Pseudo-Wealth and Consumption Fluctuations

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1. Analytical puzzle from the perspective of DSGE models: Physical state variables (capital, labor force, natural resources) ordinarily change slowly, but in spite of this, there can be large changes in the state of the economy
2. Welfare analysis under heterogeneous beliefs

- A theory of endogenous wealth misperceptions
- That can account for changes in the state of the economy without changes in the state variables that describe the economy

- When individuals have differences in beliefs and engage in bets over the state of the world next period, the (subjective) expected wealth is increased–each side "expects" to win
- We refer to this wealth as pseudo-wealth
- The presented discounted value of expected consumption by the two parties exceeds societal feasibility locus
- Two effects at play:
  - More risk $\implies$ Substitution effect that incentivizes savings
  - Wealth effect that incentivizes spending

- If wealth effect dominates:
  - When the market for bets is created, individuals' and aggregate consumption increases
  - When pseudo-wealth disappears, aggregate consumption falls discontinuously
- Intertemporal individual and aggregate consumption misallocations
- Risk increases with no effects on output
- Results raise unsettling welfare questions

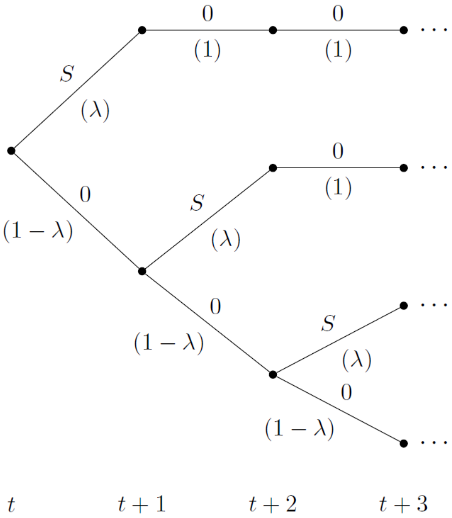
- In richer environment, pseudo-wealth can affect output and create distributional consequences
- There can exist negative pseudo-wealth
- Theory is complementary of other explanations of macroeconomic fluctuations
  - It has testable implications that distinguish it from other theories of macroeconomic fluctuations

- RBC on excessive macro volatility (Aguiar-Gopinath 2006, 2007)
- News shocks (Lorenzoni 2010, Jaimovich-Rebelo 2009, Beaudry-Portier 2004, 2006)
- Learning (Evans-Honkapohja 2001, Boz et al. 2009, Heymann-Sanguinetti 1998, Guzman 2013, Guzman-Howitt 2016, Pintus-Suda 2015)
- Sentiments (Angeletos-La'O 2013)
- Heterogeneous beliefs (Geanakoplos 2010, Scheinkman-Xiong 2003, Iachan-Nenov-Simsek 2016)

A Model of Pseudo-wealth

- Infinitely-lived small open economy
- Two agents, A and B
- In every period, each agent receives the same constant exogenous endowment $y > 0$
- $u(c)$ is twice differentiable and strictly concave, $u'(c) > 0$, $u''(c) < 0$
- Agents have perfect access to international credit markets

The environment: States



- States:

$$Z_t = \begin{cases} \{S, O\} & \text{if } z_j = O \ \forall j < t \\ \{O\} & \text{if } z_j = S \text{ for any } j < t \end{cases}$$

- Poisson probability $\lambda = Prob(z_t = S)$
- Agents disagree on the true value of λ: $\lambda^A > \lambda^B$
- In $t = 0$ a market for short term (one period) bets is created

- The creation of the market for bets completes the market
- Net betting returns:

$$\psi_t^A(z_t) = \begin{cases} 1 - p_t & \text{if } z_t = S \\ -p_t & \text{if } z_t = O \end{cases}$$

$$\psi_t^B(z_t) = \begin{cases} -(1 - p_t) & \text{if } z_t = S \\ p_t & \text{if } z_t = O \end{cases}$$

$$PW_t^A = \begin{cases} \boxed{(\lambda^A - p_t)b_t(z_t)} & \text{if } z_j = O \forall\, j \leq t \\ 0 & \text{if } j \leq t : z_j = S \end{cases}$$

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- Expected pseudo-wealth of agent A in period t:

$$E_t PW^A = \begin{cases} \boxed{E_t \sum_{j=t}^{\infty} [\beta(1-\lambda^A)]^{j-t} (\lambda^A - p_j) b_j(z_j) > 0} & \text{if } z_j = O \forall\, j \leq t \\ 0 & \text{if } j \leq t : z_j = S \end{cases}$$

- Expected pseudo-wealth of agent B in period t:

$$E_t PW^B = \begin{cases} \boxed{E_t \sum_{j=t}^{\infty} [\beta(1-\lambda^B)]^{j} (p_j - \lambda^B) b_j(z_j) > 0} & \text{if } z_j = O \ \forall j \leq t \\ 0 & \text{if } j \leq t : z_j = S \end{cases}$$

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- Consumers are forward-looking

$$max_{\{c^i_j(z_j),d^i_j(z_j),b^i_j(z_j)\}^{\infty}_{j=t}} E^i_t \sum_{j=t}^{\infty} \beta^{j-t} u(c^i_j(z_j)) \ \ \forall i$$

with $\beta \in (0,1)$, subject to

$$c^i_t(z_t) + (1+r)d^i_{t-1}(\mathbf{z}_{t-1}) = y + d^i_t(z_t) + \psi^i_t(z_t)b_t(z_t) \ \ \forall i$$

and to the transversality condition

$$lim_{j\to\infty} \frac{d^i_j}{(1+r)^j} = 0$$

- We assume $\beta(1+r) = 1$ wlog

- Two effects when the market for bets is created
  - Wealth effect
  - Precautionary savings effect

Lemma 1

Suppose u is differentiable, $u' > 0$, $\lambda^A > \lambda^B$. Then, $b^i > 0 \; \forall i$ when the market for bets is created

Proposition 1

Suppose u is three times differentiable, $u' > 0$, $u'' < 0$, $u''' > 0$, two period economy. Then, $\exists \lambda^* \in (1/2, 1)$ such that savings will increase at $t = 0$ when the market for bets is created if $\lambda^A < \lambda^*$

- More generally, consumption will increase in $t = 0$ if wealth effect dominates over precautionary savings effect
- This holds for quadratic utility function, that features no precautionary savings
  - The focus of this paper is the wealth effect

- To isolate precautionary savings effects and for tractability, we assume a quadratic utility function

$$u(c_t^i(z_t)) = \alpha c_t^i(z_t) - \gamma c_t^i(z_t)^2$$

Note: by TC, $d_t \geq -\frac{y}{1-\beta}$. As c_t will be a linear function of expected wealth, $\exists \bar{c} < \infty$ s.t. $c_t^i < \bar{c}\ \forall t, \forall i$. We assume $\gamma < \frac{1}{2\bar{c}}$ to ensure $u' > 0$ always.

- The expected wealth $E_t W^i$ has three parts:
  - The expected present value of the endowment
  - Pseudo-wealth
  - Outstanding debt

$$E_t W^i(\mathbf{z}_t) = \frac{y}{1-\beta} + E_t PW^i(z_t) - (1+r)d^i_{t-1}(\mathbf{z}_{t-1}) \quad \forall i \forall t$$

- With a quadratic utility function, agent i faces the following intertemporal budget constraint:

$$\sum_{j=t}^{\infty} \beta^j E_t(c_j^i(\mathbf{z}_j)) = \frac{y}{1-\beta} + E_t PW^i(z_t) - (1+r)d_{t-1}^i(\mathbf{z}_{t-1})$$

- Optimal consumption rule:

$$c_t^i(\mathbf{z}_t) = y + (1-\beta)[E_t PW^i(z_t) - (1+r)d_{t-1}^i(\mathbf{z}_{t-1})]$$

- Pre-sunspot debt dynamics:

$$d_t^A(\mathbf{z}_t) = (1-\beta)\sum_{j=0}^{t} E_j PW^A(O) + \sum_{j=0}^{t-1} p_j b_j - \psi^A(z_t) b_t$$

$$d_t^B(\mathbf{z}_t) = (1-\beta)\sum_{j=0}^{t} E_j PW^B(O) - \sum_{j=0}^{t-1} p_j b_j - \psi^B(z_t) b_t$$

- Aggregate consumption:

$$c_t(\mathbf{z}_t) = y + (1-\beta)[E_t PW(z_t) - (1+r)d_{t-1}(\mathbf{z}_{t-1})]$$

- Aggregate borrowing:

$$d_t(\mathbf{z}_t) = d_t^A(\mathbf{z}_t) + d_t^B(\mathbf{z}_t) = (1-\beta)\sum_{j=0}^{t} E_j PW$$

Proposition 2

At $z_t = S$, there is a discontinuous decrease in aggregate consumption

Corollary 1

Aggregate consumption will be lower after the sunspot the longer it takes for the sunspot to occur

Corollary 2

Aggregate consumption volatility is larger when there exists a market for bets

- Fundamental welfare theorems hold
- But completing markets increased risk without increasing actual wealth
- Raises question of welfare analysis under heterogeneous beliefs

Definition 1

(Stiglitz, 1982): Beliefs satisfy **group rationality** *if*

$$\frac{1}{2}\lambda^{A} + \frac{1}{2}\lambda^{B} = \lambda$$

where λ is the the probability of occurrence of sunspot

Corollary 3

Suppose the planner computes welfare using average beliefs and suppose beliefs satisfy group rationality. Then, under a utilitarian social welfare function, the creation of a market for bets leads to a decrease in the expected present value of welfare.

- Special case of Brunnermaier-Simsek-Xiong (2014, QJE): "reasonable beliefs" and "neutral-beliefs Pareto efficiency"

Definition 2

Reasonable beliefs: convex combination of agents' beliefs,

$$\lambda^h = \sum_i h^i \lambda^i$$

$h^i \geq 0$, $\sum_i h^i = 1$

Definition 3

Consider a social allocation y. Suppose that for every reasonable probability measure λ^h $\exists$ another allocation x such

$$E^h(u_i(y)/Z_t) \leq E^h(u_i(x)/Z_t)$$

with strict inequality for at least one agent. Then, allocation y is belief-neutral Pareto inefficient.

- The creation of the betting market is *belief-neutral Pareto inefficient*

- Criticism: the *reasonable belief* criterion is too "invasive"
    - It does not respect individual beliefs
- Prohibiting betting markets will make everyone worse-off ex-ante *given their beliefs*
- What should the planner do?

Extensions

- The economy produces one tradable good
- Labor is the only input:

$$y_{T,t} = l_t$$

- Preferences:

$$U^i = u(c^i_t) + v(1 - l^i_t)$$

$v' > 0$, $v'' < 0$

- $p_T = w_t = 1$

- The creation of the market for bets will still lead to an increase in the individuals' and aggregate consumption
- But wealth effect decreases labor supply at the fixed wage $\implies$ employment and output will decrease in equilibrium
- At sunspot, aggregate negative wealth effect $\implies$ employment and output will increase
- General point: in a production economy the creation of the betting market will increase the volatility of output

Extension 2 (related paper): Pseudo-wealth fluctuations and aggregate demand effects

- Two goods: tradable (T) and non-tradable (N)
- T is produced by foreign firms (do not consume in domestic economy)
- Production functions:

$$y_{N,t} = {l_{N,t}}^{\alpha}$$

with $\alpha \in (0,1)$

$$y_{T,t} = min\{l_{T,t}, \gamma X_t\}$$

  - Utilization of fixed factor is limited by endowment constraint:

$$X_t \leq \bar{X}$$

- Perfect labor mobility across sectors

Extension 2 (related paper): Pseudo-wealth fluctuations and aggregate demand effects (cont.)

- New mechanisms at play:
  - Sunspot triggers consumption and labor supply adjustments
  - Fisher effects
  - Aggregate demand effect due to decrease in w and increase in profits in T sector
    - The downward wages spiral amplifies the increase for profits in T sector
    - Which decreases aggregate demand, creating negative macro feedback loop
- Creation of market for bets not only increases risk but decreases output

- Can be seen as corollary of example 2

- Differences in priors could lead to negative pseudo-wealth
- Example:
  - Suppose an agent X owns an asset that can be used for productive purposes
  - Agent X produces 1 unit of services with the asset
  - Agent Y produces $A > 1$ with the same asset
  - Both X and Y are consumers of the services produced by the asset
  - It is Pareto efficient that X rents asset to Y (suppose a sale is not feasible)

- Suppose that at the time of signing a rental contract there is uncertainty about the market price p of the services
- $p \in \{p^L, p^H\}$, $p^L < p^H$
- Value functions when rental contract is signed:

$$V^X = \lambda^X u\left(\frac{R}{p^H}\right) + (1-\lambda^X)u\left(\frac{R}{p^L}\right) - u(1)$$

$$V^Y = \lambda^Y u\left(\frac{p^H A - R}{p^H}\right) + (1-\lambda^Y)u\left(\frac{p^L A - R}{p^L}\right) - u(0)$$

where R is the rental cost

- Let $\{R\}$ be set of fixed rental contracts that make both agents ex-ante better off:

$$\{R\} = \{R \in \mathbb{R}_{\geq 0} : V^X \geq 0 \wedge V^Y \geq 0\}$$

- It can be shown that under a sufficiently large disagreement of beliefs there are conditions that imply $\{R\} = \emptyset$
- In this context, contingent contracts would improve efficiency

- Key premise: heterogeneous beliefs over rare event
- Model can explain situations in which the state of the economy changes despite no changes in the state variables
  - Due to aggregate wealth misperceptions
- It shows that completing markets under heterogeneous beliefs does not necessarily increase wealth
  - But under the standard criteria, completing markets is efficient despite the increase in risk and no increase in wealth
- The model can be extended in several ways to analyze macroeconomic dynamics and distributional consequences