MONOPOLISTIC COMPETITION IN A DSGE MODEL: PART II

OCTOBER 4, 2011

BUILDING THE EQUILIBRIUM

- DS MODEL I or II
  - Putting things together – impose symmetry across all *i*

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

↓ implies

$$mc_t=\frac{w_t}{z_t f_n(k_t,n_t)}=\frac{r_t}{z_t f_k(k_t,n_t)}$$

Symmetric equilibrium ***relative price*** of an intermediate good? Substitute demand functions into DS aggregator and compute…

$$p_t=1$$

↓

$$mc_t=\frac{\varepsilon-1}{\varepsilon}$$

With measure one of intermediate firms, can think of as a normalization…but what if measure [0,N] of firms?

< 1 with ε > 1 and ε < infinity

Monopoly power causes factor prices to fall below marginal products…hence inefficiently low equilibrium factor use…hence inefficiently low total output

MONOPOLISTICALLY-COMPETITIVE EQUILIBRIUM

- **Equilibrium Conditions (symmetric across all differentiated goods)**
  - **Consumption-leisure optimality condition**
  - **Consumption-savings optimality condition**
  - **Aggregate resource constraint**

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

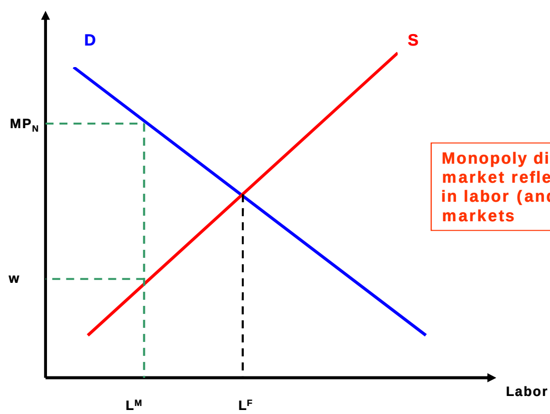
  - **(Market clearing in labor, capital, and goods markets)**
  - $mc_t = \frac{\varepsilon - 1}{\varepsilon} \quad \forall t$ **(< 1 with ε > 1)**
  - **Factor prices a *markdown* of marginal products**

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

THE LABOR WEDGE

markdown of real wage from marginal product of labor

"Labor Wedge"



Monopoly distortion in goods market reflected in distortion in labor (and other factor) markets

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

- Empirical Issues
  - Are output fluctuations associated with labor demand shifts or labor supply shifts? For example, 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)

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

- Effects of TFP shocks in RBC model…and with monopolistic competition (μ = 1.2)

	SD %		Relative SD: SD(x)/SD(GDP)	
Effect of TFP shocks on hours are dampened by imperfect competition	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

BUSINESS CYCLE IMPLICATIONS OF MONOPOLY

❐ **Effects of TFP shocks in RBC model…and with monopolistic competition (μ = 1.4)**

	SD %		Relative SD: SD(x)/SD(GDP)	
Effect of TFP shocks on hours are dampened by imperfect competition	RBC Model	Imperfect Competition	RBC Model	Imperfect Competition
GDP	1.75	1.65	1	1
Consumption	1.31	1.49	0.745	0.898
Gross Investment	5.77	6.64	3.283	4.015
Hours	0.68	0.56	0.386	0.341
Real Wage	1.38	1.49	0.785	0.902
Marginal Product of Labor	1.38	1.49	0.785	0.902

DSGE Dixit-Stiglitz Model

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	μ = 1.2	μ = 1.4	μ = 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

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…

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    - Cyclical behavior of "labor wedge" perhaps the most important challenge for business cycle modeling – Chari, Kehoe, McGrattan (2007 *Econometrica*), Shimer (2009 *AEJ:Macro*)
- Variable markups may be important for cyclical fluctuations
  - An active area of research: entry and exit of firms and product varieties over the business cycle

PRODUCT VARIETIES

$$\max_{\{N_{t+1}, N_{E,t}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left[\int_0^{N_t} (\rho_{it} - mc_t) q(\rho_{it}) di - mc_t f_{E,t} N_{E,t} \right]$$

f_E the product development cost, in terms of labor units

s.t.

$$N_{t+1} = (1-\delta)(N_t + N_{E,t})$$

Law of motion for number of product varieties, which turn over at rate δ

- FOCs

  N_{t+1} :

  $N_{E,t}$:

Beyond Basic Dixit-Stiglitz Model

PRODUCT VARIETIES

$$\max_{\{N_{t+1}, N_{E,t}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left[\int_0^{N_t} (\rho_{it} - mc_t) q(\rho_{it}) di - mc_t f_{E,t} N_{E,t} \right]$$

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Law of motion for number of product varieties, which turn over at rate δ

- FOCs

  N_{t+1} :

  $N_{E,t}$:

- "Product creation condition"
  - Characterizes optimal investment in R&D / product development

$$mc_t f_{E,t} = (1-\delta) E_t \left\{ \Xi_{t+1|t} \left[(\rho_{t+1} - mc_{t+1}) q(\rho_{t+1}) + mc_{t+1} f_{E,t+1} \right] \right\}$$

  - δ = 1 → ?... so try instead $N_{t+1} = (1-\delta)N_t + N_{E,t}$

PRODUCT VARIETIES

- Different forms of "final goods" aggregators
- Dixit-Stiglitz (1977)

$$y_t = \left[\int_0^{N_t} y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

ϵ measures elasticity of substitution across any two differentiated varieties

- Benassy (1996)

$$y_t = N_t^{\kappa+1-\frac{\varepsilon}{\varepsilon-1}} \left[\int_0^{N_t} y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

$\kappa + 1 = \epsilon / (\epsilon - 1)$ recovers Dixit-Stiglitz

κ measures "love of variety effect"

- Translog
  - No closed-form aggregator exists
  - Primitive is expenditure function
  - See Feenstra (2003 *Economics Letters*) for good overview

Dixit-Stiglitz	Benassy	Translog
$\mu(N_t) = \mu = \frac{\theta}{\theta-1}$	$\mu(N_t) = \mu = \frac{\theta}{\theta-1}$	$\mu(N_t) = 1 + \frac{1}{\sigma N_t}$
$\rho(N_t) = N_t^{\mu_t - 1} = N_t^{\frac{1}{\theta-1}}$	$\rho(N_t) = N_t^{\kappa}$	$\rho(N_t) = \exp\left(-\frac{1}{2}\frac{\tilde{N}-N_t}{\sigma \tilde{N} N_t}\right)$, $\tilde{N} \equiv$ Mass(potential products)
$\epsilon(N_t) = \mu - 1$	$\epsilon(N_t) = \kappa$	$\epsilon(N_t) = \frac{1}{2\sigma N_t} = \frac{1}{2}(\mu(N_t) - 1)$

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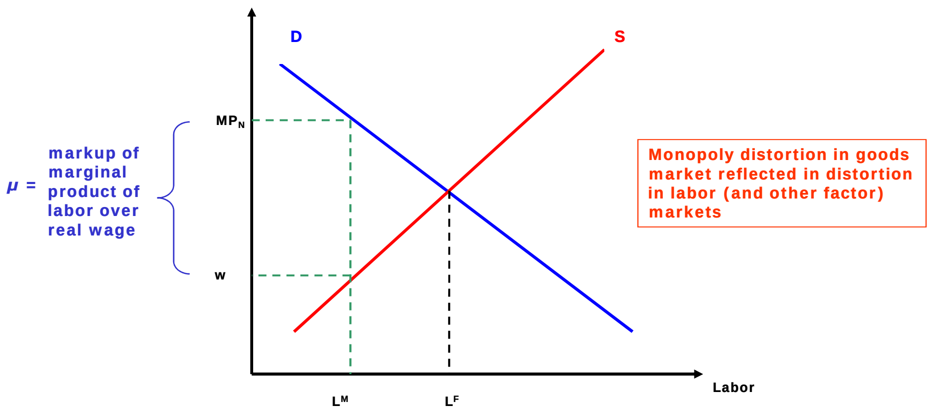
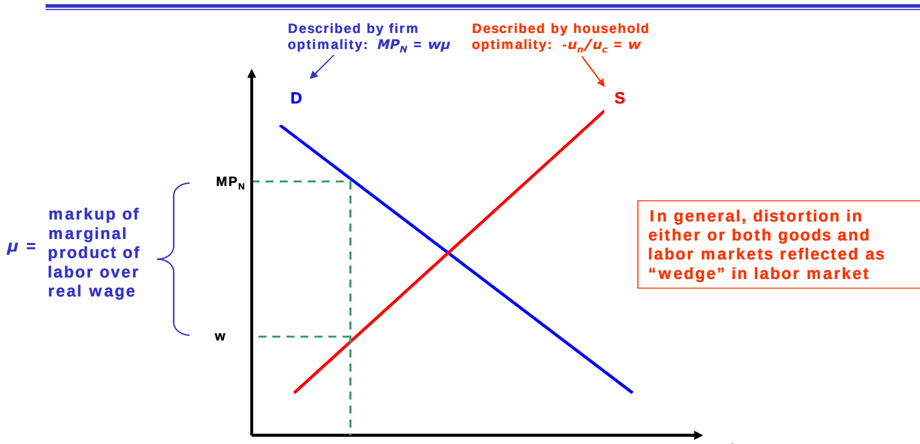
More generally, variable labor wedges important for cyclical fluctuations…

- Variable markups may be important for cyclical fluctuations
  - An active area of research: entry and exit of firms and product varieties over the business cycle

LABOR MARKET DYNAMICS



LABOR MARKET DYNAMICS



- Labor wedge measurement and theory an active area of research
  - Shimer (2009 ***AEJ:Macro***), Ohanian (2010 ***JEP***), many others

THE LABOR WEDGE

- **Shimer (2009 *AEJ:Macroeconomics*)**

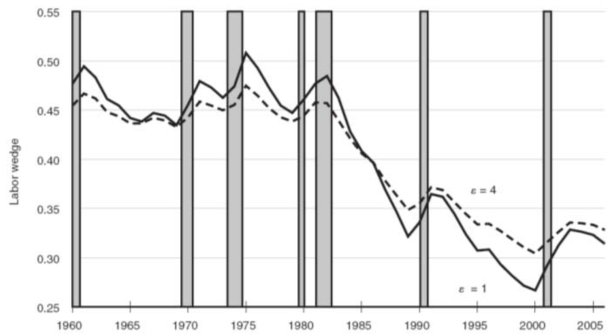


FIGURE 2

Notes: The US labor wedge from equation (8). The solid line shows $\varepsilon = 1$, and the dashed line shows $\varepsilon = 4$. In both cases, I fix the remaining parameters to ensure that the average labor wedge is 0.40. The gray bands show National Bureau of Economic Research (NBER) recession dates.

THE LABOR WEDGE

- **Ohanian (2010 *Journal of Economic Perspectives*)**

Table 2
Recession Diagnostic Distortions
(percent changes)

	Labor deviation	*Capital deviation*	*Productivity deviation*
A: U.S., Postwar Recessions vs. 2007–2009 Recession			
Average postwar recessions	–2.4	1.8	–2.2
2007–09 recession (2007-Q4 to 2009-Q3)	–12.9	0.3	–0.1
B: 2007–2009 Recession, U.S. vs. Other High-Income Countries			
United States	–12.9	0.3	–0.1
Canada	–0.9	0.7	–7.0
France	1.7	1.3	–6.1
Germany	4.8	–1.1	–7.0
Italy	–0.8	0.3	–7.2
Japan	2.9	–0.4	–7.1
United Kingdom	–2.3	0.0	–8.2
Average other high-income countries	0.9	0.1	–7.1

Notes: The labor deviation is the percent difference between the marginal rate of substitution between consumption and leisure, and the marginal product of labor when actual data are plugged into that equation. The capital deviation is the percent difference between the intertemporal marginal rate of substitution between consumption and the marginal product of capital net of depreciation when actual data are plugged into that equation. The productivity deviation is the Solow residual.