Appendix to:
"Political budget cycles in the European Union and the impact of political pressures"

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A   Appendix

A.1   Theoretical Model

A.1.1   A simple version of Person-Tabellini's PBC

In this section we describe a simple version of the model of electoral cycles with seignorage developed by Persson & Tabellini (2000)[2]. We consider an economy with two main actors: a government (or an incumbent politician) and voters (who also play the role of consumers). Let us write the government budget constraint as

$$g_t = \eta_t(\bar{\tau}y + s_t) \qquad (A.1)$$

where g_t is the government expenditure in period t, $\bar{\tau}$ is the fixed percentage rate of taxes, y is the average income, s_t denotes "seignorage" or, more generally, a hidden and distorting tax observed and paid for by the voters only after the elections, and η_t represents the incumbent's competence level (ability to handle the economy, for example, increase government expenditure using the given tax revenue). Voters' welfare in period t, denoted by w_t, is given by

$$w_t = y(1 - \bar{\tau}) - s_t - V(s_t) + \lambda g_t \qquad (A.2)$$

where $V(.)$ is a function capturing the distortions of seignorage[3], so that $V(0) = 0$, $V'(.) > 0$ for $s_t > 0$ and $V''(.) > 0$, and $\lambda \geq 1$ is an exogenous parameter. To simplify the analysis, the voters' marginal utility from public consumption is assumed to be constant (that is, voters

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[2]The model was originally formulated by Holmstrom (1982) to describe how career concerns shape the incentives of managers inside an organization. Persson & Tabellini (2000) show how to adapt this model to a political setup.

[3]Note that the quantity s_t can also represent public borrowing and $V(.)$ the cost function of public borrowing.

are risk-neutral). As is common in these models, competence is a moving average process of order 1^4, determined by

$$\eta_t = \vartheta_t + \vartheta_{t-1} \tag{A.3}$$

where ϑ_t is drawn from a continuous uniform distribution with support that covers $[1 - \frac{1}{2\varphi}, 1 + \frac{1}{2\varphi}]$ and is serially uncorrelated. Thus, its mean value is equal to 1 and its probability density is equal to φ. Notice that φ represents the sensitivity of re-election probability to the level of the incumbent's competence, which is assumed to be constant over time. We further assume that policy decisions in each period t are made before knowing the realization of ϑ_t and that the realization of ϑ_{t-1} is known to everyone.

The incumbent politician maximizes voter's welfare and some exogenous "ego rents" $R > 0$ according to

$$E(w_t|\vartheta_{t-1}) + p_t R \tag{A.4}$$

where p_t is the probability that the incumbent is re-elected. For simplicity, we set R equal to 1. The sequence of the stage game at time t is as follows: (1) the politician chooses s_t, given ϑ_{t-1} and without observing ϑ_t; (2) nature determines ϑ_t; (3) voters observe g_t only; (4) if t is an on-election period, voters re-elect the incumbent politician or elect a new contender drawn from the same distribution; if t is an off-election period, we move to the election period. The stage game is infinitely repeated.

Under these assumptions, the equilibrium in off-election periods is straightforward, as the incumbent maximizes voters' welfare only. Even though the quantity of seignorage in the current period t reveals incumbent's ϑ_t, the voters disregard it, as elections take place only in period $t + 1$. At that point, voters will look ahead to period $t + 2$. By (A.3),

$$E(\eta_{t+2}|g_{t+1}) = E(\vartheta_{t+2}|g_{t+1}) + E(\vartheta_{t+1}|g_{t+1}) = 1 + \vartheta_{t+1} \tag{A.5}$$

Hence knowledge of ϑ_t in period t is irrelevant for the voters and the incumbent politician sets s_t at the socially optimal level. More formally, the incumbent politician maximizes $E(w_t|\vartheta_{t-1})$, which, after substituting (A.1) and (A.3) into (A.2), can be written as

$$E(w_t|\vartheta_{t-1}) = y(1 - \bar{\tau}) - s_t - V(s_t) + \lambda(1 + \vartheta_{t-1})(\bar{\tau}y + s_t) \tag{A.6}$$

Solving the FOC for s_t, we get

$$-1 - V'(s_t) + \lambda(1 + \vartheta_{t-1}) = 0 \qquad \text{or}$$

$$V'(s_t) = \lambda(1 + \vartheta_{t-1}) - 1 \tag{A.7}$$

In on-election periods, on the other hand, the situation is different. When period $t + 1$ arrives, the value of ϑ_{t+1} is not irrelevant for the voters, as shown by (A.5). Even though voters do not directly observe ϑ_{t+1}, they can infer it from g_{t+1} and beliefs about the level of seignorage. We denote the voters' guesses about ϑ_{t+1} and s_{t+1} as $\tilde{\vartheta}_{t+1}$ and $\tilde{s}_{t+1}$ respectively. From the budget constraint, we have

$$g_{t+1} = (\tilde{\vartheta}_{t+1} + \vartheta_t)(\bar{\tau}y + \tilde{s}_{t+1}) \qquad \text{or}$$

$$\tilde{\vartheta}_{t+1} = \frac{g_{t+1}}{\bar{\tau}y + \tilde{s}_{t+1}} - \vartheta_t \tag{A.8}$$

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[4]Thus, competence changes over time, but slowly: if a policymaker was competent yesterday, he retains some of his competence today, though some may depend on new factors. The MA(1) specification is also convenient because it does not allow competence to carry over for more than two periods, that is, if after the election the challenger replaces the incumbent.

Inserting equation (A.1) (one period ahead) into the numerator of the first term on the right-hand side of (A.8) gives

$$\tilde{\vartheta}_{t+1} = \frac{\bar{\tau}y + s_{t+1}}{\bar{\tau}y + \tilde{s}_{t+1}}(\vartheta_{t+1} + \vartheta_t) - \vartheta_t \tag{A.9}$$

The voters' behavior is then simple to explain: the incumbent is reappointed only if $\tilde{\vartheta}_{t+1}$ exceeds his opponent's expected competence:

$$\tilde{p}_{t+1} = \begin{cases} 1 & \text{iff } \tilde{\vartheta}_{t+1} \geq 1 \\ 0 & \text{otherwise} \end{cases} \tag{A.10}$$

As the incumbent politician does not yet know his own competence, his probability of re-election, as perceived in period $t + 1$ when choosing the level of seignorage, is given by $p_{t+1} = Pr(\tilde{p}_{t+1} = 1) = Pr(\tilde{\vartheta}_{t+1} \geq 1)$. Using equation (A.9) we can write this probability as

$$Pr\left(\frac{\bar{\tau}y + s_{t+1}}{\bar{\tau}y + \tilde{s}_{t+1}}(\vartheta_{t+1} + \vartheta_t) - \vartheta_t \geq 1\right) \qquad \text{or}$$

$$Pr\left(\vartheta_{t+1} \geq \frac{\bar{\tau}y + \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}} - \vartheta_t \frac{s_{t+1} - \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}}\right) \tag{A.11}$$

which can be calculated using the cumulative distribution function of ϑ_{t+1}[5]. That is,

$$\begin{aligned} Pr\left(\vartheta_{t+1} \geq \frac{\bar{\tau}y + \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}} - \vartheta_t \frac{s_{t+1} - \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}}\right) &= \frac{1}{2} + \varphi\left(1 - \frac{\bar{\tau}y + \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}} + \vartheta_t \frac{s_{t+1} - \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}}\right) \\ &= \frac{1}{2} + \varphi\left(\frac{s_{t+1} - \tilde{s}_{t+1}}{\bar{\tau}y + s_{t+1}} - \vartheta_t \frac{\tilde{s}_{t+1} - s_{t+1}}{\bar{\tau}y + s_{t+1}}\right) \\ &= p_{t+1} \end{aligned} \tag{A.12}$$

By substituting equation (A.12) into equation (A.4) (one period ahead), we get the incumbent's maximization problem in period $t + 1$

$$E(w_{t+1}|\vartheta_t) + p_{t+1} = y(1 - \bar{\tau}) - s_{t+1} - V(s_{t+1}) + \lambda(1 + \vartheta_t)(\bar{\tau}y + s_{t+1}) + p_{t+1} \tag{A.13}$$

where p_{t+1} is defined by equation (A.12). Solving the FOC for s_{t+1}, we get

$$-1 - V'(s_{t+1}) + \lambda(1 + \vartheta_t) + \varphi(1 + \vartheta_t)\frac{\bar{\tau}y + \tilde{s}_{t+1}}{(\bar{\tau}y + s_{t+1})^2} = 0 \tag{A.14}$$

In equilibrium, politicians' choice of seignorage must be consistent with the voters' guesses (conjectures): $s_{t+1} = \tilde{s}_{t+1}$. This gives us

$$V'(s_{t+1}) = \lambda(1 + \vartheta_t) - 1 + \varphi\frac{1 + \vartheta_t}{\bar{\tau}y + s_{t+1}} \tag{A.15}$$

Comparing equations (A.15) and (A.7), we see that incumbents choose higher levels of distortions (hence higher levels of seignorage) during elections periods, as the last term on the right hand side of equation (A.15) is non-negative. This yields the central result of the model: the government's budget balance is influenced by the timing of elections, and hence PBCs are expected to appear in all election periods and in all countries that have elections.

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[5]Recall that ϑ_{t+1} is drawn from a uniform distribution with mean 1 and density φ and hence $\forall x$

$$Pr(\vartheta_{t+1} \geq x) = 1 - Pr(\vartheta_{t+1} \leq x) = \frac{1}{2} + \varphi(1 - x)$$

A.1.2 Non-economic voting and competitiveness

A strong assumption of the above model is that the sensitivity of re-election probability to the level of competence is considered to be the same in all periods. This assumption may be satisfied when neither the government nor the voters can observe how this sensitivity parameter varies over time; that is, when there is no access to free media or when the available media do not deliver any information about voters' attitudes and voting intentions. In the opposite case, the observable value of this sensitivity parameter can reshape politicians' incentives in election years and affect the size of distortions identified in the above model. To see this, let us assume that the re-election-to-competence sensitivity in period t, denoted now by φ_t, is given by

$$\varphi_t = \Omega_t(1 - \Sigma_t) + v_t \tag{A.16}$$

where v_t is an *i.i.d.* error term with mean equal to 0, Σ_t is the level of non-economic voting in period t, such that $0 \leq \Sigma_t < 1$, and Ω_t is the level of competitiveness in period t, such that $\Omega_t > 0$ and $E(\Omega_t) = \varphi$. Equation (A.16) suggests that the higher the weight voters assign to non-economic issues and the lower the level of competitiveness, the less sensitive is the probability of re-election to marginal changes in the incumbent's competence level. We further assume that the realizations of Σ_t and Ω_t are known to everyone (policymakers and voters) in period t (due to full access to free media that deliver such information via the publication of opinion polls) and that policy decisions in period t are made after observing Σ_t and Ω_t. Under these assumptions ϑ_t is now drawn from a continuous uniform distribution with mean 1 and density $\bar{\varphi}_t$ defined as

$$\bar{\varphi}_t = E(\varphi_t | \Sigma_t, \Omega_t) = \Omega_t(1 - \Sigma_t) \tag{A.17}$$

and hence the equilibrium seignorage in on-election periods is now given by

$$V'(s_{t+1}) = \lambda(1 + \vartheta_t) - 1 + \Omega_t(1 - \Sigma_t)\frac{1 + \vartheta_t}{\bar{\tau}y + s_{t+1}} \tag{A.18}$$

Notice that when we consider the special case in which the evaluation of government performance depends only on economic issues and the level of competitiveness is equal to its expected value (that is, when we impose the restrictions that $\Sigma_t = 0$ and $\Omega_t = \varphi$), the conditional expectation in (A.17) becomes equal to φ and the equilibrium seignorage in on-election years is the same as the one defined in (A.15). On the other hand, once we relax these restrictions, we can see from the last term on the right hand side of equation (A.18) that the seignorage distortion costs that politicians are willing to pay in equilibrium (and hence the incentives to manipulate fiscal policy), $V'(s_{t+1})$, are a negative function of the level of non-economic voting Σ_t and a positive function of the level of competitiveness Ω_t. As $V'(.) > 0$, this also implies that $\frac{\partial s_{t+1}}{\partial \Sigma_t} < 0$ and $\frac{\partial s_{t+1}}{\partial \Omega_t} > 0$. Intuitively, the larger the level of non-economic voting, the weaker are politicians' incentives to increase government expenditure in order to enhance their chance of re-election, as fewer voters can be influenced by an electoral expenditure boom. As a result, the equilibrium level of seignorage decreases in election years. On the other hand, a higher level of competitiveness has the opposite effect, as the electoral outcome becomes more sensitive to marginal changes in votes, which results in a higher level of equilibrium seignorage in election years. Notice also that, if the level of non-economic voting is close to 1 (that is, voters do not care about economic issues when casting their votes) or the level of competitiveness is close to 0 (that is, the government is certain of losing or winning the elections), the equilibrium levels of seignorage in on-election and off-election periods will be about the same, as the last term on the right hand side of (A.18) is close to zero. Therefore, the central result of Section A.1.2 is that PBCs are only identifiable in countries/years with sufficiently large levels of competitiveness and sufficiently low levels of non-economic voting.

A.2 Tables

Table A.2.1: Country Classification

No	Country	Year of entering the EU	Year of adopting the euro	Established democracy[a]	Plurality rule[b]	Presidential regime[c]
1	Austria	1995	1999	✓		
2	Belgium	1952	1999	✓		
3	Bulgaria	2007				
4	Cyprus	2004	2008	✓		✓
5	Czech Republic	2004			✓	
6	Denmark	1973		✓		
7	Estonia	2004				
8	Finland	1995	1999	✓		
9	France	1952	1999	✓	✓	
10	Germany	1952	1999	✓	✓	
11	Greece	1981	2001	✓	✓	
12	Hungary	2004			✓	
13	Ireland	1973	1999	✓		
14	Italy	1952	1999	✓	✓	
15	Latvia	2004				
16	Lithuania	2004			✓	✓
17	Luxembourg	1952	1999	✓		
18	Malta	2004	2008	✓		
19	Netherlands	1952	1999	✓		
20	Poland	2004				✓
21	Portugal	1986	1999	✓		
22	Romania	2007				
23	Slovakia	2004	2009			
24	Slovenia	2004	2007			
25	Spain	1986	1999	✓	✓	
26	Sweden	1995		✓		
27	United Kingdom	1973		✓	✓	

[a] Refers to a country which has been democratic for more than 20 years. [b] Refers to a country with a plurality rule in legislative elections (a country with either a strictly plurality or a mixed plurality-proportional system). [c] Refers to a country where the executive is not accountable to the legislature. Source: World Bank's Database of Political Institutions (Beck *et al.*, 2001).

Table A.2.2: Components and Subcomponents of Expenditure and Revenue

Total Expenditure	Current Expenditure	(1)	Final Consumption Expenditure
		(2)	Social Benefits other than Social Transfers in Kind
		(3)	Interest
		(4)	Subsidies
		(5)	Other Current Expenditure
	Capital Expenditure	(1)	Gross Fixed Capital Formation
		(2)	Other Capital Expenditure
Total Revenue	Current Revenue	(1)	Taxes
		(2)	Social Contributions Received
		(3)	Other Current Revenue
	Capital Revenue	(1)	Capital Transfers Received

The partition of expenditure and revenue into components and subcomponents is based on the European System of Accounts 1995 (ESA 95). Source: Statistical Annex to European Economy; European Commission.

Table A.2.3: VARIABLES AND DATA SOURCES

Abbreviation	Variable	Source
NL	General government net lending (+) or net borrowing (−) (total general government revenue minus total general government expenditure excluding interest payable) as a percentage of GDP at market prices.	SAEE
$TEXP$	Total general government expenditure as a percentage of GDP at market prices.	SAEE
$TREV$	Total general government revenue as a percentage of GDP at market prices.	SAEE
$CEXP$	Current general government expenditure as a percentage of GDP at market prices.	SAEE
$CREV$	Current general government revenue as a percentage of GDP at market prices.	SAEE
FCE	Final consumption expenditure of general government as a percentage of GDP at market prices. Includes the value of goods and services produced by the government itself (collective consumption) and purchases of goods and services produced by market producers that are supplied to households as social transfers (individual consumption).	SAEE
TAX	Total taxes of general government as a percentage of GDP at market prices. Includes current taxes on income and wealth (direct taxes) and taxes linked to imports and production (indirect taxes).	SAEE
$GROWTH$	Output growth. Defined as the annual percentage change of real GDP.	SAEE
$LnGDP$	Level of development. Constructed using the natural logarithm of real GDP per capita.	SAEE
$TRADESK$	Deviation of trade share from its trend value. Constructed using the difference between the natural logarithm of trade share and its country-specific trend (derived using the Hodrick-Prescott filter).	SAEE
$PROP1564$	Percentage of population between 15 and 64 years old in the total population.	IDB, WDI
$PROP65$	Percentage of population over the age of 65 in the total population.	IDB, WDI
$FRAC$	Fractionalization of government. Measured by the probability that two deputies picked at random among the government parties will be of different parties.	DPI
$EXECRLC$	Positioning of the government on a left-right scale. Measured by a dummy variable that equals -1 for left governments, 0 for centrist governments and +1 for right governments.	DPI
$LnGLOB$	The natural logarithm of the KOF index of globalization. The index has three dimensions: economic (described by actual flows and restrictions), social (described by, for example, international tourism and the number of internet hosts and users) and political (described by, for example, the number of foreign embassies and membership in international organizations).	Dreher (2006)
$LnCONS$	The natural logarithm of the POLCON index of political constraints. The index measures the number of veto points, their partisan alignment and the heterogeneity or homogeneity of the preferences within each branch.	Henisz (2000)
BET	Proxy for non-economic voting computed as the percentage of respondents who think that their financial situation will improve over the coming year, rescaled by subtracting the mean across all countries in the same year.	SEB
NEC	Proxy for non-economic voting computed as the proportion of responses to survey items associated with non-economic issues, rescaled by subtracting the mean across all countries in the same year.	SEB
VOT	Proxy for competitiveness calculated as the mean monthly difference in the polled vote share between the largest government party and the largest opposition party, plus the mean monthly change in this difference.	ARGM, RCPO
$DVOT$	Alternative proxy for competitiveness calculated as the value of VOT minus the actual vote share difference between the two parties in the previous executive election.	ARGM, RCPO

SAEE: Statistical Annex to European Economy, published in Spring 2009; **IDB**: US Census Bureau International Data Base; **WDI**: World Bank's World Development Indicators; **DPI**: World Bank's Database of Political Institutions; **SEB**: Standard Eurobarometer; **ARGM**: Angus Reid Global Monitor; **RCPO**: Market Research Centers & Polling Organizations

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