Local Spending, Transfers, and Costly Tax Collection: Online Appendix

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A Model extensions

A.1 Asymmetric income distribution

In the baseline model I assume a symmetric distribution of the type y_i. Let us relax this assumption and consider a more general case. Denote the median and average y_i are y_m and y, respectively. Also let us define the ratio $k \equiv \frac{y_m}{y}$. I assume that k can be affected by changes on average y_i and that $0 < k < 1$. In this setup k captures the degree of inequality between the average taxpayer and the median voter. The rest of the setup is the same.

With this modification, the government's budget constraint remains the same, $g = y\left[\tau - \Gamma C(\tau)\right] + a$, and the tax rate can still be written as $\tau = f(\frac{g-a}{y})$. However the equilibrium policy becomes

$$g^* = \arg\max \; 1 - \tau y_m + H(g)$$

because the politician maximizes the median voter's indirect utility.

Solving the maximization problem we can rewrite the equilibrium policy as:

$$g^* = h(kf'(\frac{g-a}{y})) \tag{1}$$

Recall that $h' < 0$ and thus the level of public spending decreases with income inequality k.

Taking total derivatives to (1) we obtain the propensities to spend out of local income and grants:

$$\begin{aligned}\frac{dg^*}{dy} &= \frac{yk'h'f'}{y - kh'f''} - \frac{kh'f''}{y - kh'f''}\frac{g^* - a}{y} \\ \frac{dg^*}{da} &= -\frac{kh'f''}{y - kh'f''}\end{aligned}$$

From these two expressions and definition (??) we can relate both propensities to spend to obtain the magnitude of the flypaper effect:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\left(-\frac{k'}{k}\frac{f'}{f''}y + \tau - \Gamma C(\tau)\right)^{-1} \tag{2}$$

Note that, similar to the case of symmetric income distribution, the magnitude of the flypaper effect is increasing on the administrative costs shifter Γ. Moreover, in the particular case when the income distribution is unaffected by changes on average income, $k' = 0$, expression (2) becomes identical to equation (10) in the main paper.

A.2 Compliance and administrative costs

Consider a more general case with both compliance and administrative costs. In particular, for citizen i the compliance cost is $\Gamma_c C_c(\tau) y_i$ while for the tax authority the administrative cost represents a proportion $\Gamma_a C_a(\tau)$ of the tax base. Both $\Gamma_c C_c(\tau)$ and $\Gamma_a C_a(\tau)$ are increasing and convex functions and adopt values strictly between 0 and τ.

Given the previous assumptions, we can re-write equations (2) and (3) in the main paper as

$$V_i = 1 - y_i[\tau + \Gamma_c C_c(\tau)] + H(g)$$

$$g = y\left[\tau - \Gamma_a C_a(\tau)\right] + a$$

Rearranging the budget constraint, we can express τ as a function of g:

$$F(\tau) \equiv \tau - \Gamma_a C_a(\tau) = \frac{g-a}{y} \tag{3}$$

where $F' > 0$, $F'' < 0$ by assumption 1 and convexity of $C_a(\tau)$. Since F is a monotonic function, we can write the tax rate as

$$\tau = f\left(\frac{g-a}{y}\right)$$

where $f(\cdot) = F^{-1}(\cdot)$.

It follows that the median citizen's indirect utility can be written as

$$1 - y\left[f + \Gamma_c C_c(f)\right] + H(g) \tag{4}$$

The maximization of equation 4 with respect to g provides the level of public spending in equilibrium;

$$g^* = h((1 + \Gamma_c C_c')f') \tag{5}$$

where $h(\cdot)$ is the inverse function of $H'(\cdot)$.

Calculating comparative statics from (5), we obtain:

$$\frac{dg^*}{dy} = -\frac{h'A}{y - h'A}\frac{g^* - a}{y} \tag{6}$$

$$\frac{dg^*}{da} = -\frac{h'A}{y - h'A} \tag{7}$$

where $A = (1 + \Gamma_c C_c')f'' + f'f'\Gamma_c C_c''$

From visual inspection of (6) and (7), and using definition (3), we obtain the following relation between both propensities to spend:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\frac{1}{\tau - \Gamma_a C_a(\tau)} \tag{8}$$

Note that the magnitude of the flypaper effect is similar to the obtain in the case without compliance costs. However, the propensities to spend are different.

Note that in the special case of no administrative costs, $\Gamma_c = 0$, expression (8) becomes:

$$\frac{dg^*}{da} = \frac{dg^*}{dy}\frac{1}{\tau^*}$$

Similar to the model only with administrative costs, this extension predicts a propensity to spend out of grants larger than the propensity to spend out of local income.

A.3 Using a Cobb-Douglas utility function

The baseline model assumes a quasilinear utility function $U_i = c_i + H(g)$. Consider instead a Cobb-Douglas utility function $U_i = c_i^\alpha g^\beta$. The rest of the model remains identical.

In the case of costless taxation, the optimal policy maximizes the median voter utility $U = c^\alpha g^\beta$ subject to the government budget constraint $g = \tau y + a$. Note that the budget constraint implies $c = y - g + a$. Solving the problem we obtain that:

$$g^* = \frac{\beta}{\alpha + \beta}(y + a).$$

It is straightforward to see that $\frac{dg}{da} = \frac{dg}{dy}$, i.e. intergovernmental grants are fungible.

In the case of costly taxation, the government budget constraint becomes $g = \tau y + a - \Gamma C(\tau)y$ and $c = y(1 - f(\frac{g-a}{y}))$, where $f(\cdot) = F^{-1}(\tau)$. Note that the first order conditions imply:

$$gf'(\frac{g-a}{y}) = \frac{\beta}{\alpha}y(1 - f(\frac{g-a}{y})). \tag{9}$$

Taking total derivatives to (9) we obtain:

$$\begin{aligned} \frac{dg}{dy} &= \frac{g-a}{y}\frac{B}{A} + \frac{\frac{\beta}{\alpha}(1-f)}{A}, \\ \frac{dg}{da} &= \frac{B}{A}, \end{aligned}$$

where $A = f' + \frac{gf''}{y} + \frac{\beta}{\alpha}f'$ and $B = \frac{gf''}{y} + \frac{\beta}{\alpha}f'$ Note that $\frac{dg}{da} \in (0,1)$ since f', $f'' > 0$

It can be shown that $\frac{dg}{da} > \frac{dg}{dy}$. This result is similar to the main prediction of the model using a quasilinear utility function and costly taxation.

To see this note that:

$$\frac{dg}{da} - \frac{dg}{dy} = \frac{1}{A}[(1 - \frac{g-a}{y}) - \frac{\beta}{\alpha}(1-f)] \tag{10}$$

Since $\frac{g-a}{y} = \tau - \Gamma C(\tau)$ and $\tau = f$, then $\frac{g-a}{y} < f$. This implies that expression (**??**) is positive if $B \equiv \frac{gf''}{y} + \frac{\beta}{\alpha}f' > \frac{\beta}{\alpha}$. A sufficient condition for this to hold is that $f' > 1$. Since $f' = \frac{1}{F'} = \frac{1}{1-\Gamma C'}$, this condition is satisfied by the assumption that $\Gamma C' < 1$. Recall that this assumption guarantees that the net tax revenue is an increasing function of the tax rate.

B Additional empirical results

Table 1: Main results including other transfers as controls

	Ln(expenditure per capita)		Expenditure per capita	
	(1)	(2)	(3)	(4)
Ln(Foncomun per capita)	0.246***	0.577***		
	(0.074)	(0.085)		
Ln(Foncomun per capita) × *HIGHCOST*	0.216***	0.188**		
	(0.072)	(0.076)		
Ln(other transfers per capita)	0.210***	0.192***		
	(0.025)	(0.028)		
Foncomun per capita			0.728***	0.954***
			(0.142)	(0.190)
Foncomun per capita × *HIGHCOST*			0.288**	0.257
			(0.139)	(0.173)
Other transfers per capita			0.810***	0.811***
			(0.104)	(0.106)
Estimation method	OLS	2SLS	OLS	2SLS
Observations	4,025	4,025	4,025	4,025
Nr municipalities	1,445	1,445	1,445	1,445
R-squared	0.320	0.290	0.368	0.361

Notes: Robust errors in parentheses. Standard errors are clustered by province. * significant at 5%; ** significant at 1%. All columns include municipality fixed effects and a time trend. High cost is a dummy equal to 1 if municipality does not have an updated cadaster or an automated tax system. Column 2 uses ln(add transfer) and ln(add transfer)×*HIGHCOST* as excluded instruments. Column 3 uses the same variables but in levels.

Table 2: Testing additional model predictions - using tax per capita

	Ln(expenditure per capita)			
	(1)	(2)	(3)	(4)
Ln(Foncomun per capita)	0.542***	0.787***	0.526***	0.812***
	(0.054)	(0.076)	(0.054)	(0.070)
Ln(Foncomun per capita) $\times$ Ln(tax per capita 1998)	-0.062	-0.094***	-0.077**	-0.084***
	(0.039)	(0.036)	(0.035)	(0.031)
Ln(other transfers per capita)			0.227***	0.214***
			(0.026)	(0.028)
Estimation method	OLS	2SLS	OLS	2SLS
Observations	3,300	3,300	3,300	3,300
Nr municipalities	1,173	1,173	1,173	1,173
R-squared	0.255	0.242	0.310	0.286

Notes: Robust errors in parentheses. Standard errors are clustered by province. * significant at 5%; ** significant at 1%. All columns include municipality fixed effects and a time trend. Column 2 and 4 use ln(add transfer) as an instrument for ln(Foncomun per capita).

Table 3: Alternative measures of tax collection costs - without municipality fixed effect

	Ln(expenditure per capita)					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Foncomun per capita)	0.407***	0.560***	0.256*	0.473***	0.226*	0.466***
	(0.099)	(0.081)	(0.131)	(0.103)	(0.134)	(0.107)
Ln(Foncomun per capita)	0.210***	0.108**				
× *NOCADASTER*	(0.052)	(0.049)				
Ln(Foncomun per capita)			0.381***	0.206***		
× *NOAUTOMATED*			(0.096)	(0.075)		
Ln(Foncomun per capita)					0.227***	0.119***
× *HIGHNUMBER*					(0.055)	(0.044)
Estimation method	OLS	2SLS	OLS	2SLS	OLS	2SLS
Municipality fixed effect	No	No	No	No	No	No
Department fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,606	3,606	4,128	4,128	4,137	4,137
R-squared	0.659	0.648	0.682	0.673	0.693	0.683

Notes: Robust errors in parentheses. Standard errors are clustered by province. * significant at 5%; ** significant at 1%. All regressions include department fixed effects and a time trend. Column 2, 4 and 6 uses ln(add transfer) as instrument for ln(Foncomun per capita). See main text for definition of *NOCADASTER*, *NOAUTOMATED* and *HIGHNUMBER*.