

MONOPOLISTIC COMPETITION IN A DSGE MODEL: PART II

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Canonical Dixit-Stiglitz Model

MONOPOLISTICALLY-COMPETITIVE EQUILIBRIUM

□ **Equilibrium Conditions (symmetric across all differentiated goods)**

- **Consumption-leisure optimality condition**
- **Consumption-savings optimality condition**
- **Aggregate resource constraint**

$$c_t + k_{t+1} - (1 - \delta)k_t = z_t f(k_t, n_t) \quad (\text{possibly also include } g_t)$$

- **(Market clearing in labor, capital, and goods markets)**

- $mc_t = \frac{\varepsilon - 1}{\varepsilon} \quad \forall t \quad (< 1 \text{ with } \varepsilon > 1)$

- **Factor prices a *markdown* of marginal products**

$$w_t = \frac{\varepsilon - 1}{\varepsilon} \cdot z_t f_n(k_t, n_t), \quad k_t = \frac{\varepsilon - 1}{\varepsilon} \cdot z_t f_k(k_t, n_t)$$

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

- Embed D-S framework in standard RBC model
- Can approximate and simulate using "usual" methods
 - Rotemberg and Woodford use King, Plosser, Rebelo (1988) linear approximation method
 - (One...) predecessor to SGU algorithm
- Empirical Issues
 - Are output fluctuations associated with labor demand shifts or labor supply shifts? In particular, those induced by g shocks?
 - Empirical evidence on goods-market markups?
 - Variations in markups? Exogenous or Endogenous?
- Theoretical Issue: endogenous/self-fulfilling/sunspot fluctuations?
 - i.e., fluctuations **not** due to changes in primitives (technology, preferences, endowment, etc.) of economy
 - Cannot occur in RBC economy (unique equilibrium)

September 30, 2010

3

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

- Effects of TFP shocks in RBC model...and with monopolistic competition ($\mu = 1.2$)

	SD %		Relative SD: SD(x)/SD(GDP)	
	RBC Model	Imperfect Competition	RBC Model	Imperfect Competition
GDP	1.75	1.71	1	1
Consumption	1.31	1.41	0.745	0.826
Gross Investment	5.77	6.28	3.283	3.668
Hours	0.68	0.62	0.386	0.363
Real Wage	1.38	1.44	0.785	0.841
Marginal Product of Labor	1.38	1.44	0.785	0.841

September 30, 2010

4

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

- **Effects of government purchase shocks in RBC model...and with monopolistic competition (can depend on other details of model...)**

	Relative SD: $SD(x)/SD(GDP)$			
	RBC Model	$\mu = 1.2$	$\mu = 1.4$	$\mu = 1.6$
GDP	1	1	1	1
Consumption	0.998	0.925	0.882	0.857
Gross Investment	8.027	9.277	10.494	11.679
Hours	1.435	1.435	1.436	1.437
Real Wage	0.477	0.490	0.504	0.519
Marginal Product of Labor	0.477	0.490	0.504	0.519

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5

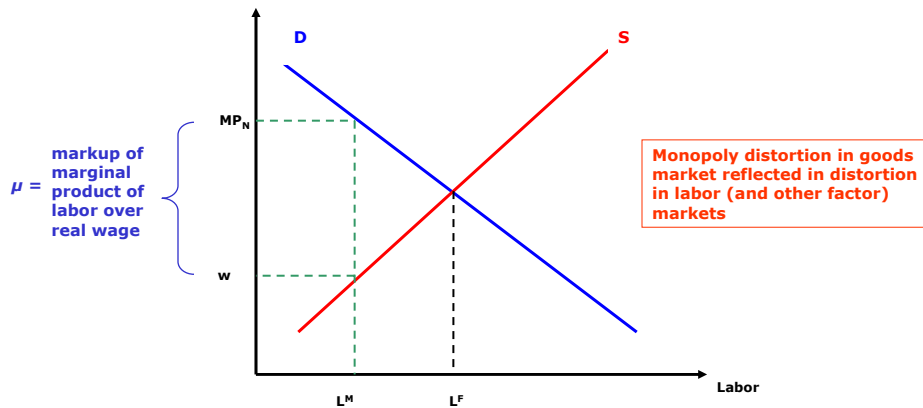
BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

- **Main Message:** model fluctuations can (qualitatively and quantitatively) depend on nature of steady state
- **Distorted or efficient long-run equilibrium?**
 - **Can be important for cyclical properties of a model**
 - **Analogy:** welfare costs of "bad" monetary policy depend on presence/magnitude of other distortions (Cooley and Hansen 1991)
- **Monopoly power a static distortion on the equilibrium**
 - **Akin to a labor income tax**
 - **Introduces a wedge between u_n/u_c and marginal product of labor**
 - **But a constant wedge...so far...**
 - **Cyclical behavior of "labor wedge" perhaps the most important challenge for business cycle modeling – Chari, Kehoe, McGrattan (2007 *Econometrica*), Shimer (2009 *AJ:Macro*)**
- **Variable markups may be important for cyclical fluctuations**
 - **In particular, for understanding output response to government purchase shocks (and, soon, monetary policy shocks...)**

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6

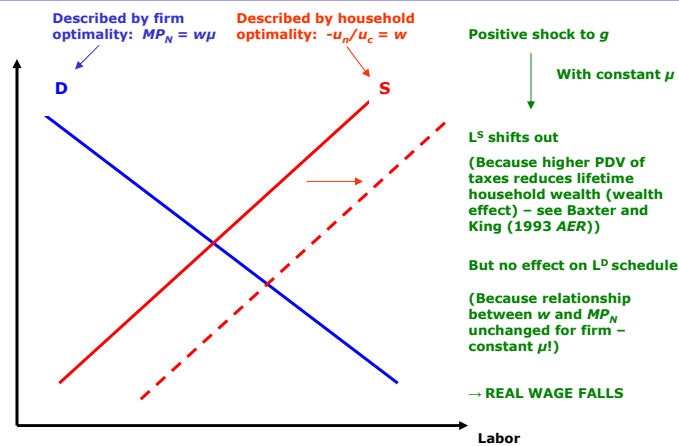
LABOR-MARKET DYNAMICS



September 30, 2010

7

LABOR-MARKET DYNAMICS



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8

VARIATIONS IN MARKUPS

- **Active empirical debate: does observed w rise or fall following exogenous changes in government spending?**
 - **w rises:** Blanchard and Perotti (2002 *QJE*), Gali, Lopez-Salido, and Valles (2007 *JEEA*)
 - **w falls:** Ramey and Shapiro (1999 *JME*), Burnside, Eichenbaum, and Fisher (2004 *JET*)
 - **Key issue:** how to empirically identify shock to g ?

- **Theoretical Consequence**
 - Rise in w would require outwards shift of L^D schedule...
 - ...which a fall in markup would achieve

- **Modeling endogenously countercyclical markups an active research topic in business-cycle models**
 - Ravn, Schmitt-Grohe, and Uribe (2006 *ReStud*), Jaimovich (2007 *JME*)
 - Bilbiie, Ghironi, and Melitz (2007)
 - Edmond and Veldkamp (2008)
 - Sticky-price models typically deliver it...

Supported by data

EXOGENOUS VARIATIONS IN MARKUPS

- **Define $\mu \equiv \frac{\varepsilon}{\varepsilon-1}$ and let μ be μ_t**

- **Simplest model of exogenous variation in markup**

$$y_t = \left[\int_0^1 y_t(i)^{\frac{1}{\mu}} di \right]^{\mu}$$

$$\ln \mu_{t+1} = (1 - \rho_\mu) \ln \bar{\mu} + \rho_\mu \ln \bar{\mu}_t + \varepsilon_{t+1}^\mu$$

- **Wide range of estimates of average μ**
 - **Generally in range [1.1, 1.6]**
 - Basu and Fernald (1997 *JPE*), Bils (1987 *AER*), Rotemberg and Woodford (1991 *NBER Macroeconomics Annual*), many others

- **Calibrate long-run $\mu = 1.2$, $\rho = 0.90$, and S.D. of shock to μ_t process such that $\text{S.D.}(\log(\mu_t)) \approx 0.015$ (Rotemberg and Woodford *Frontiers* chapter)**

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

Effects of markup shocks

	Volatility		Correlation (x, GDP)	
	SD %	Relative SD		RBC model w/TFP shocks
Markup shock a time-varying wedge between w and MP_N				
GDP	2.01	1	1	1
Consumption	1.18	0.588	0.994	0.981
Gross Investment	10.0	4.980	0.845	0.899
Hours	2.50	1.245	0.847	0.894
Real Wage	1.63	0.813	0.946	0.969
Marginal Product of Labor	0.86	0.429	0.872	0.969

September 30, 2010

11

SUNSPOT EQUILIBRIA

- Imperfect competition admits possibility of **multiple equilibria**
 - Think of as "**multiple stable arms**" (Cass-Koopmans phase diagram)
 - Cannot occur in basic RBC model (Theorem: unique equilibrium exists)
- "**Sunspot**:" a non-fundamental event/variable that may cause economy to "**switch**" back and forth between alternative equilibria
- Simple way to check if sunspot equilibria may exist
 - Write dynamic equilibrium conditions as

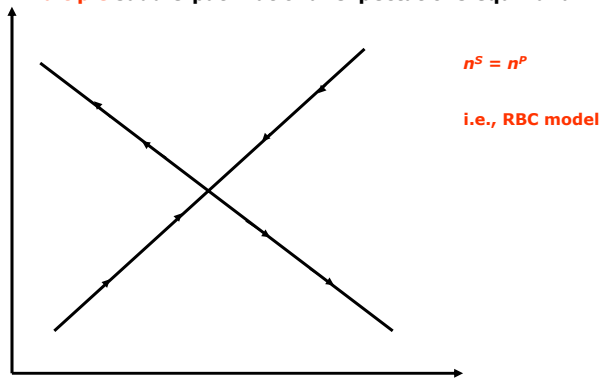
$$\text{All endogenous variables} \longrightarrow y_t = Ay_{t-1} + Bz_t \longleftarrow \text{All exogenous variables}$$
 - Compute eigenvalues of A
 - $n^S = \#$ of eigenvalues < 1 in absolute value
 - $n^P = \#$ of endogenous state variables

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12

SUNSPOT EQUILIBRIA

- **Stability Analysis**
 - $n^S = n^P$: **unique** saddle-path rational-expectations equilibrium
 - $n^S < n^P$: **no** saddle-path rational-expectations equilibrium exists
 - $n^S > n^P$: **multiple** saddle-path rational expectations equilibria

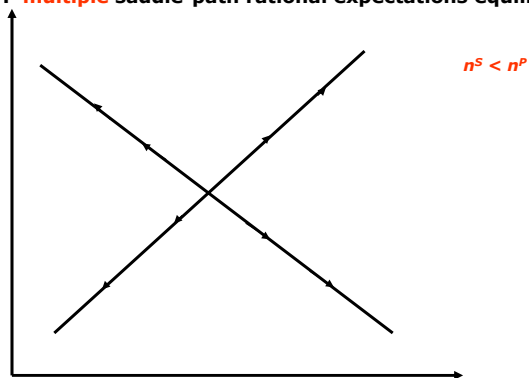


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13

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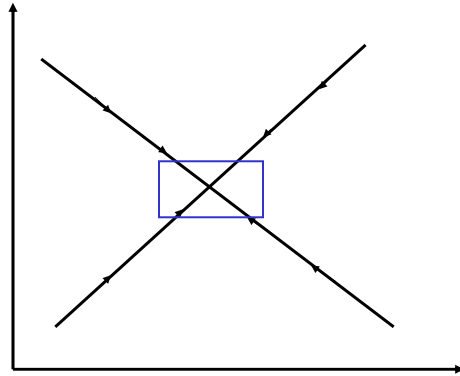


September 30, 2010

14

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$n^S > n^P$

Admits possibility of "switching" equilibria, driven by "sunspots" or "self-fulfilling expectations"

Farmer, *Macroeconomics of Self-Fulfilling Prophecies*