Macroeconomic Implications of the Underground Sector: Challenging the Double Business Cycle Approach

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Theory vs. Evidence

Time series of irregular sector

- Procyclical: Giles (1997), Bajada (2003)
- Countercyclical: Russo (2008)

'Double business cycle' approach

- Real business cycle models based on premise that fluctuations in official and unofficial sectors are negatively correlated
- Examples: Busato & Chiarini (2004), Russo (2008)
- Intersectoral reallocation of labor and production explain employment volatility puzzle

This paper . . .

- Develops RBC model not assuming countercyclicality between official and unofficial economy
  - Regular and irregular labor additively separable in utility
  - Leisure spent on irregular work effort and non-market activities
- Contrasts resulting moments with estimated correlations in Granda-Carvajal (2010)
- Assesses effect of tax structure, enforcement and tastes for irregular labor on decision to become underground and on macroeconomic fluctuations

Structure

- Firms:
  - Produce one homogeneous commodity
  - Hide part of production in order to evade taxes
- Households:
  - Work in both sectors
- Government:
  - Balances budget
  - Enforces a monitoring system for tax evasion

Technologies

Official:

$$y_t^f = z_t^f k_t^{\alpha} (l_t^f)^{1-\alpha}$$

Underground:

$$y_t^u = z_t^u l_t^u$$

where z_t^i are sectoral productivity shocks

Total production:

$$y_t^{tot} = y_t^f + y_t^u$$

Profit maximization

Let τ_t^f: corporate tax rate, τ^s: social security tax rate, ϕ: detection probability, and ς: fine

Expected revenues:

$$(1-\tau_t^f)y_t^f + (1-\phi\varsigma\tau_t^f)y_t^u$$

Expected costs:

$$(1+\tau^s)w_t l_t^f + (1+\phi\varsigma\tau^s)w_t l_t^u + r_t k_t$$

Arbitrage condition (from F.O.C.s):

$$\frac{1-\tau_t^f}{1+\tau^s}(1-\alpha)z_t^f k_t^\alpha (l_t^f)^{-\alpha} = \frac{1-\phi\varsigma\tau_t^f}{1+\phi\varsigma\tau^s} z_t^u$$

Alternatively, $w_t^f \equiv w_t(1+\tau^s)$ yields a wage differential

Momentary utility function

$$U(c_t, l_t^f, l_t^u) = \ln c_t - a\frac{(l_t^f)^{1+\gamma}}{1+\gamma} - b\frac{(l_t^u)^{1+\eta}}{1+\eta}$$

- Based on Cho & Cooley's (1994) family labor supply model
- $1/\eta$ positively related to disutility of underground work effort
- No adjustment cost of moving across sectors

F.O.C.s with respect to both types of labor:

$$a(l_t^f)^{\gamma} = \frac{1-\tau_t^w}{c_t}\frac{1-\tau_t^f}{1+\tau^s}(1-\alpha)z_t^f k_t^{\alpha}(l_t^f)^{-\alpha}$$

$$b(l_t^u)^{\eta} = \frac{1-\phi\varsigma\tau_t^f}{1+\phi\varsigma\tau^s}\frac{z_t^u}{c_t}$$

Budget constraint

$$g_t + T_t = \tau_t^f y_t^f + \phi\varsigma\tau_t^f y_t^u + (\tau^s + \tau_t^w) w_t l_t^f + \phi\varsigma\tau^s w_t l_t^u$$

Government consumption follows stochastic process:

$$g_t = z_t^g y_t^{tot}$$

Parameters

Matching U.S. business cycle stylized facts for 1960-2006

β	δ	α	a	b	γ	η	ϕ	ς
0.95	0.10	0.36	3.7569	2.8814	1	0.2381	0.015	1.2

- Attempts to incorporate evidence on elasticity of underground labor supply
- Calibration of technology shocks from BRW (1991)
- Parameterization of tax disturbances from Braun (1994)

Comparing volatilities . . .

	Data	Model forecast		BC ('04)
	$\sigma(x)/\sigma(y^f)$	$\sigma(x)/\sigma(y^f)$	$\sigma(x)/\sigma(y^{tot})$	$\sigma(x)/\sigma(y^{tot})$
y^f	1.00000	1.00000	1.12169	1.86
y^{tot}	–	0.89151	1.00000	1.00
c^{tot}	–	0.30647	0.34377	0.80
c^f	0.89129	0.54997	0.61689	–
i	4.08135	5.29241	5.93645	6.64
l^f	1.92521	1.16877	1.31100	1.10
y^f/l^f	1.20065	1.36146	1.52713	2.00

- Understates properties of consumption (c^f more volatile than c^{tot})

Comparing comovements . . .

	Correl. with y^f			Correl. with y^{tot}	
	Data	Model	MRW('97)	Model	BC ('04)
y^f	1.0000	1.0000	1.00	0.9930	0.95
c^{tot}	–	0.3450	–	0.2376	0.69
c^f	0.8795	0.3225	0.91	0.2106	–
i	0.8425	0.9233	0.66	0.9582	0.98
l^f	0.8479	0.9613	0.70	0.9837	0.73
y^f/l^f	-0.5268	-0.9572	–	-0.9761	0.08
y^u	–	-0.2720	–	-0.1561	-0.96

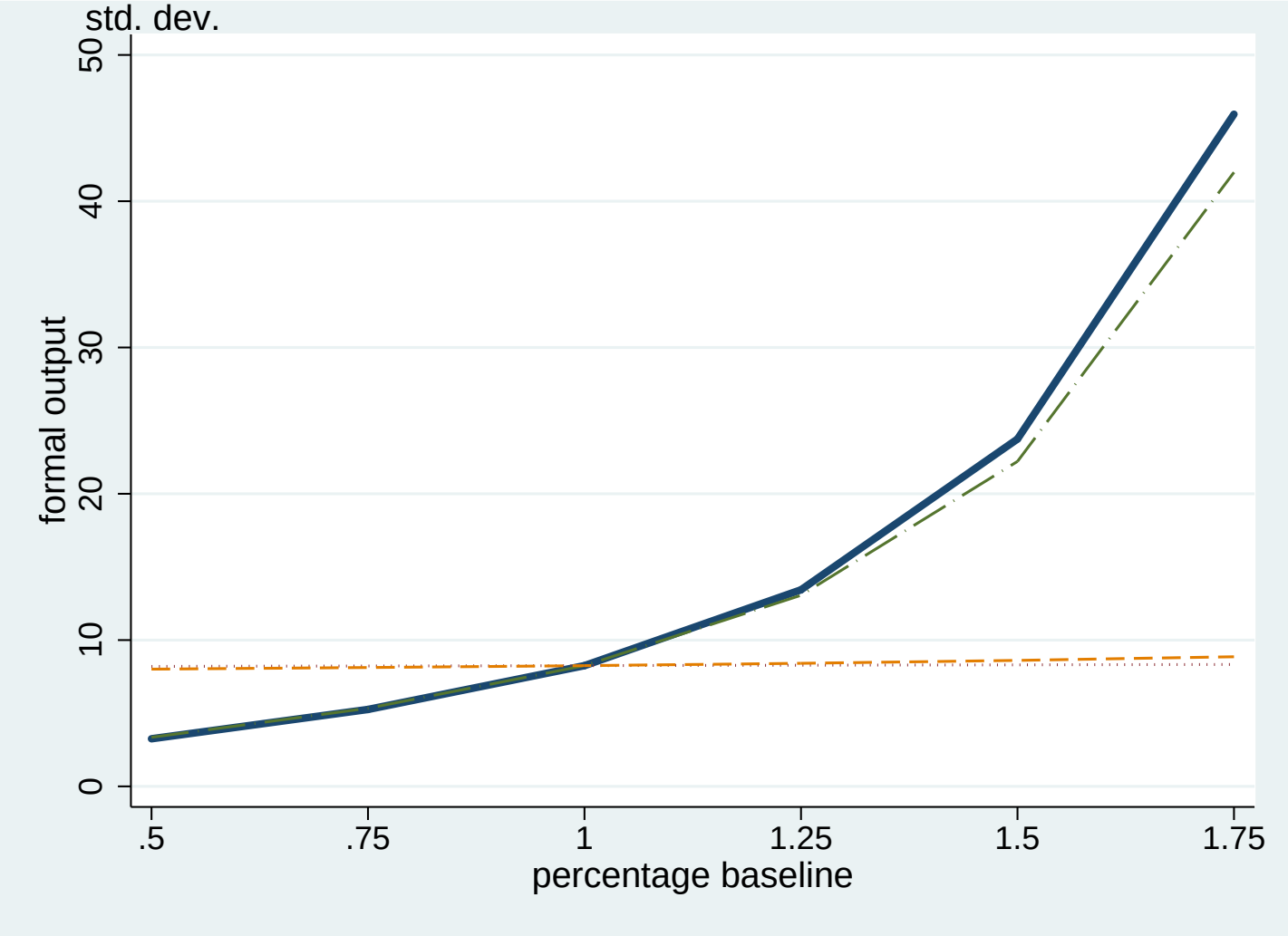
- Predicts volatility and cyclicality of investment, average hours and labor productivity fairly well
- Unofficial sector is weakly countercyclical

More on comovements . . .

	Correl. with hours		
	Data	Model	BC ('04)
Productivity	-0.8973	-0.9935	0.04

- Significant improvement on Busato & Chiarini (2004) as to labor productivity
- Model replicates recent tendencies in labor market dynamics accurately

Sensitivity of output volatility to tax rates



Computational experiments – Volatility

Changed parameter	Effect on volatility of y^f	c^f	i	I^f	g	r	y^f/I^f
$\downarrow \phi$	$\nearrow$	$\nearrow$	–	–	$\searrow$	$\searrow$	$\wedge$
$\downarrow \varsigma$	$\nearrow$	$\nearrow$	–	–	$\searrow$	$\searrow$	$\wedge$
$\uparrow \tau^s$	–	–	–	–	–	–	–
$\uparrow \tau^f_{ss}$	$\nearrow$	$\nearrow$	$\nearrow$	$\searrow$	$\searrow$	$\searrow$	$\searrow$
$\uparrow \tau^w_{ss}$	–	–	–	–	–	–	–
$\uparrow$ avgtax	$\nearrow$	$\nearrow$	$\nearrow$	$\searrow$	$\searrow$	$\searrow$	$\searrow$
$\downarrow 1/\eta$	$\nearrow$	$\nearrow$	–	–	$\searrow$	–	–
Data	y^f	c^f	i	I^f	g	r	y^f/I^f
	$+$	$+^{\pm}$	$+^{\mp}$	0	$+^{\mp}$	$+$	0

Notes: $^{\pm}$ Robust ; $^{\mp}$ Not robust

Computational experiments – Cyclicality

Changed parameter	Effect on cyclicality of c^f	i	I^f	g	r	y^f/I^f
$\downarrow \phi$	$\searrow$	–	–	–	–	Γ
$\downarrow \varsigma$	$\searrow$	–	–	–	–	Γ
$\uparrow \tau^s$	–	–	–	–	–	–
$\uparrow \tau^f_{ss}$	$\nearrow$	$\searrow$	–	$\nearrow$	$\searrow$	–
$\uparrow \tau^w_{ss}$	–	–	–	–	–	–
$\uparrow$ avgtax	$\nearrow$	$\searrow$	–	$\nearrow$	$\searrow$	–
$\downarrow 1/\eta$	$\searrow$	$\searrow$	–	$\searrow$	$\searrow$	–
Data	c^f	i	I^f	g	r	y^f/I^f
	$-^{\mp}$	$-^{\mp}$	$-^{\mp}$	0	$-^{\mp}$	0

Note: $^{\mp}$ Not significant

Concluding remarks

- Fiscal policy shocks, rather than underground sector, explain employment volatility puzzle
  - Non-significant relation between comovement of labor input and shadow activities
  - Labor volatility uncorrelated with extent of unofficial sector
- Distortionary taxation in two-sector framework rationalizes cyclical behavior of labor market variables
  - Cyclical properties of labor productivity not related with irregular economy
- Positive connection between unofficial sector and volatility of output and its private components

Extensions

Alternative specifications of preferences:

- Non-additively separable utility functions
- Imperfect substitution in consumption goods

Busato & Chiarini (2004)

Let $l_t^u \equiv 1 - l_t^f$, then

$$U(c_t, l_t^f, l_t^u) = \ln c_t - a\frac{(l_t^f)^{1+\gamma}}{1+\gamma} l_t^u - b\frac{(l_t^u)^{1+\eta}}{1+\eta}$$