates and inflation.
- Privately-issued debt = "mortgage-backed securities."
- The economy has a large credit sector and a small cash sector.
- Friction: Non-state contingent nominal contracting (NSCNC).
- Aggregate labor productivity growth is the only source of uncertainty.
- Monetary policy can substitute for the missing state-contingent contracts by choice of the price level.
- Labor supply will be heterogeneous but independent of monetary policy choices.

THE MONETARY POLICY IMPLICATIONS

- In ordinary times, optimal monetary policy looks like "nominal GDP targeting"—countercyclical price level movements.
- Household labor supply is then driven by non-monetary factors.
- These results may help inform the debate on monetary policy in a low nominal interest rate environment.

Environment

SEGMENTED MARKETS

- Standard T-periods (quarterly) DSGE life-cycle endowment economy with segmented markets. Any $T \geq 3$ will work; I prefer $T = 241$ (quarterly); odd values are convenient; $T \to \infty$ is continuous time.
- Households are divided into two types, "participants" in the credit markets and "non-participants".
- There are three assets in the model, *privately-issued* debt (consumption loans), publicly-issued debt, and currency.
- Participants are indifferent between holding privately-issued or publicly-issued debt but, in the stationary equilibria we study, they will not hold currency as it is dominated in rate of return.
- Non-participants can only hold currency.

DEMOGRAPHICS

- The population (=labor force) of both the credit-using sector and the cash-using sector grows at a constant gross rate $\psi > 1$.
- Because of the assumptions we impose, the gross real interest rate in the economy, R, will be equal to the product of the gross rate of productivity growth, λ, and the gross population growth rate, that is, $R = \lambda\psi$, the growth rate of the economy.
- This will continue to hold period-by-period even in the case where λ is stochastic.
- We will show how household labor supply is altered when population growth slows by comparing steady states with higher versus lower values of ψ.

A PASSIVE FISCAL AUTHORITY

- The population (=labor force) growth means that there are more younger households than older households at any point in time.
- This upsets our theoretical desire to keep the model perfectly symmetric so that R is equal to the real output growth rate at all times.
- To restore perfect symmetry, we allow the fiscal authority to issue nominally-denominated, non-state contingent debt. This debt pays the same rate of return as privately-issued debt.
- The fiscal authority issues enough debt each period to pay the interest plus principle on previously-issued debt (=GBC).
- The fiscal authority plays no other role in this version of the model.

PREFERENCES

- All participant households entering the economy at date t have log preferences with no discounting

$$V_t = E_t \sum_{j=0}^{T} \left[\eta \ln c_t \left(t+j \right) + \left(1-\eta \right) \ln \ell_t \left(t+j \right) \right]$$

  where $\eta \in (0,1]$, $c_t \left(t+j \right) > 0$ is the date $t+j$ consumption of the household born at date t, and $\ell_t \left(t+j \right) \in (0,1)$ represents the fraction of a unit time endowment per period devoted to leisure.
- Households that entered the economy at previous dates have similar preferences and carry a net-asset-holding position into date t.
- Other assumptions: Within-cohort agents are identical, no population growth, no capital, no default, flexible prices, no borrowing constraints.

KEY FRICTION: NSCNC

- *Loans are dispersed and repaid in the unit of account—that is, in nominal terms—and are not contingent on income realizations.*

- There are two aspects to this friction: (1) The non-state contingent aspect means that real allocations will be perturbed by this friction, and (2) the nominal aspect means that the monetary authority may be able to repair the distortion.

STOCHASTIC STRUCTURE

- Labor supply with $\eta \in (0,1)$ will turn out to be independent of the real wage.
- The real wage $w(t)$ is exogenously given by

$$w(t+1) = \lambda(t,t+1)\, w(t), \tag{1}$$

where $w(0) > 0$, and

$$\lambda(t,t+1) = (1-\rho)\,\lambda + \rho\lambda(t-1,t) + \sigma\epsilon(t+1), \tag{2}$$

where $\lambda > 1$ represents the average gross growth rate, $\rho \in (0,1)$, $\sigma > 0$, and $\epsilon(t+1) \sim N(0,1)$.

- For sufficiently large, negative draws of $\epsilon(t+1)$, the ZLB will threaten (not discussed in this talk).

TIMING PROTOCOL

- At the beginning of date t, nature moves first and chooses $\lambda(t-1,t)$, which implies a value for $w(t)$.
- The policymaker moves next and chooses a value for the price level, $P(t)$.
- Households then decide how much to consume and save.

LIFE-CYCLE PRODUCTIVITY

- All participant households are endowed with an identical productivity profile over their lifetime.
- The profile begins at a low value, rises to a peak at the middle period of life, and then declines to the low value.
- We assume the "low value" is bounded away from zero for this talk.
- Agents can sell productivity units in the labor market at the competitive wage.
- The productivity profile is symmetric.

LIFE-CYCLE PRODUCTIVITY = CROSS SECTION

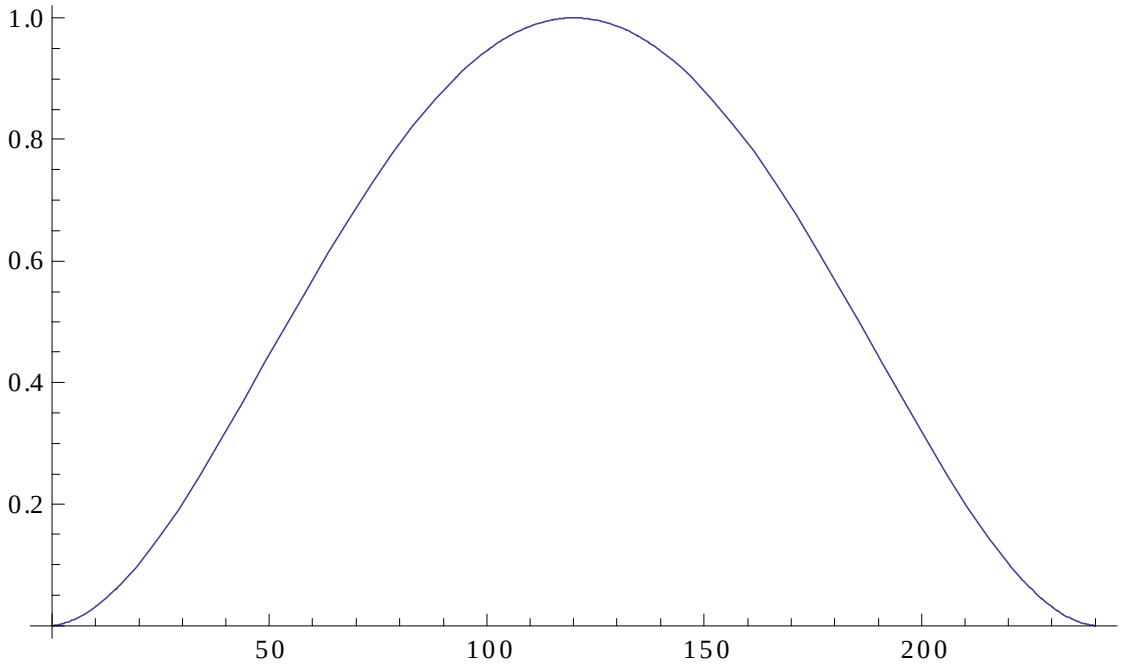


FIGURE: A schematic productivity endowment profile for credit market participants also represents the cross section of households at date t. The profile is symmetric and peaks in the middle period of the life cycle. About 50 percent of the households earn 75 percent of the labor income in the credit sector for $\eta = 1$.

LABOR INCOME CHANGES IN CROSS SECTION

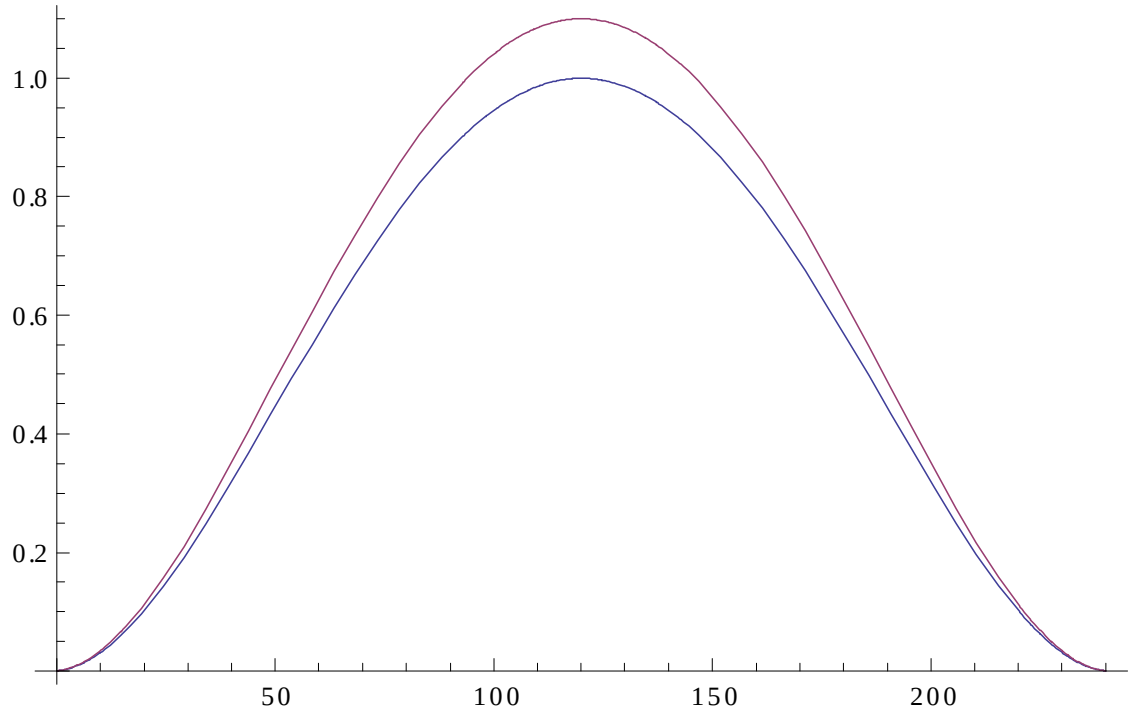


FIGURE: How labor income changes across cohorts when the real wage increases 10 percent for $\eta = 1$.

Money and Nominal Interest Rates

NON-PARTICIPANT HOUSEHOLDS

- Completely precluded from credit markets.
  - Inactive in the first period 0.
  - Productivity endowment is γ "small" in every odd period of life 1, 3, 5, ..., $T-2$.
  - These households consume in every other subsequent period 2, 4, 6, ..., $T-1$.
- There is *no life-cycle aspect* to productivity or consumption.
- Conclude: *Non-participants work only intermittently and save all income by holding currency*.

CURRENCY PROVISION

- The central bank can print currency and sell it to non-participant households who value it.
- Currency demand at date t is a simple function of real wages in the cash sector.
- The central bank completely controls the date t price level via the gross growth rate of currency creation.
- The choice of the price level characterizes equilibrium for the cash sector.
- Seigniorage revenue is rebated lump sum to even-dated cash users.

NOMINAL INTEREST RATE

- Participant households contract by fixing the nominal interest rate one period in advance.
- The non-state contingent nominal interest rate, the contract rate, is given by

$$R^n\left(t,t+1\right)^{-1}=E_t\left[\frac{c_t\left(t\right)}{c_t\left(t+1\right)}\frac{P\left(t\right)}{P\left(t+1\right)}\right]. \tag{3}$$

- This rate depends on the expected rate of consumption growth and the expected rate of inflation.

STATIONARY EQUILIBRIA

- We let $t \in (-\infty, +\infty)$.
- We only consider stationary equilibria under perfectly credible policy rules governing $P(t)$.
- We let $R(t)$ be the gross real rate of return in the credit market.
- Stationary equilibrium is a sequence $\{R(t), P(t)\}_{t=-\infty}^{+\infty}$ such that markets clear, households solve their optimization problems, and the policymaker credibly adheres to the stated policy rule.
- The key condition is that net aggregate asset holding, $A(t)$, is equal to the debt issued by the government, $B(t)$, $\forall t$, given the issuance rule for the fiscal authority.

Non-Stochastic Balanced Growth

NET ASSET HOLDING

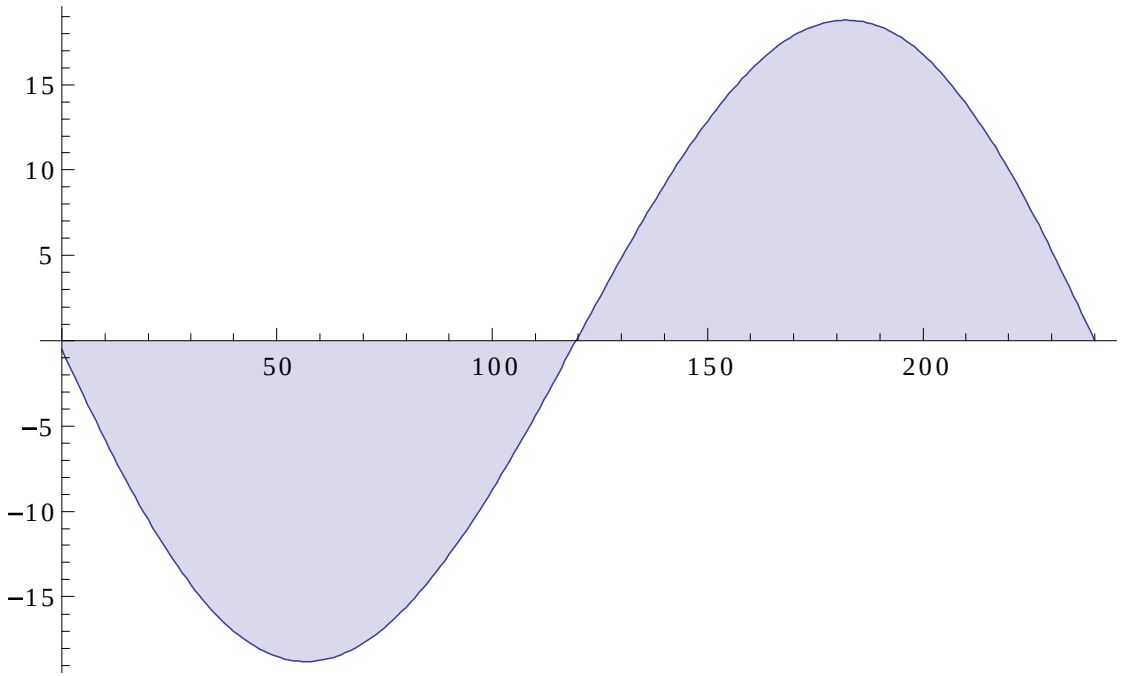


FIGURE: Net asset holding by cohort along the complete markets balanced growth path with $\eta = 1$. Borrowing, the negative values to the left, peaks at stage 60 of the life cycle (age ~35), while positive assets peak at stage of life 180 (age ~65). About 25 percent of the population holds about 75 percent of the assets.

CHANGE IN NET ASSET HOLDING

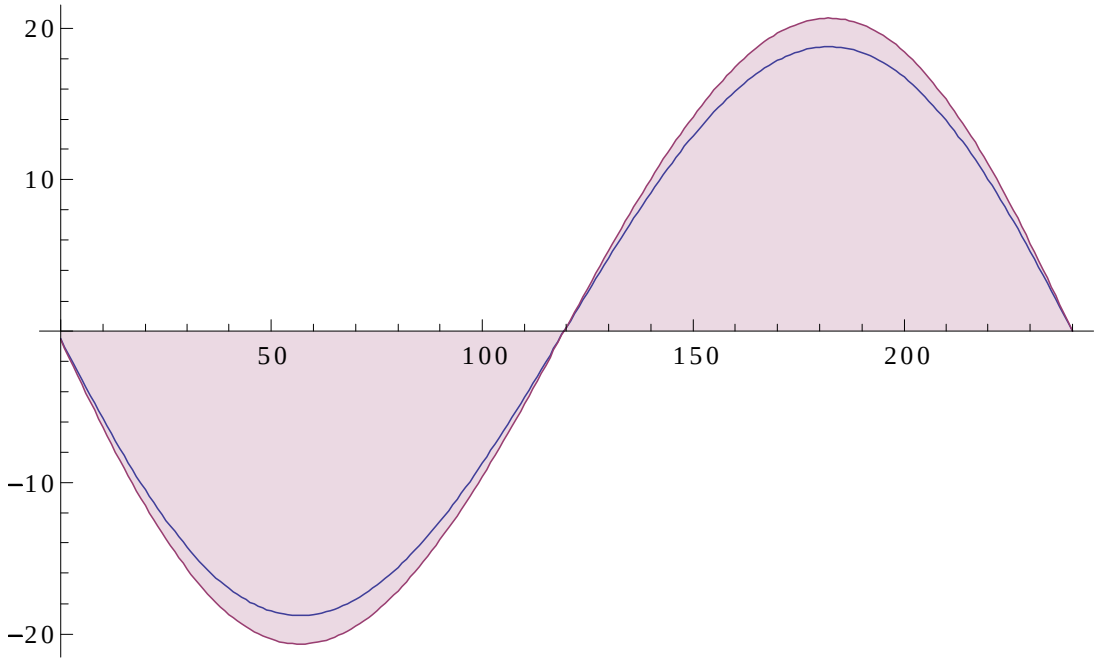


FIGURE: How net asset holding changes by cohort when the wage increases by 10 percent when $\eta = 1$.

CONSUMPTION

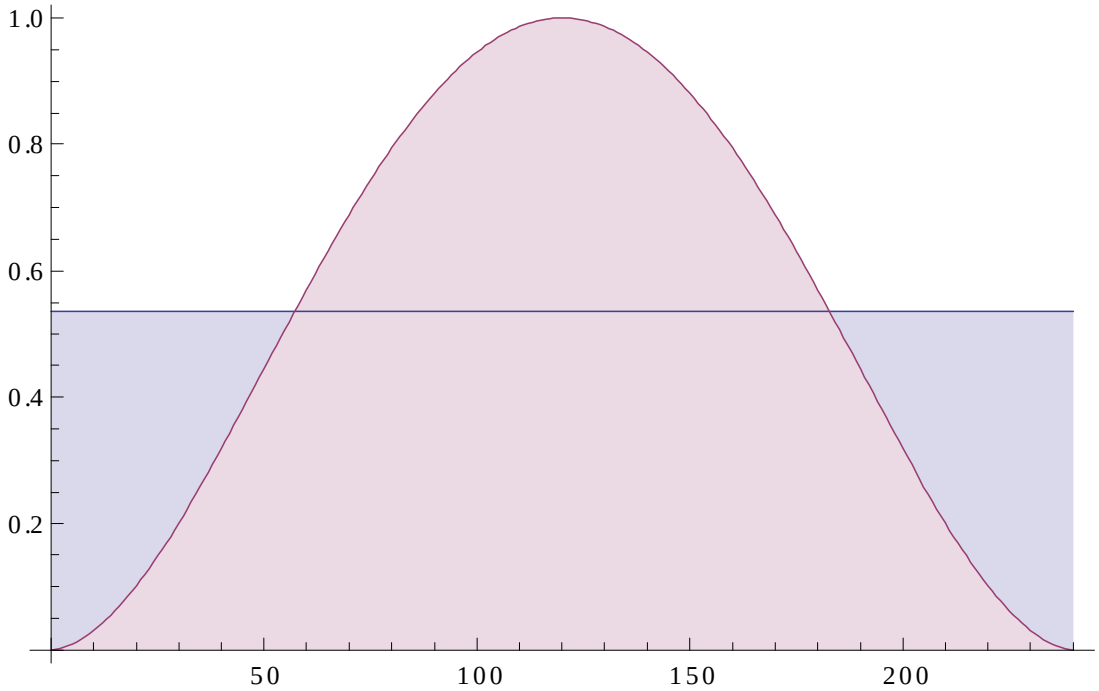


FIGURE: Schematic representation of consumption, the flat line, versus labor income, the bell shaped curve, by cohort along the complete markets balanced growth path with $w(t) = 1$ and $\eta = 1$. The private credit market completely solves the point-in-time income inequality problem.

CHANGE IN CONSUMPTION

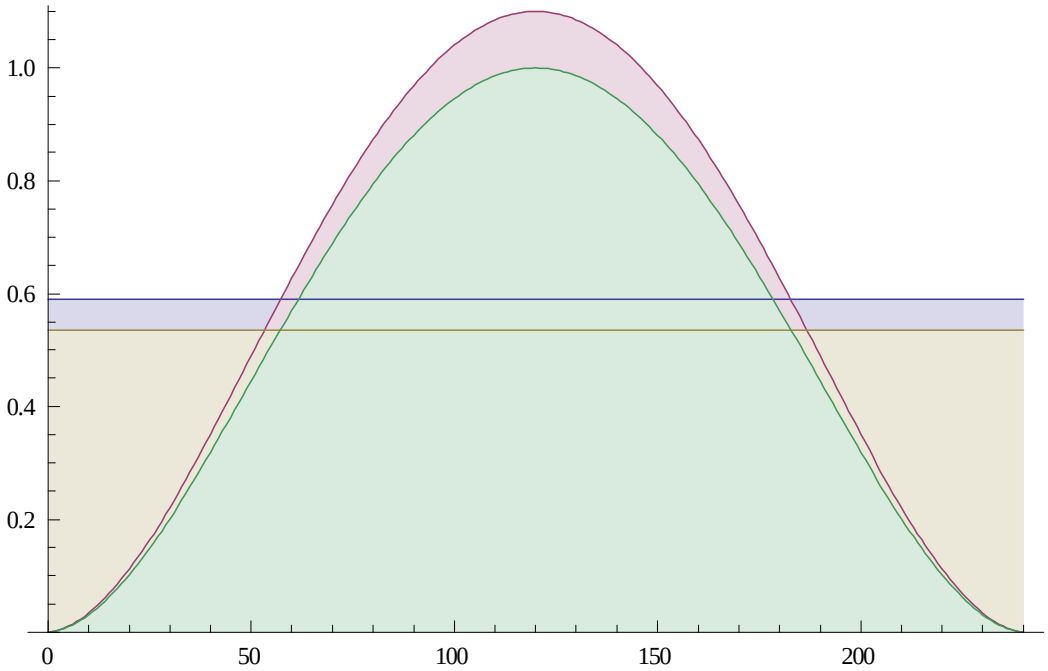


FIGURE: How labor income and consumption change by cohort when the wage increases by 10 percent with $\eta = 1$.

HOUSEHOLD LABOR SUPPLY

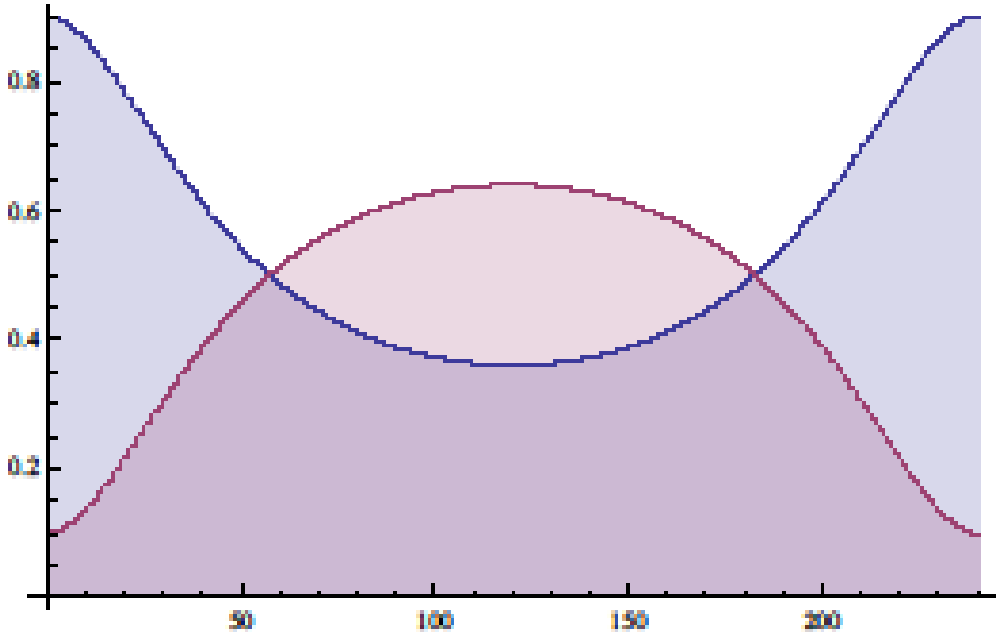
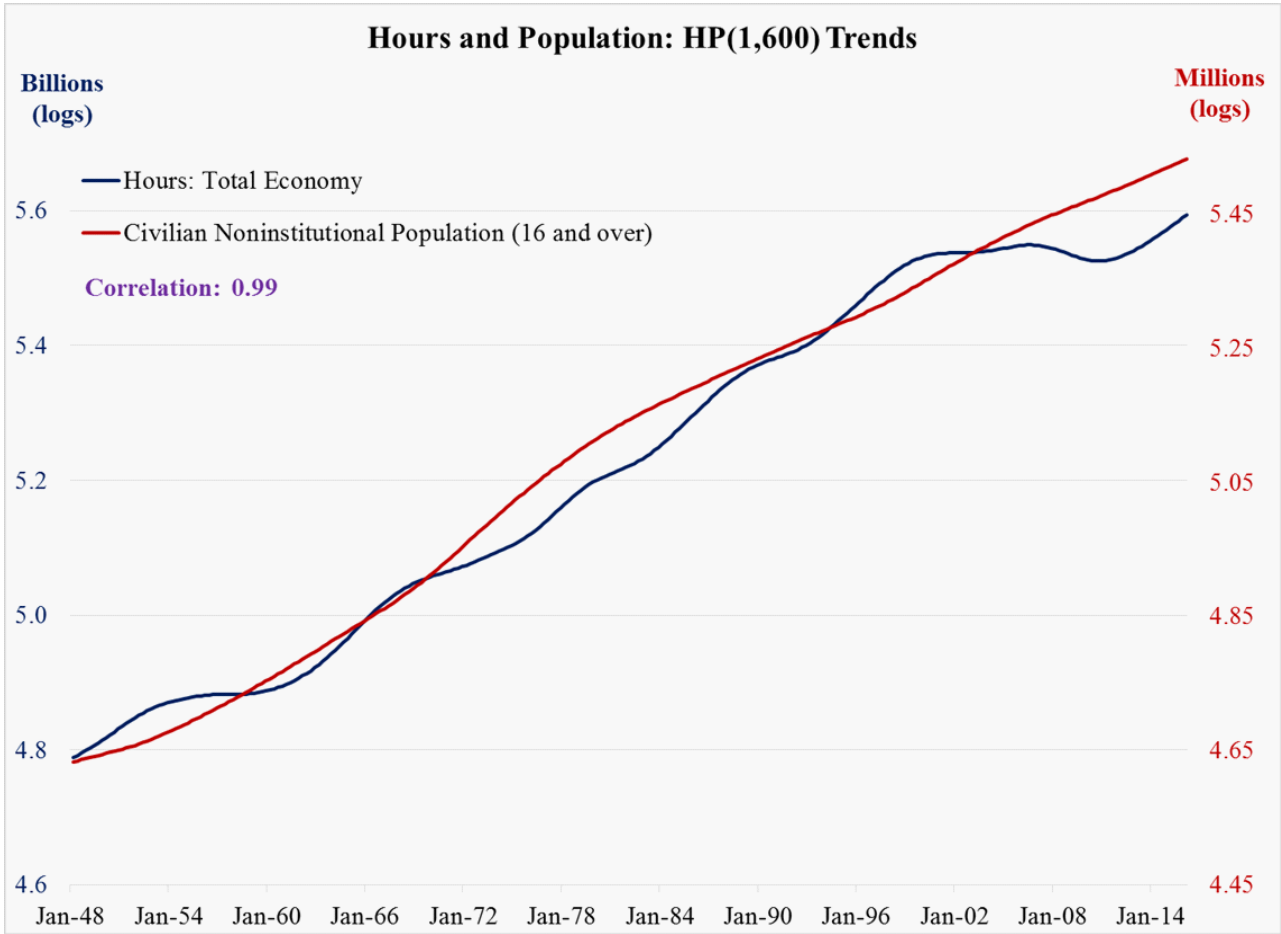


FIGURE: Schematic hump-shaped labor supply and U-shaped leisure by cohort under log-log preferences. Participant households in peak earning years work more, and those at the beginning and end of the life cycle work less, independent of consumption choices. The vertical axis is percent of available household time per period.

HETEROGENEOUS HOUSEHOLD LABOR SUPPLY

- Household labor supply is heterogeneous—middle-aged households work more. This is independent of monetary policy choices.
- As shocks hit the economy, labor supply by cohort remains the same.
- Key implication: Labor supply and population growth should be highly correlated.
- Key implication: An economy with an aging workforce should experience a slowing labor supply compared to an economy with a constant age distribution of the workforce.

LABOR SUPPLY AND POPULATION IN THE U.S. DATA



HETEROGENEOUS HOUSEHOLD LABOR SUPPLY

- The pace of population growth dictates the age distribution of the workforce, which will be skewed toward younger households.
- We can think of another equilibrium with a lower pace of population growth, say $\psi' < \psi$.
- This equilibrium will have an older workforce. This is what has happened in the U.S.
- Key implication: The comparative statics of this model indicate that younger households will work less and older households will work more in the equilibrium with $\psi' < \psi$.
- This is confirmed in the U.S. labor force participation data 1996-2016.

OLDER WORKERS VERSUS YOUNGER WORKERS LFP

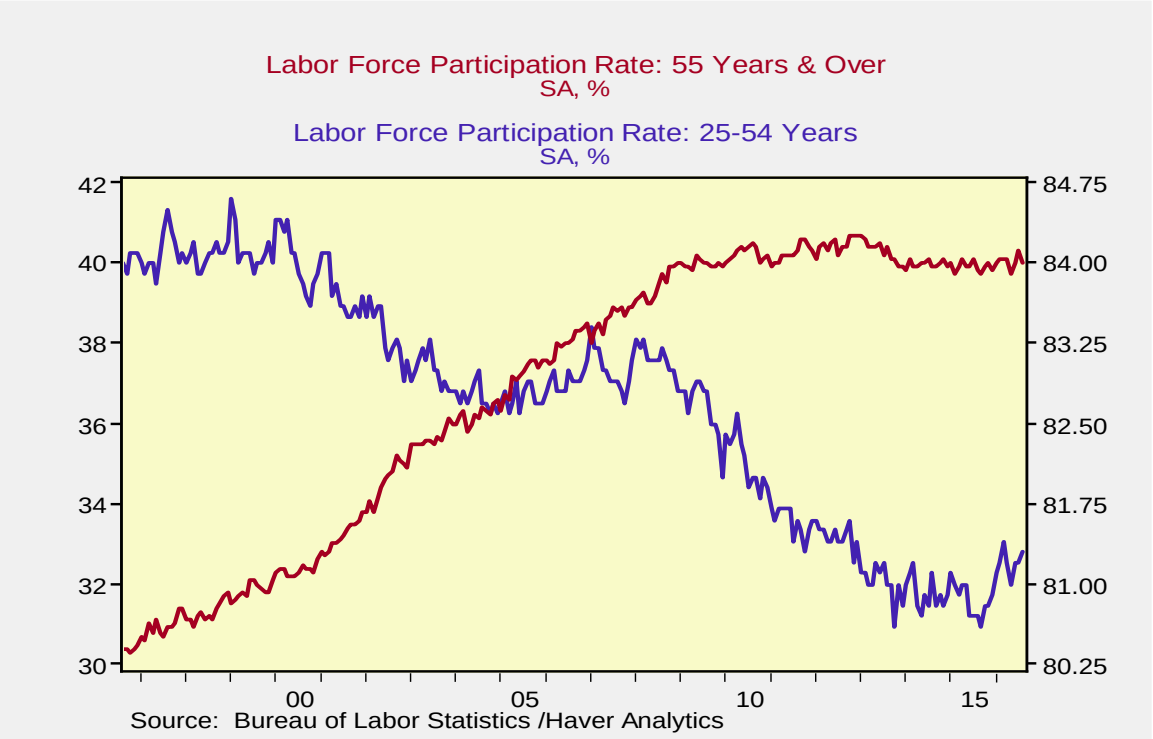


FIGURE: Younger workers participate less (right scale) and older workers participate more (left scale) in the U.S. data 1996-2016, consistent with the model prediction for an aging workforce due to slower labor force growth.

KEY FEATURE OF THE NON-STOCHASTIC STEADY STATE

- *All households have an "equity share" in the economy—they consume their population share of the output produced at date t—this is the optimal contract under homothetic preferences.*

MONETARY GROWTH IN THE NON-STOCHASTIC STEADY STATE

- The pace of currency creation $\theta = \lambda$ along the complete markets balanced growth path with an inflation target of zero.
- The gross nominal interest rate

$$R^n = \lambda > 1, \tag{4}$$

  so the net nominal interest rate would always be positive.
- This is an important part of the non-stochastic benchmark.

Complete Markets

COMPLETE MARKETS WITHOUT NSCNC

- Now allow aggregate shocks, under the price stability policy $P(t) = 1 \; \forall t$.
- Set the NSCNC friction aside *for this slide only*.
- Conjecture and verify a stationary equilibrium with $R(t) = \lambda^r(t-1,t)$, where $\lambda^r(t-1,t)$ is the realized value of the stochastic process governing productivity growth.
- Participant households again consume equal amounts of available production in the credit sector.
- Consumption and asset holdings fluctuate from period to period, but in proportion to the value of $w(t)$.

COMPLETE MARKETS WITH NSCNC

- Now include NSCNC. The countercyclical price level policy rule delivers complete markets allocations:

$$P(t) = \frac{E_{t-1}\left[\lambda(t-1,t)\right]}{\lambda^{r}(t-1,t)} P(t-1) \tag{5}$$
$$= \frac{(1-\rho)\lambda + \rho\lambda(t-2,t-1)}{(1-\rho)\lambda + \rho\lambda(t-1,t-2) + \sigma\epsilon(t)} P(t-1).$$

- Similar to Sheedy (*BPEA*, 2014) and Koenig (*IJCB*, 2013).
- Households again consume equal amounts of available production in the credit sector.
- Consumption and asset holdings fluctuate from period to period, but in proportion to the value of $w(t)$.

THE NATURE OF COMPLETE MARKETS POLICY

- This policy involves countercyclical price level movements. Heuristically:

$$\pi(t) - \pi^{\star} = E_{t-1}[\Delta y(t)] - \Delta y(t)$$

  where $\pi(t)$ is the net inflation rate and $\Delta y(t)$ is the net output growth rate.
- On average, an inflation target could still be maintained.
- This can be interpreted as nominal income targeting.

Conclusions

CONCLUSIONS

- The desire behind many actual policy choices over the last several years has been to help credit markets perform better.
- This paper features a credit market that is essential to good macroeconomic performance, in which the friction is NSCNC.

BOTTOM LINE

- Here one would want to keep nominal interest rates positive, not at zero.
- This result is in stark contrast to common policy recommendations in recent years—forward guidance committing to stay at the ZLB even longer, or quantitative easing justified as "keeping longer-term nominal interest rates low."
- Household labor supply is heterogeneous, but independent of monetary policy choices, consistent with the traditional, demographically-based view of labor force participation.
- This may help inform the current debate on labor force participation and monetary policy.