

# Pseudo-Wealth Fluctuations and Aggregate Demand Effects

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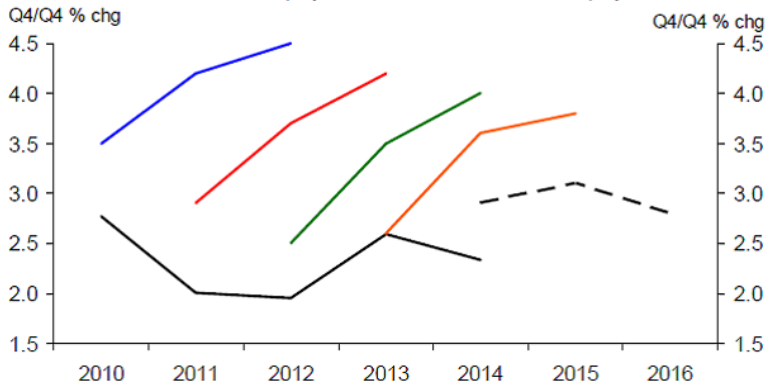
## Motivation

- Two analytical puzzles from the perspective of DSGE models:
  - 1 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 The benchmark model (and its variants) can't explain long-lasting downturns with underutilization of factors of production

## The Fed's forecasting models are broken



- Actual GDP growth
- June 10 FOMC projection
- June 11 FOMC projection
- June 12 FOMC projection
- June 13 FOMC projection
- March 14 FOMC projection



Note: Actual GDP for 2014 is the yoy change in GDP for 2014Q1. Source: FRB, BEA, DB Global Markets Research

## Motivation

- Also: Does completing markets *a/ways* improve welfare?

## Basic idea

- 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 incomes by the two parties exceeds societal feasibility locus
- Given their expectations of future wealth (under certain conditions) that leads to an increase in current levels of consumption and a lower labor supply (and associated larger borrowing) from what it otherwise would be
- The moment of disappearance of the bet leads to destruction of pseudo-wealth

## Implications

- Destruction of pseudo-wealth triggers behavioral adjustments with large macroeconomic consequences
- Consumption will fall and labor supply will increase
- Then wages will fall and value of real debt will increase
  - Which leads to further adjustments
  - Large changes in prices and wages may be required to achieve a new equilibrium

## Implications

- Betting creates risk in an economy that would otherwise be stable
- Macroeconomic adjustments may be destabilizing (Fisher-Greenwald-Stiglitz)
- The equilibrium with rigid wages could feature lower production than the equilibrium with (somewhat) rigid wages
- If the planner used “reasonable beliefs” for welfare analysis, prohibiting the bet could lead to a superior equilibrium

## Extensions

- “Bets” are metaphors –many other ways of creating and destroying pseudo-wealth
- There can exist negative pseudo-wealth
- Theory is complementary of other explanations of macroeconomic fluctuations



## Related literature

- Real business cycle literature on excessive consumption volatility (Aguar-Gopinath 2006, 2007)
- News shocks (Lorenzoni 2010, Jaimovich-Rebelo 2009, Beaudry-Portier 2004, 2006)
- Leverage cycles (Geanakoplos)
- Learning about trends (Evans-Honkapohja 2001, Boz et al. 2011, Guzman 2014)
- Research agenda on pseudo-wealth (Guzman-Stiglitz 2014)

## The model's environment

- Infinitely-lived small open economy
- Two representative consumers,  $A$  and  $B$
- Two goods,  $T$  and  $N$ , produced by foreign firms
- Only source of uncertainty is the possibility of a sunspot that can only occur once
- Consumers disagree on the probability of occurrence of the sunspot

## States and Bets

- Two possible states: sunspot ( $S$ ) or no sunspot ( $O$ )
- Once  $S$  occurs, it cannot occur again
- Poisson probability  $\lambda$  for the arrival of  $S$
- Agent  $A$  is more optimistic about the probability of  $S$ ,  $\lambda$ :  
 $\lambda^A > \lambda^B$
- There is a market for short-term bets
  - Implication: positive betting in equilibrium

## Consumers/Workers

- Continuum of measure one of each type of consumer
- Receive labor income  $w_t$  per hour they work
- Can borrow in the international markets at the risk-free interest rate (default ruled out by assumption)

## Consumers/Workers

- Two effects of creation of betting markets
  - Wealth effect
  - Precautionary savings effect
- Preferences are defined over the consumption of tradable and non-tradable goods, and leisure/work

$$U_t^i = u(c_{T,t}^i, c_{N,t}^i, h_t^i)$$

with  $u_{T,t} > 0$ ,  $u_{TT,t} < 0$ ,  $u_{N,t} > 0$ ,  $u_{NN,t} < 0$ ,  $u_{h,t} < 0$ ,  $u_{hh,t} < 0$

And conditions on third derivatives for wealth effect to dominate over precautionary savings effect

## Consumers' problem

- Consumers are forward-looking

$$\max_{\{c_{T,t}^i, c_{N,t}^i, h_t^i, b_t^i\}} E_t^i \sum_{j=t}^{\infty} \beta^j U_j^i$$

s.t. budget constraints

$$c_{T,t}^A + p_{N,t} c_{N,t}^A + (1+r)(d_{t-1}^A - P_{t-1}^A b_{t-1}^A) + p_t b_t^A = w_t h_t^A + d_t^A$$

$$c_{T,t}^B + p_{N,t} c_{N,t}^B + (1+r)(d_{t-1}^B - P_{t-1}^B b_{t-1}^B) - p_t b_t^B = w_t h_t^B + d_t^B$$

## Consumers' problem

Bets' payoffs:

$$P_t^A = \begin{cases} 1 & \text{if } s_t = S \\ 0 & \text{if } s_t = O \end{cases}$$

and

$$P_t^B = \begin{cases} -1 & \text{if } s_t = S \\ 0 & \text{if } s_t = O \end{cases}$$

## Production

- Foreign firms produce  $y_T$  and  $y_N$

### NON-TRADABLE GOODS

- Production of  $y_N$  requires only labor:

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

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



## Production

### TRADABLE GOODS

- We introduce a real rigidity in the production function of tradable goods
- Production of  $y_T$  requires labor and a fixed factor  $X$  (that can be interpreted as land)

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

- Utilization of land is limited by the land endowment constraint:

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

$\bar{X}$ : total stock of land in the economy

## Equilibrium

### Definition 1

An equilibrium is a vector of quantities  $\{c_{T,t}^i, c_{N,t}^i, h_t^i, d_t^i\}_{i=A,B}$ ,  $\{h_{j,t}, y_{j,t}\}_{j=T,N}$ , and prices  $\{p_{N,t}, p_t, w_t; r\}$  such that consumers maximize utility given prices, firms maximize profits given prices, and all markets clear in every state:

$$c_{T,t}^A + c_{T,t}^B = y_{T,t} + d_t^A + d_t^B - (1+r)(d_{t-1}^A + d_{t-1}^B)$$

$$c_{N,t}^A + c_{N,t}^B = y_{N,t}(p_{N,t})$$

$$h_{T,t}(w_t) + h_{N,t}(w_t) = h_t^A + h_t^B$$

$$b_t^A(p_t) = b_t^B(p_t) = b_t(p_t)$$

## Pre-sunspot dynamics

- Before the sunspot occurs, there will be creation of pseudo-wealth
  - Each consumer will feel wealthier
  - Consumption of  $T$  and  $N$  will be “large”
  - Supply of labor will be “low”
  - However, consumption will not be smooth:  $\{c_{T,t}^A, c_{N,t}^A\}$  will be decreasing and  $\{c_{T,t}^B, c_{N,t}^B\}$  will be increasing over time
  - Also,  $h_t^A$  will be increasing and  $h_t^B$  will be decreasing over time

## Sunspot and adjustments

- At this moment  $A$  wins,  $B$  loses, but betting opportunities disappear
- Pseudo-wealth disappears

$$PW_t = \begin{cases} (\lambda^A - \lambda^B)b_t > 0 & \text{if } s_{t-1} = O \\ 0 & \text{if } \exists j < t : s_j = S \end{cases}$$

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## Sunspot and adjustments

- Aggregate demand for tradable and non-tradable goods will fall, and the aggregate labor supply will increase
- The decrease in the demand for non-tradable goods leads to a fall of demand for labor in the non-tradable sector and a decrease in  $p_N$
- Further adjustments depend on the capacity of the tradable sector to absorb the excess of labor supply

## Sunspot and adjustments

- 1 If there is a sufficiently large excess of capacity of land in the tradable sector, it will absorb the excess of labor supply
  - Wages would not fall
  - The adjustment process would end with a larger number of hours worked in equilibrium, a larger total labor income, and an improvement in the trade balance and in the current account
- 2 If instead the land constraint is binding, there will be a lower aggregate labor demand and a **decrease in wages**
  - This is our case of interest



## Sunspot and adjustments

- There is a macroeconomic pecuniary externality: Consumers of type  $B$  push the labor supply upwards, hence wages fall for everyone
- The decrease in wages increases the value of real debt
- As wages fall, there is a new round of new adjustments: all agents want to reduce their demand for goods (tradable and non-tradable), and to work more hours
- The new adjustments lead to a further decrease in wages

## Sunspot and adjustments

- The new equilibrium will feature a lower wage, lower labor income, a more depreciated real exchange rate (defined as the ratio between the price of non-tradable goods over the price of tradable goods), and an improvement in the trade balance and the current account
- In the new equilibrium, it is even possible that the winner of the bet is worse-off

## Post-sunspot dynamics

- After the sunspot, there is no more uncertainty
- The economy will be in a new equilibrium (forever), and aggregate consumption will be “low” (to repay the debt consumers borrowed when they expected to be wealthier)

## Destabilizing adjustments

- At the original wage, destruction of pseudo-wealth leads to a decrease in demand for goods and an increase in labor supply
  - The restoration of full employment requires large changes in wages and relative prices
  - These changes are larger when substitution effects are relatively weak compared to wealth
- The “natural” adjustments lead to further reductions in expected wealth and further lower aggregate demand, worsening the macroeconomic state
- The equilibrium with flexible wages is associated with lower production and aggregate labor income than the equilibrium with (somewhat) rigid wages under plausible conditions

## Destabilizing adjustments

- Suppose that there is a limit to the speed at which wages can change from one period to another:

$$w_t \geq \theta w_{t-1}$$

where  $\theta \in [0, 1]$  ( $\theta = 1$ : total downward wage rigidity,  $\theta = 0$ : maximum wage flexibility)

- Let  $w_t^*$  be the equilibrium wage when the sunspot occurs, and let  $\bar{w}_t$  be the wage when the wage rigidity constraint binds
- When the wage rigidity constraint binds, there will be excess labor supply, and the level of employment will be  $h_{T,t}(\bar{w}_t) + h_{N,t}(\bar{w}_t)$

## Destabilizing adjustments

- The equilibrium with wage rigidity is associated with larger total labor income than the one with wage flexibility if

$$w_t^* [h_{T,t}(w_t^*) + h_{N,t}(w_t^*)] < \bar{w}_t [h_{T,t}(\bar{w}_t) + h_{N,t}(\bar{w}_t)]$$

which holds if

$$(p_{N,t}\alpha)^{\frac{1}{1-\alpha}} w_t^{*\frac{\alpha}{\alpha-1}} - (p_{N,t}\alpha)^{\frac{1}{1-\alpha}} \bar{w}_t^{\frac{\alpha}{\alpha-1}} < (\bar{w}_t - w_t^*)\gamma\bar{X}$$

- The inequality is more likely to hold when (i) the size of the tradable sector is larger; (ii) the response of labor demand to wages in the non-tradable sector is not too large
- The optimal policy (assuming profits of foreign firms get zero weight in the welfare function) would entail full wage rigidity
  - A solution that would maximize labor income and would reduce the profits in the tradable sector

## Welfare analysis

- Suppose the planner prohibits the bet: Is the decentralized equilibrium under no betting Pareto superior to our equilibrium with betting?
- Answering this question requires a criterion for dealing with heterogeneous beliefs
- One possibility is to perform welfare analysis respecting the individual beliefs
- But there are deep philosophical questions regarding what beliefs should be used for determining policy interventions

## Welfare analysis

- The standard argument is that we should respect individual's own beliefs and preferences
- Normally, that would imply that betting should be allowed, since individuals' ex ante expected utility is increased
- But in the case of our model, that perspective is not persuasive



## Welfare analysis

- Betting creates variance of output and consumption in an economy that would otherwise be stable
  - The creation of the market for bets completes the market and leads to lower output both in the present and in the future
  - Raising unsettling questions about the desirability of deliverable differential disclosure of information that creates asymmetries of beliefs
- It is possible that everyone is worse-off in the betting equilibrium

## Welfare analysis I: Respecting individual beliefs

- Scenario 1: Everyone feels better off when betting is possible
  - This case arises when the increase in expected wealth as a consequence of betting more than compensates for the increase in the variance of consumption
  - In this case and under this criterion, the betting equilibrium is Pareto efficient
- Scenario 2: Everyone feels worse-off when betting is possible
  - This case arises when the fall in wages after the sunspot occurs is so large that the net effect on the market for bets on expected utility is negative for everyone
  - The betting equilibrium would be inefficient, and prohibiting the bet could increase everyone's welfare (at least within this economy)

## Welfare analysis II: Taking a stance on beliefs

- But a criterion that requires respecting individual beliefs may be overly constraining
- Respecting individual beliefs would significantly constrain the scope of action of the planner
- An alternative criterion for welfare analysis gives the planner the freedom to take a stance on the set of beliefs she considers reasonable, and to act accordingly
- Brunnermeier, Simsek, and Xiong (2014): *reasonable beliefs*, defined as any convex combination of individual beliefs

$$\lambda^R = \sum_{i=A,B} a_i \lambda^i$$

with  $\sum_{i=A,B} a_i = 1$

## Welfare analysis

- We can establish that for any  $\lambda^R$ , and for a utilitarian welfare function, welfare is lower when the market for bets exists than when it is prohibited
- Then, there would exist a set of taxes and lump sum payments such that consumers of both types are better off if *we compute their welfare using the planner's reasonable beliefs*
  - Under reasonable beliefs, there cannot be creation and destruction of pseudo-wealth
  - Prohibiting the bet prevents the additional decrease in production that would otherwise occur in the sunspot state
  - From the planner's beliefs viewpoint, everyone would be better off with this solution, as the expected value of wealth (from the planner's perspective) would be larger, and consumption would be stable over time

## Conclusions

- Key premise: heterogeneous beliefs that can be exploited through bet markets
  - The assumption of common beliefs is not consistent with much observed economic behavior and misses issues that are especially significant in times of macroeconomic instability
  - Equilibrium analysis can be very fragile to the assumption of common knowledge
- Under heterogeneous beliefs and a market for bets, pseudo-wealth can be created and destroyed, with large macroeconomic consequences
  - Changes in the state of the macroeconomy may not be commensurate with changes in the state variables that describe the system

## Conclusions

- Adjustments may be destabilizing
  - And may exacerbate the economic downturn, moving the economy to an equilibrium with lower aggregate labor income than would be obtained under non-fully flexible wages
  - An optimal policy might be directed towards *reducing* rather than increasing wage flexibility
- Completing markets *may* lead to lower output in the present and in the future
  - Raising unsettling questions in terms of welfare analysis