Online Appendix for "Different Paths to the Modern State in Europe: The Interaction between Warfare, Economic Structure and Political Regime"

Data Sources for Tax Revenues, Population, Real and Nominal Wages

The tax revenue figures are annual net monetary revenues to central treasuries excluding loans. In order to be able to compare the figures across polities, they are converted from domestic currencies to silver. For econometric analysis, the figures are averaged over decades. In calculating the averages, we did not interpolate the revenue figures for missing years.

Forming a comprehensive historical dataset of tax revenues poses a number of challenges. There were differences in fiscal systems and budgeting procedures across Europe, and each fiscal system underwent significant changes over the centuries. Consequently, the figures we provide should be considered estimates rather than exact figures. Below we list the source we used for each date. We hope to benefit from feedback from experts on individual polities regarding any misinterpretation of the sources, necessary adjustments and suggestions for new sources to improve and expand the dataset. As a precaution against the uneven quality of data across the polities, in the econometric analyses, we report separately the results for the subsamples with more reliable series.

Austrian Habsburgs: Sources for revenue series are Rauscher (2008) for 1550, Berenger (1995) for 1650-1699, Dickson (1995) for 1717-1778 and Mitchell (2003) for 1781-1800. To account for different domestic currency units we used the conversion rates 1 Florin=1 Gulden=60 Kreuzer and 1 Gulden=2 Kronen. To convert the revenues from domestic currency to silver we used silver value of Kreuzer between 1550-1753 from Allen (2001) and 1 Gulden =11.5 grams of silver between 1754-1800. The urban wages are for Vienna from Allen (2001). Population figures are for Austria-Hungary from McEvedy and Jones (1978)

Dutch Republic: For 1609-1794 we used revenue series from Fritschy (2009) subtracting the estimated loan receipts. For these years we converted the figures in Guilders to silver according to Allen (2001). Wages are for Amsterdam, from the same source. Population is from de Vries and van der Woude (1997).

England/ Great Britain: The revenue figures are total revenues of the English Crown for 1500-1749 from O'Brien (1995), central government revenue of Great Britain for 1750-1800 from Mitchell (2003). Population figures are for England and Wales from 1500 to 1707.The population of Scotland is added after 1707. Population estimates are from McEvedy and Jones (1978). Wages for London and the silver content of money is from Allen (2001).

France: The revenue figures are from Bean (1973) for 1500-1546, Hoffman (1986) for 1560-1779 and White (1989) for 1783 and 1788. The silver value of livre tournois and Franc and wages for Paris are from Allen (2001). Population series are from McEvedy and Jones (1978).

Ottoman Empire: Revenue series are taken from Genç and Özvar (2006). Silver content of the currency and daily wages for Istanbul are taken from Pamuk (2001) and Özmucur and Pamuk (2002).

Poland Lithuania: Polish-Lithuanian fiscal apparatus remained decentralized through the early modern era. The permanent revenues of *kwarta* purse were insufficient to cover military expenses, and the kings remained dependent on temporary and irregular grants by the nobility dominated *Sejm* (Filipczak-Kocur 1995). For these reasons the revenue figures are subject to greater variance and are less precise compared to other polities in our sample. The figures for 1500, 1510, 1530, 1563, 1569, 1730, 1765, 1775 and 1791 are state revenues from Stone (2001). The figures for 1788, 1789 and 1790 are state revenues from Lewitter (1976). The figures for 1576-1717 are the total of *kwarta* and *sejm* revenues from Filipczak-Kocur (1995). For 1649-1717 and 1576-1587 the figures are for Kingdom of Poland only. Silver content of Zloty is from Wójtowicz (2006). Wages are for Krakow in the 16th and for Warshaw in 17th and 18th centuries from Allen (2001). Population is from McEvedy and Jones (1978).

Portugal: The revenue figures are based on Valerio (2002) for 1506, 1518, 1588, 1607, 1619, 1716, 1763, Macedo (1998) for 1557, 1588, 1593, 1607, 1619, 1660, 1681, 1716, Costa (2009) for 1593, 1607, 1612, 1619, 1625, 1632, 1641, 1656, 1660 and 1680 and Cardosa and Lains (2010) for 1762-76 and 1797-99. For years with more than one source on revenues, we take theaverage. We drop the observations for 1580-1640 from the econometric analysis because in this period Portugal formed a union of kingdoms with Spain. Wage data and silver content for Real were provided by Jaime Reis based on "Prices,Wages and Rents in Portugal, 1500-1900" project financed by the Portuguese Foundation for Science and Technology. Population is based on McEvedy and Jones (1978)

Prussia: Revenue series are based on Kellenbenz (1980) for 1600, 1638, 1643, 1652, 1661 and Körner (1995) for 1688-1800. Population figures are based on McEvedy and Jones (1978). The estimates on the decline in population during the Thirty Years War (1618-1648) vary, and we use an average rate of 40% decline (Rabb 1962, Pfister and Fertig 2010). Because the tax revenue figures for this period are very low, higher or lower estimates for population decline do not have a major impact on the econometric results. Since wage series is not available for a

Prussian town we use Leipzig series from Allen (2001) as a substitute. Silver content of Thaler until 1800 is from Shaw (1895).

Russia: Sources for revenues are Anisimov (1982) for 1680, 1701 and 1724, Kahan (1985) for 1720-3 and 1763-96 and Troitskii (1966) for 1749, 1751 and 1758. Population is for Russian Empire from McEvedy and Jones (1978). The nominal wages and silver content of Ruble are based on data provided by Global Price and Income History Group. We use Moscow wages for 1650-1670 and 1700-1709 and Saint Petersburg wages for 1713-17, 1720-23, 1805 and 1807 respectively available at http://gpih.ucdavis.edu/files/Wages_Moscow_1613-1871.xls and http://gpih.ucdavis.edu/files/Russia_p_w_1590s-1871.xls. For the decades in-between, we interpolate. We use silver content of silver Ruble based on figures provided by Peter Lindert at http://gpih.ucdavis.edu/files/Russia_Ag_content_ruble_1535-1913.xls. Real wage series for Russia is not available.

Spain: The Spanish revenue figures are for Castilian Crown until 1716 and Spanish Crown thereafter. Sources are Thompson (1994) for 1504-1546, 1607-1645 and 1674, Mauro and Parker (1980) for 1515 and 1623, Drelichman and Voth (2007) for 1555-1596, Kamen (1980) for 1666, Kamen (1974) for 1703-1718, Ozanam (1978) for 1722-1750, Galebert (1995) for 1753-1788, Cuenca Esteban (1981) for 1789-1800. To account for different domestic currency units we used the rates 1 Ducat=11 Reales de Vellón =374 Mavaredis and 1 Peseta= 4 Reales de Vellón. Silver value of Maravedis for 1504-1800. The population figures are from Alvarez-Nogal and De La Escosura (2007). Wage series are for Valencia until 1729 and Madrid thereafter from Allen (2001).

Sweden: The revenue figures for 1722-1777 are the sum of proper and special revenues from Fregert and Gustafsson (2008). The figures are converted using the rates 1 Krona= 6 Daler Silvermynt and 1 Rigsdaler=25.6973gr.of silver. The Daler Silvermynt-Rigsdaler conversion rate is based on Edvinsson (2010), wage series on Söderberg (2010) and population on McEvedy and Jones (1978).

Republic of Venice: Revenue, population and wage data were provided by Luciano Pezzolo.

Formulas and Data Sources for the War Pressure Variable

The data on wars is based on Clodfelter (2002). We include all interstate wars where there is at least one European polity on each side, and exclude colonial conquests. The exception to the rule is Ottoman wars with Iran and Egypt that were relatively strong states in this period. We work with a definition of casualty that includes number of deaths in combat including those due

to disease as well as the numbers of captured and missing soldiers, but exclude civilian deaths. Clodfelter provides the most detailed historical source, but does not always distinguish between the subcategories of casualties, and we make adjustments to the extent the data permits. Population figures are mainly based on McEvedy and Jones (1978).

The notation for the calculation of the war pressure variable (*Warp*) is as follows. Polities are indexed by i,j,k ∈ C, wars are indexed by w∈ W, years are indexed by t∈ {1500,1501,..1799}. $Pop_{k,t}$ denotes population of polity k at year t (in millions). $Cas_{w,t}$ denotes the annual casualty for war w in year t (in thousands). $I_{k,w,t}$ is an indicator variable that takes value 1 if polity k participates in war w in year t and 0 otherwise. For each war w polity k participates in year t, we denote the set of k's allies with $A_{k,w,t} \subset C$ and the set of k's adversaries with $B_{k,w,t} \subset C$. $Warp_{k,w,t}$ denotes per capita war pressure for polity k in year t due to war w and $Warp_{k,t}$, our proxy, is the total per capita war pressure for polity k in year t.

The war pressure for polity k engaged in war w as part of coalition A in year t is calculated by dividing the annual casualty figures first by two and then by A's population:

$$Warp_{k\in A_{k,w,t},w,t} = \frac{Cas_{w,t}}{2\sum_{i\in A_{k,w,t}} Pop_{i,t}}$$

Finally, per capita war pressure for polity k at year t, $Warp_{k,t}$, is calculated by adding up the war pressures due to different wars k engaged in year t:

$$Warp_{k,t} = \sum_{w\in W} Warp_{k,w,t} * I_{k,w,t}$$

Estimation Results for Dynamic Regressions with Lagged Dependent Variable

In the OLS with panel corrected standard errors models discussed in the text, the persistence of fiscal capacity from one decade to the next is accounted by a serial correlation in the error term. An alternative approach to modeling persistence would be to include the lagged value of the dependent variable in the regression. There are two main econometric models for doing so. The first of these is Ordinary Least Squares (OLS) with lagged dependent variable, two-way fixed effects and panel corrected standard errors. Without the interaction terms, the regression equation is:

$$Taxrev_{it} = Taxrev_{i(t-1)} + \alpha_i + \beta_t + X'_{it}\gamma + \theta_1 Warp_{it} + \theta_2 Urb_{it} + \theta_3 Repr_{it} + \varepsilon_{it}$$

where $Taxrev_{i(t-1)}$ is the per capita tax revenue in t-1 and ε_{it} is the disturbance term that exhibits heteroskedasticity. The second model is Arellano Bond difference GMM with

orthogonal deviations and lagged dependent variable. Since most countries in our sample have a large number of periods, Arellano Bond estimation is considered less appropriate here, but we also report the results for it.[1]

Table 9 presents findings for the first stage of the analysis, without any interaction terms. The results are generally consistent with the results in the main text. Specifications 1-8 are dynamic OLS estimation results for different proxies for regime type, with or without the control variables, and for different subsamples. Specifications 9-10 are Arellano Bond estimation results for the full sample. In all 10 specifications war pressure is significant at 5% or lower significance levels. The coefficient for urbanization is positive in all specifications, but is insignificant at 10% confidence level in specifications 2, 4, 6-8. It should be noted, however, the inclusion of a lagged dependent variable generally leads to lower levels of significance for variables that are persistent over time. Finally, the two proxies for representation are insignificant at the 10% level across the specifications.

Table 10 reports the results for the second stage of the analysis, which includes the interaction term between war and regime. Specifications 1-8 are OLS with PCSE, 9-10 by Arellano Bond dynamic estimation. The results are consistent across the specifications in that the interaction term is insignificant at 10% level.

Finally, Table 11 is the results for the dynamic specifications for the full set of two-way and three-way interactions. Consistent with the main text, in all specifications, θ_7 is positive and significant at 5% level.

[1] When fixed effects and lagged dependent variable are both included in the OLS regression, lagged dependent variable is correlated with the error term, and this creates a downward bias in the coefficient (Nickell 1981). However, as number of periods increase, dynamic panel bias gets smaller and OLS is more efficient than IV estimation. Arellano Bond is unbiased, and also permits IV estimation for the lagged dependent variable and other regressors employing their lagged values as instruments. As the number of periods increases, however, the proliferation of the number of instruments undermines the statistical power of Sargan test for their validity. To limit the extent of this problem, unless otherwise stated, we restrict the choice of instruments to a single lag. See Beck and Katz (2009), Roodman (2009), and Wawro (2002).

TABLE 9: Dynamic Regressions with Lagged Dependent Variable

DETERMINANTS OF PER CAPITA TAX REVENUE (IN DAYS OF WAGES)

	OLS with PCSE								Arellano Bond Dynamic Estimator	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L.Taxrev	0.564****	0.535****	0.555****	0.533****	0.531****	0.508****	0.545****	0.546****	0.435****	0.443****
	(0.07)	(0.08)	(0.08)	(0.09)	(0.08)	(0.10)	(0.09)	(0.09)	(0.07)	(0.10)
Warp	2.870***	3.239***	2.605***	2.989***	2.980**	3.376**	2.715***	2.932***	3.281***	3.470***
	(0.89)	(1.01)	(0.91)	(1.02)	(1.16)	(1.34)	(0.99)	(1.03)	(1.06)	(1.19)
Urb	15.267***	10.85	13.104**	9.45	15.697*	9.23	11.82	11.18	19.684****	13.650*
	(5.55)	(7.91)	(6.12)	(8.21)	(8.40)	(10.21)	(7.35)	(8.94)	(5.64)	(7.21)
Repr	-0.08	0.37	-0.14	-0.04	0.10	1.06	0.02	-0.32	-0.15	0.36
	(0.72)	(1.21)	(0.77)	(1.32)	(1.11)	(2.49)	(0.84)	(1.36)	(0.88)	(0.71)
Observations	169	140	164	135	133	108	135	125	157	130
R2	0.95	0.94	0.95	0.94	0.95	0.93	0.94	0.95		
ar1									-1.91	-1.79
ar1p									0.06	0.07
ar2									0.40	0.57
ar2p									0.69	0.57
Regime proxy	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract
Control Variables			L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop
Dropped from Sample		Poland, Austria	Russia	Poland, Austria, Russia	Russia, 16th century	Poland, Austria, Russia, 16th century	Russia, Poland, Portugal, Sweden	Poland, Austria, Russia, Portugal, Sweden		Poland, Austria

Standard errors in paranthesis

Levels of statistical significance:* 0.1 ** 0.05 *** 0.01 **** 0.001

(1)- (8) estimated using Stata xtpcse procedure, with two-way fixed effects and hetonly options

(9)-(10) estimated using stata xtabond2 procedure with decade fixed effects and noleveleq, orthogonal, robust options

TABLE 10: Dynamic Regressions with Lagged Dependent Variable and Representation-War Pressure Interaction

DETERMINANTS OF PER CAPITA TAX REVENUE (IN DAYS OF WAGES)

	OLS with PCSE								Arellano Bond Dynamic Estimator	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L.Taxrev	0.560****	0.523****	0.554****	0.527****	0.531****	0.501****	0.544****	0.539****	0.449****	0.463****
	(0.07)	(0.08)	(0.08)	(0.09)	(0.08)	(0.10)	(0.09)	(0.09)	(0.08)	(0.09)
Warp	3.45	4.154*	3.22	4.239*	3.55	4.745*	3.43	4.425*	4.222**	4.572***
	(2.21)	(2.13)	(2.30)	(2.25)	(2.42)	(2.48)	(2.41)	(2.27)	(1.78)	(1.69)
Urb	15.935***	12.30	13.724**	11.31	16.521*	11.69	12.701*	13.84	20.094***	14.443*
	(5.62)	(8.02)	(6.22)	(8.37)	(8.55)	(10.35)	(7.47)	(9.27)	(6.11)	(7.38)
Repr	0.03	0.60	-0.06	0.08	0.19	1.15	0.11	-0.22	0.06	0.65
	(0.80)	(1.25)	(0.82)	(1.32)	(1.16)	(2.47)	(0.87)	(1.36)	(0.70)	(0.68)
Warp*Repr	-0.79	-1.42	-0.81	-1.89	-0.84	-2.23	-0.99	-2.27	-1.37	-1.85
	(2.30)	(2.36)	(2.39)	(2.54)	(2.56)	(2.79)	(2.59)	(2.60)	(1.77)	(1.87)
Observations	169	140	164	135	133	108	135	125	157	130
R2	0.95	0.94	0.95	0.94	0.95	0.93	0.94	0.95		
ar1									-1.91	-1.86
ar1p									0.06	0.06
ar2									0.36	0.54
ar2p									0.72	0.59
Regime proxy	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract
Control Variables			L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop
Dropped from Sample		Poland, Austria	Russia	Poland, Austria, Russia	Russia, 16th century	Poland, Austria, Russia, 16th century	Russia, Poland, Portugal, Sweden	Poland, Austria, Russia, Portugal, Sweden		Poland, Austria

Standard errors in paranthesis

Levels of statistical significance:* 0.1 ** 0.05 *** 0.01 **** 0.001

(1)- (8) estimated using Stata xtpcse procedure, with two-way fixed effects and hetonly options

(9)-(10) estimated using stata xtabond2 procedure with decade fixed effects and noleveleq, orthogonal, robust options

TABLE 11: Dynamic Regressions with Lagged Dependent Variable and 2 and 3-way Interactions

DETERMINANTS OF PER CAPITA TAX REVENUE (IN DAYS OF WAGES)

	OLS with PCSE								Arellano Bond Dynamic Estimator	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L.Taxrev	0.548****	0.501****	0.556****	0.517****	0.525****	0.474****	0.528****	0.528****	0.483****	0.432***
	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.09)	(0.14)
Warp	18.007***	15.450***	19.234***	17.130***	20.411***	19.434***	21.982****	20.665***	19.110****	16.389****
	(5.76)	(5.73)	(6.24)	(6.40)	(6.52)	(6.97)	(6.68)	(6.75)	(3.58)	(3.59)
Urb	31.09	6.23	35.060*	7.91	6.56	17.60	22.62	28.75	36.383*	10.00
	(20.29)	(14.44)	(20.39)	(14.91)	(28.26)	(18.92)	(21.37)	(22.63)	(19.42)	(9.63)
Repr	1.23	1.11	1.44	0.82	-0.54	4.60	0.89	2.15	1.38	1.41
	(1.69)	(2.10)	(1.68)	(2.12)	(2.45)	(3.24)	(1.70)	(2.40)	(1.54)	(1.23)
Warp*Repr	-17.168***	-18.047**	-18.483***	-19.999**	-19.979***	-27.026***	-21.081***	-22.512***	-17.894****	-19.385***
	(6.01)	(7.22)	(6.45)	(7.80)	(6.78)	(8.53)	(7.03)	(7.93)	(4.40)	(6.11)
Warp*Urb	-222.912***	-152.887**	-239.041***	-169.915**	-243.044***	-205.861**	-270.092****	-224.109***	-233.535****	-159.710***
	(69.07)	(66.76)	(73.87)	(72.80)	(77.35)	(79.98)	(79.88)	(78.21)	(58.18)	(53.16)
Repr*Urb	-17.80	4.64	-22.85	2.60	10.85	-11.70	-11.00	-18.44	-20.28	2.71
	(18.49)	(15.64)	(18.62)	(16.05)	(27.87)	(20.71)	(19.18)	(22.50)	(18.29)	(10.72)
Warp* Repr*Urb	234.104****	180.377**	249.382****	197.144***	257.060***	257.170***	279.761****	245.808***	243.059****	189.315***
	(69.93)	(70.10)	(74.52)	(75.85)	(78.17)	(83.30)	(80.85)	(79.87)	(62.48)	(62.80)
Observations	169	140	164	135	133	108	135	125	157	130
R2	0.95	0.95	0.95	0.95	0.95	0.94	0.95	0.95		
ar1									-1.99	-1.78
ar1p									0.05	0.08
ar2									0.65	0.77
ar2p									0.52	0.44
Regime proxy	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract	Reprtax	Repract
Control Variables			L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop	L.Rwage, L.lnPop
Dropped from Sample		Poland, Austria	Russia	Poland, Austria, Russia	Russia, 16th century	Poland, Austria, Russia, 16th century	Russia, Poland, Portugal, Sweden	Poland, Austria, Russia, Portugal, Sweden		Poland, Austria

Standard errors in paranthesis

Levels of statistical significance:* 0.1 ** 0.05 *** 0.01 **** 0.001

(1)- (8) estimated using Stata xtpcse procedure, with two-way fixed effects and hetonly options

(9)-(10) estimated using stata xtabond2 procedure with decade fixed effects and noleveleq, orthogonal, robust options

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