Dynamic Tax Externalities and the U.S. Fiscal Transformation[☆] Online Appendix

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Appendix A. Probabilistic Voting

The microfoundations for the political part of the model are due to Lindbeck and Weibull (1987) and Persson and Tabellini (2000). There are two groups of voters, retirees whose size is normalized to one, and workers of size ν_t. Both at the federal level and in each region, two political candidates compete for office in each period. Elections take place simultaneously. Since the candidates (and the voters) lack commitment, the competing policy platforms comprise a single policy instrument, namely the contemporaneous (federal or regional) tax rate. Which candidate a voter supports depends both on the candidate's policy platform and on the relative "ideological" attachment of the voter to the candidate.

Consider a specific (federal or regional) election and denote the generic candidates by A and B. Voter i supports candidate A if the voter's indirect utility in the competitive equilibrium implemented by A's policy platform and the continuation policies induced by the policy functions of future decision makers, under rational expectations, exceeds the indirect utility when B's policy platform is implemented, by more than a threshold value. This threshold

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value, which reflects the ideological attachment mentioned before, is a random variable with two i.i.d. components: A voter specific component, ξ^i, and an aggregate component, ξ.

The voter specific component is drawn from a symmetric, group-specific (worker or retiree), uniform distribution with density ϕ^ℓ, $\xi^i \sim U[-1/(2\phi^\ell), 1/(2\phi^\ell)], \ell \in w, r$. A positive ξ^i reflects a permanent ideological bias of voter i in favor of candidate B. On average, neither group is biased towards A or B. The aggregate component is drawn from a symmetric, uniform distribution with density φ, $\xi \sim U[-1/(2\varphi), 1/(2\varphi)]$. This component represents an aggregate shock to ideological attachment which is realized after the candidates have proposed their policy platforms. The sum of the two components represents the total ideological bias of voter i in favor of candidate B in the current election.

Let $U^\ell(\pi)$ denote the indirect utility function of any voter i in group $\ell \in w, r$ when the policy platform of candidate $\pi \in A, B$ is implemented. Voter i supports candidate A iff

$$U^\ell(A) \geq U^\ell(B) + \xi + \xi^i.$$

Let $\Delta^\ell \equiv U^\ell(A) - U^\ell(B)$. Conditional on ξ, the probability that i votes in favor of candidate A equals

$$\text{prob}_{\xi^i}(\xi^i \leq \Delta^\ell - \xi) = \frac{1}{2} + \phi^\ell \times (\Delta^\ell - \xi).$$

Conditional on ξ, candidate A's vote share therefore equals

$$\frac{1}{2} + \frac{\phi^r \times (\Delta^r - \xi) + \nu_t \phi^w \times (\Delta^w - \xi)}{1 + \nu_t},$$

and the unconditional probability that candidate A's vote share exceeds one half is given by

$$\begin{aligned} \text{prob}_\xi \left(\frac{\phi^r \times (\Delta^r - \xi) + \nu_t \phi^w \times (\Delta^w - \xi)}{1 + \nu_t} \geq 0 \right) &= \text{prob}_\xi \left(\frac{\phi^r \Delta^r + \nu_t \phi^w \Delta^w}{\phi^r + \nu_t \phi^w} \geq \xi \right) \\ &= \frac{1}{2} + \varphi \frac{\phi^r \Delta^r + \nu_t \phi^w \Delta^w}{\phi^r + \nu_t \phi^w}. \end{aligned}$$

The probability that candidate B wins equals one minus the former probability.

The probability that candidate A gains the majority is a smooth function of $\phi^r \Delta^r + \nu_t \phi^w \Delta^w$, and conditional on B's platform, candidate A's optimal choice of platform is the one that maximizes this expression. Similarly, candidate B's optimal platform choice minimizes

the expression, conditional on A's platform. Since the two candidates face parallel problems, with opposite signs, the equilibrium platforms of both candidates coincide and maximize the weighted sum of indirect utilities,

$$\phi^r U^r + \nu_t \phi^w U^w.$$

The relative per-capita weight of the old that we use in the text, ω, corresponds to ϕ^r/ϕ^w. It represents the variability of ideological attachment among the young relative to the variability among the old. More within-group variability of ideological attachment reduces voters' responsiveness to changes in the policy platform and therefore also reduces the weight the equilibrium platform attaches to the policy preferences of the group.

Appendix B. Proof of Proposition 1

The first-order conditions for τ_t^j and τ_t (conditions (9) and (10) in the paper), respectively, are given by

$$\left(\frac{\omega}{\nu_t}+1\right)\frac{\gamma_t}{\tau_t^j+\tau_t}-\frac{1+\beta}{1-\tau_t-\tau_t^j}\leq 0,$$
$$\left(\frac{\omega}{\nu_t}+1\right)\frac{\gamma_t}{\tau_t^j+\tau_t}-\frac{1+\beta}{1-\tau_t-\tau_t^j}+\mathcal{F}_t\leq 0.$$

Since at least one of the tax rates τ_t^j and τ_t must be strictly positive in equilibrium (otherwise $g_t^j=0$), at least one of the two first-order conditions must hold with equality. But $\mathcal{F}_t\neq 0$ implies that at most one first-order condition can hold with equality and thus, that either τ_t or τ_t^j equals zero. If $\mathcal{F}_t>0$ then the first-order condition with respect to τ_t holds with equality, that is τ_t is interior and $\tau_t^j=0$. If $\mathcal{F}_t<0$, in contrast, the first-order condition with respect to τ_t^j holds with equality, that is τ_t^j is interior and $\tau_t=0$.

In either case, the equilibrium tax rate is orthogonal to the endogenous state variables since the latter do not appear in the first-order (or complementary slackness) conditions. The conjecture that the policy functions are orthogonal to the endogenous state variables, thus is verified.

The equilibrium with policy functions that are orthogonal to the endogenous state variables is the unique symmetric Markov perfect equilibrium that can arise in the limit of the

finite-horizon economy (see the discussion after definition 2 in the paper). This follows from a simple backward induction argument: In the last period, policy makers only internalize the direct effect of their policy choice as effects on future state variables are ruled out. As a consequence, there exists a unique equilibrium choice of tax rates, corresponding to the Nash equilibrium of the static game played by the federal and regional decision makers. This unique equilibrium choice of tax rates is orthogonal to the endogenous state in the last period. Anticipating the unique equilibrium choice of tax rates in the last period, and anticipating that this choice is orthogonal to the endogenous state variables, the policy makers in the last period but one choose the equilibrium policy characterized in proposition 1. The logic extends to earlier periods (see Gonzalez-Eiras and Niepelt, 2008).

With an infinite horizon the model might feature other equilibria as well; our limit-of-the-finite-horizon selection criterion is standard.

Appendix C. Robustness

Appendix C.1. Endogenous Labor Supply

In deriving proposition 1 we have assumed that labor is supplied inelastically. This assumption is not important for the results. To see this, suppose that households value leisure in addition to consumption and government services such that household preferences are given by

$$\ln(c^i_{1,t}) + v(l^i_t) + \gamma_t \ln(g^i_t) + \beta \left(\ln(c^i_{2,t+1}) + \gamma_{t+1} \ln(g^i_{t+1}) \right),$$

where l^i_t and $v(\cdot)$ denote leisure and a smooth utility function, respectively.[1] The budget constraint of a worker now reads

$$c^i_{1,t} = w_t(1 - l^i_t)(1 - \tau_t - \tau^i_t) - s^i_t.$$

It is easy to check that in this more general model labor supply does not respond to contemporaneous taxes, and proposition 1 therefore applies without changes.

[1] We assume that $v(\cdot)$ is continuously differentiable, strictly increasing, concave and satisfies $\lim_{l \downarrow 0} v'(l) = \infty$.

Maybe more interestingly, one may wonder whether in an environment with endogenous labor supply voters would employ additional distorting policy instruments to manipulate prices for their benefit. We consider an environment where voters at the federal and regional level may impose additional taxes whose proceeds are fully refunded to workers. These taxes therefore only serve to distort labor supply (which they do because the proceeds are refunded). At the regional level, voters do not benefit from creating such distortions. But at the federal level, where general equilibrium effects are internalized, the tax might be perceived to be valuable.

Introduction of these new instruments does not change the first-order condition for τ_t, but adds a distortion term, $-\mathcal{X}_t \leq 0$ say, to the first-order condition for τ_t^j. The results of proposition 1 thus continue to hold subject to replacing $\mathcal{F}_t$ by $\mathcal{F}_t + \mathcal{X}_t$: Taxation at the federal level constitutes an equilibrium outcome as long as $\mathcal{F}_t + \mathcal{X}_t > 0$. Intuitively, under the equilibrium choice of the new tax instrument at the federal level, the net benefit in general equilibrium from distorting labor supply equals zero. The choice of τ_t thus reflects the same considerations as in the model without elastic labor supply.

We introduce additional taxes on labor income, levied at rates $\eta_t \geq 0$ and $\eta_t^i \geq 0$ by the federal and regional governments respectively, whose proceeds are reimbursed to workers.[2] The program of a worker in region i is given by

$$\begin{aligned} \max \quad & \ln(c_{1,t}) + v(l_t) + \gamma_t \ln(g_t^i) + \beta \left(\ln(c_{2,t+1}) + \gamma_{t+1} \ln(g_{t+1}^i) \right) \\ \text{s.t.} \quad & c_{1,t} = w_t(1-l_t)(1-\tau_t - \tau_t^i - \eta_t - \eta_t^i) + T_t^i - s_t, \quad c_{2,t+1} = s_t R_{t+1}, \end{aligned}$$

where T_t^i denotes the lump sum transfer to workers. In equilibrium, $\tau_t^i = \tau_t^j$ and $\eta_t^i = \eta_t^j$. Moreover, since preferences for consumption and leisure do not vary across regions, labor supply is constant across regions and $T_t^j = (\eta_t + \eta_t^j) w_t (1 - l_t)$. Workers' optimal savings and labor supply choices therefore imply

$$\frac{(1-\tau_t - \tau_t^j - \eta_t - \eta_t^j)(1+\beta)}{(1-\tau_t - \tau_t^j)(1-l_t)} = v'(l_t).$$

[2]For a related analysis in another context, see Gonzalez-Eiras and Niepelt (2008).

Thus, as long as $\eta_t + \eta_t^j > 0$, taxation distorts labor supply.

In addition to the terms present in the baseline model, the objective functions of regional and federal voters now also account for the effect of leisure on utility. Moreover, the objective function of voters at the federal level also accounts for the general equilibrium implications of endogenous labor supply for contemporaneous and future interest rates and wages (the latter mediated through changes in capital accumulation). The objective functions of regional and federal voters, $\mathcal{V}_t^i$ and $\mathcal{V}_t$ respectively, are

$$\begin{aligned}
&\mathcal{V}_t^i = V_t^i + v(l_t) + (1+\beta)\ln(1-l_t), \\
&\mathcal{V}_t = V_t + g(l_t) \equiv V_t + v(l_t) + \ln(1-l_t)\left[(1-\alpha)\left(1+\alpha\beta+\frac{\omega}{\nu_t}+\left(\frac{\omega}{\nu_t}+1\right)\gamma_t+\alpha\beta\gamma_{t+1}\right)\right],
\end{aligned}$$

where V_t^i and V_t, the objective functions with exogenous labor supply, are defined in the main text.

Because η_t^j is distorting and regional governments do not perceive general equilibrium effects, in equilibrium $\eta_t^j = 0$.[3]

At the federal level, the first-order condition with respect to η_t is given by

$$\frac{dg(l_t)}{dl_t}\frac{\partial l_t}{\partial \eta_t} \leq 0.$$

If the equilibrium choice of η_t is interior, then $\partial l_t/\partial \eta_t > 0$; this implies that $dg(l_t)/dl_t = 0$. Alternatively, if the equilibrium η_t is in a corner such that $\eta_t + \eta_t^j = 0$, then labor supply is unaffected by η_t (as well as by τ_t and τ_t^j).

Turning to the equilibrium choice of taxes that fund public services, we have

$$\begin{aligned}
&\frac{\partial \mathcal{V}_t^i}{\partial \tau_t^i} - \frac{\partial V_t^i}{\partial \tau_t^i} = \left(v'(l_t) - \frac{1+\beta}{1-l_t}\right)\frac{\partial l_t}{\partial \tau_t^i} \equiv -\mathcal{X}_t \leq 0 \quad \forall i, \\
&\frac{\partial \mathcal{V}_t}{\partial \tau_t} - \frac{\partial V_t}{\partial \tau_t} = 0.
\end{aligned}$$

The equality in the second line holds because, as shown above, either $dg(l_t)/dl_t = 0$ or $\partial l_t/\partial \tau_t = 0$ when η_t is chosen optimally. Intuitively, the equilibrium choice of η_t "absorbs"

[3]The derivative of the regional objective function with respect to η_t^j yields $-\frac{1+\beta}{1-l_t} + v'(l_t)$ which is negative if $\eta_t + \eta_t^j > 0$.

all political cost-benefit considerations that relate to the distortion of labor supply, and the choice of τ_t therefore reflects the same considerations as in the model without elastic labor supply.

In conclusion, whether taxes to fund public services are raised at the regional or federal level depends on the strength of the general equilibrium effects on capital accumulation, $\mathcal{F}_t$, and the deadweight losses of taxation perceived by regional governments, $\mathcal{X}_t$.

Appendix C.2. Labor Mobility

As another extension, consider a model where young households supply labor inelastically, but are mobile across regions. After voting, but before taking up work and being taxed, they may move at a utility cost. In a symmetric equilibrium, regional voters then still do not perceive general equilibrium price effects of their tax choices. But they do account for the fact that a marginal tax increase fosters emigration and reduces the tax base, driving up taxes for the remaining population in the region. Denoting by $\mathcal{Y}_t$ the welfare cost of such emigration, results similar to those of proposition 1 follow, with taxation at the federal level an equilibrium outcome as long as $\mathcal{F}_t + \mathcal{Y}_t > 0$.

Appendix C.3. Government Debt and Social Security

In our setup, voters at the federal level only internalize the general equilibrium effects that affect themselves; they disregard the income losses of future workers that go hand in hand with their own gains due to higher interest rates. One may therefore suspect that the availability of instruments for intergenerational redistribution—government debt or pay-as-you-go financed social security—could undermine the main result.

To see that this is not the case, suppose that the federal government also levies a social security tax at rate η_t whose proceeds are distributed among retirees.[4] The first-order

[4]Our setup satisfies the conditions for politico-economic equivalence (Gonzalez-Eiras and Niepelt, 2015, condition 4). This implies that absent commitment, the politico-economic equilibrium allocation in an environment with public debt and another one with pay-as-you-go financed social security are identical. We leave an extension with public debt issued by *both* levels of government for further work.

conditions that characterize public services provision, conditions (9) and (10), then are unchanged except that the tax wedge now includes the new tax rate. This might affect the magnitude of the general equilibrium term, $\mathcal{F}_t$, but not its sign.[5] The main message of proposition 1 therefore is robust: The level of government that collects taxes to fund public services is determined by the sign of $\mathcal{F}_t$.

Appendix C.4. Longer-Lived Households

In the baseline model, voters at the federal level fully account for the general equilibrium effect on interest rates while they internalize the general equilibrium effect on wages only partly, to the extent that it affects the public service provision in the subsequent period. This asymmetry is a consequence of the assumption that agents live for just two periods; if households lived, and supplied labor for more than two periods then some of the voters would also internalize the effect of contemporaneous taxes on their own subsequent wage income.

This feature is irrelevant for the results summarized in proposition 1, though, since these results hold independently of the weight attached to the effect on future wages. In the baseline model, the weight reflects the preference for public services. But nothing substantive would change if the weight also reflected future labor income. Note also that some asymmetry of the type described above would remain in place even if agents lived for many periods. This is because independently of agents' life span, current voters always fully internalize the effects of policy on future capital income while they only partly internalize the effects on future labor income which also benefits some workers who are yet unborn when policy is chosen.

[5]The additional first-order condition determining the level of social security tax rate, η_t, is given by

$$\frac{\omega}{\nu_t}\frac{1}{\frac{\alpha}{1-\alpha}+\eta_t}-\frac{1+\beta}{1-\tau_t-\tau_t^j-\eta_t}+\mathcal{F}_t=0.$$

With intergenerational redistribution, the taxes levied to fund public services thus fall. Similarly, social security taxes are lower than in a model without public services.

Appendix D. Proof of Proposition 2

The first-order conditions for τ_t^j and τ_t (conditions (12) and (13) in the paper), respectively, are given by

$$\left(\frac{\omega}{\nu_t}+1\right)\frac{\gamma_t^j\delta}{\tau_t^j+\sigma x_t}-\frac{1+\beta}{1-\tau_t-\tau_t^j}\leq 0,\ j=1,2,$$
$$\sum_{j=1}^{2}\theta_t^j\left\{\left(\frac{\omega}{\nu_t}+1\right)\frac{\gamma_t^j(1-\delta)}{\tau_t-x_t}-\frac{1+\beta}{1-\tau_t-\tau_t^j}\right\}+\mathcal{E}_t+\mathcal{F}_t\leq 0.$$

(i) Given that public services are a Cobb-Douglas aggregate of federal and regional spending, federal spending is necessary for $g_t^i>0$. Given that grants are non-negative the federal tax rate must be positive. Formally, the marginal benefit of federal taxes is proportional to $(1-\delta)/(\tau_t-x_t)$; since $\delta\in(0,1)$, the tax rate τ_t cannot equal zero since otherwise the marginal benefit would diverge. In contrast, the regional tax rates need not be positive unless grants equal zero.

(ii) Define $\Omega_t\equiv(\omega/\nu_t+1)$, $\Phi_t(\gamma_t)\equiv 1+\beta+\delta\Omega_t\gamma_t$, and $\Lambda_t\equiv(\epsilon_{Rk}+\epsilon_{wk}(1+\lambda)\bar{\gamma}_{t+1})$. Suppose that all regional tax rates are interior such that (from the first-order condition)

$$\tau_t^j=\frac{(1-\tau_t)\delta\gamma_t^j\Omega_t-(1+\beta)\sigma x_t}{\Phi_t(\gamma_t^j)}.$$

This implies $(1-\tau_t-\bar{\tau}_t)=(1+\beta)(1-\tau_t+\sigma x_t)\sum_j\theta_t^j/\Phi_t(\gamma_t^j)$ and $\sum_j\theta_t^j/(1-\tau_t-\tau_t^j)=\Phi_t(\bar{\gamma}_t)/[(1+\beta)(1-\tau_t+\sigma x_t)]$.

With an interior federal tax rate the corresponding first-order condition holds with equality. Substituting the expressions above into this first-order condition yields

$$\frac{\Omega_t(1-\delta)(1+\lambda)\bar{\gamma}_t}{\tau_t-x_t}=\frac{\Phi_t(\bar{\gamma}_t)+\frac{\beta}{1+\beta}\Lambda_t\left(\sum_j\frac{\theta_t^j}{\Phi_t(\gamma_t^j)}\right)^{-1}}{1-\tau_t+\sigma x_t}.$$

Similarly, substituting the expressions above into the equilibrium condition for grants yields

$$\frac{\sigma}{\Omega_t}\frac{\Phi_t(\bar{\gamma}_t)+\lambda\bar{\gamma}_t\sum_j\frac{\theta_t^j\Phi_t(\gamma_t^j)}{\gamma_t^j}}{1-\tau_t+\sigma x_t}\leq\frac{(1+\lambda)(1-\delta)\bar{\gamma}_t}{\tau_t-x_t}.$$

Combining the last two relations, we conclude that interior tax rates at the federal level and in all regions constitute an equilibrium if the following parametric inequality condition is

satisfied:

$$\Phi_t(\bar{\gamma}_t) + \frac{\beta}{1+\beta}\Lambda_t \left(\sum_j \frac{\theta_t^j}{\Phi_t(\gamma_t^j)} \right)^{-1} \geq \sigma \left(\Phi_t(\bar{\gamma}_t) + \lambda \bar{\gamma}_t \sum_j \frac{\theta_t^j \Phi_t(\gamma_t^j)}{\gamma_t^j} \right). \tag{D.1}$$

In the non-generic case when the condition holds with equality positive tax rates constitute an equilibrium and grants are indeterminate. If the condition holds strictly then the marginal benefit of grants is negative; tax rates are positive in all regions in this case and grants equal zero.

(iii) If the parametric condition does not hold it must be the case that at least in one type of region the tax rate is zero. This implies that grants are positive, since otherwise the marginal benefit of regional taxation in that type of region would diverge. Since the marginal benefit of regional taxation is increasing in the preference for public services, γ_t^j, grants crowd out taxes in regions with the lowest valuations.

(iv) Dividing the first-order condition for grants, equation (14), by $\bar{\gamma}_t$ yields

$$\sigma\delta \sum_{j=1}^{2} \frac{\theta_t^j (\frac{\gamma_t^j}{\bar{\gamma}_t} + \lambda)}{\tau_t^j + \sigma x_t} - \frac{(1-\delta)(1+\lambda)}{\tau_t - x_t} \leq 0.$$

This establishes that the dispersion of preferences for public services (but not their average value) and the strength of static externalities (λ) directly affect x_t.[6] Increased preference heterogeneity (holding $\bar{\gamma}_t$ constant) reduces the left-hand side and increases the right-hand side of condition (D.1) since it increases the geometric average of $1/\gamma_t^j$. It therefore reduces the set of parameter values for which condition (D.1) holds, rendering grants more likely, and increasing them when they are positive. From the first-order condition for grants and the implicit function theorem, $\partial x_t / \partial \lambda \geq 0$.

Since the first order conditions do not depend on $\vec{s}_{t-1}$ we have verified the conjecture that the policy functions are orthogonal to the endogenous state variables. A similar argument as in the proof of proposition 1 establishes that the equilibrium characterized in proposition 2 is the unique symmetric Markov perfect equilibrium that arises in the limit of the finite-horizon economy.

[6] Average preferences affect x_t indirectly, through their effect on taxes. See the discussion in the paper.

Appendix E. Preferences for Public Services in Rural and Urban Regions

We provide two pieces of evidence that rural and urban voters in the United States differently value public services. On the one hand, observed patterns of political support differ by urbanization. For example, Frank (2004) argues that low-income Americans living in rural areas vote strongly Republican even though the Republican party's economic platform cuts against their economic interests. We interpret this behavior as reflecting a lower preference for government spending in rural areas.[7] On the other hand, different valuations also seem to be borne out by survey evidence. Data on attitudes towards public spending collected in the General Social Survey in the years 1985, 1990, 1996, and 2006 indicates that respondents in rural areas favored government spending cuts more strongly than respondents in urban areas, see table E.1.[8] The hypothesis that responses are on average the same across regions is rejected with a p-value of 0.013.[9]

There is also indirect evidence for the connection between time varying preference heterogeneity (reflected in urbanization) and the rise of grants. This evidence blends the model with data on state level spending. Recall that the model predicts regions with a weaker preference for public services to choose a higher ratio of grants relative to regional tax revenue. If urbanization is positively correlated with the valuation of public services, as we argue, it should be negatively correlated with that ratio. This prediction is borne out in state level data over the period 1969 to 2008: A panel regression of the ratio of federal grants and direct general revenue of state and local governments on urbanization (and controls including state income per capita) yields the expected negative sign, see table E.2.[10]

Note that the General Social Survey data on attitudes towards public spending suggests that the support for government spending developed roughly in parallel in rural and urban regions. (Between 1985 and 2006, the share of respondents supporting public spending cuts

[7] Other observers have argued that voters care more about moral than economic issues. See Ansolabehere et al. (2006) for a discussion of the "culture war" interpretation of these voting patterns.

[8] The annual survey is conducted by The National Data Program for the Social Sciences. Respondents in the years 1985, 1990, 1996, and 2006 were asked about their attitudes towards government spending cuts. The survey was initially conducted in 1972. Answers to questions about the proper role of government,

Table E.1: Support for government spending cuts (in %)

	Total	1985	1990	1996	2006
All	75.4	82.0	78.2	83.4	63.3
Urban	74.8	80.7	77.5	83.1	62.7
Rural	79.5	87.3	82.1	86.1	67.4

The table shows the percentage of respondents answering "strongly in favor of" or "in favor of" government spending cuts. Data from General Social Survey. Counties without towns of 10,000 or more inhabitants are classified as rural. There are between 540 and 1293 urban observations in the four samples and between 126 and 190 rural observations.

Table E.2: Urbanization and grants

	Federal grants/state and local revenue
Urbanization	-0.309^{*}
	(0.183)
Income per capita	0.294
	(0.247)
State FE	YES
Time FE	YES
R^2	72.5
Observations	100

The table displays panel OLS regression results over the period 1969–2008 with federal grants relative to state and local revenue as the dependent variable. The explanatory variables are state-level urbanization and state income per capita relative to the national average. Sources: Federal grants relative to state and local direct general revenue for 1969 are taken from Dales (1970); grants for 2008 from the Census Bureau's Consolidated Federal Funds Report for Fiscal Year 2008, Table 4 (www.census.gov/prod/2009pubs/cffr-08.pdf); and state and local government finances for 2008 from the Census Bureau (www.census.gov/govs/local/historical_data_2008.html). Relative state income per capita is taken from the Bureau of Economic Analysis (www.bea.gov/itable). Population and urbanization data comes from the Census Bureau (www.census.gov). Robust standard errors are in parenthesis. $^{\star}: p < 0.10$.

decreased by 22.3% in urban regions and 25.6% in rural regions.) In the quantitive analysis we therefore assume that the preference parameter γ_t^j grows at the same rate for $j = 1, 2$.

Appendix F. On the Role of Substitutability Between Regional and Federal Spending

As discussed in the main text the predictive power of the model substantially increases under the assumption that federal and regional spending are perfect substitutes rather than complements. The reason for this difference is that, depending on the degree of substitutability between regional and federal spending the interaction between the spending motives of the two levels of government varies in strength. When the two spending levels are substitutes then the marginal benefit of as perceived at the level of a high valuation region falls with the federal tax rate, in contrast to the case with complements.

When the two spending levels are substitutes or complements, respectively, the effect of a marginal increase in the federal tax rate on the net benefit of a regional tax hike in the high valuation region (keeping all other instruments constant) equals

$$\begin{aligned}
\frac{\partial}{\partial \tau_t}\left(\frac{\left(\frac{\omega}{\nu_t}+1\right)\gamma_t^1}{\tau_t^1+\tau_t}-\frac{1+\beta}{1-\tau_t-\tau_t^1}\right) &= -\frac{\left(\frac{\omega}{\nu_t}+1\right)\gamma_t^1}{(\tau_t^1+\tau_t)^2}-\frac{1+\beta}{(1-\tau_t^1-\tau_t)^2} \\
\frac{\partial}{\partial \tau_t}\left(\frac{\left(\frac{\omega}{\nu_t}+1\right)\gamma_t^1\delta}{\tau_t^1}-\frac{1+\beta}{1-\tau_t-\tau_t^1}\right) &= -\frac{1+\beta}{(1-\tau_t^1-\tau_t)^2}.
\end{aligned}$$

Both cross partials are negative but the absolute value of the cross partial in the case of complements is smaller than in the case of substitutes. In the case of complements, regional taxes therefore respond less strongly to federal tax changes than of substitutes.

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which were collected in the 1975 survey, show similar differences between urban and rural voters.

[9]The pooled data include 4626 observations, 4010 urban and 614 rural. A test of the hypothesis that the mean for rural is higher than the mean for urban has a p-value of 0.007.

[10]We use 2008 data to minimize measurement problems caused by the effects of the Great Recession, and we use data for the year 1969 rather than 1970 since the table in Dales (1971) appears to contain a typo in the entry for Colorado. We exclude the District of Columbia as its urbanization rate is 100% in both periods.

As a consequence, regional taxes fall more strongly in response to a federal tax hike when spending levels are substitutes and this, in turn, induces the federal government to increases taxes by more in response to a given increase in $\mathcal{F}$.

References

Ansolabehere, S., Rodden, J. and Snyder Jr., J. M. (2006), 'Purple America', *Journal of Economic Perspectives* **20**(2), 97–118.

Dales, S. R. (1970), 'Federal grants to state and local governments 1968–1969', *Social Security Bulletin* **33**, 31–38.

Dales, S. R. (1971), 'Federal grants to state and local governments 1969–1970', *Social Security Bulletin* **34**, 15–23.

Frank, T. (2004), *What's the Matter with Kansas?*, Henry Holt, New York.

Gonzalez-Eiras, M. and Niepelt, D. (2008), 'The future of social security', *Journal of Monetary Economics* **55**(2), 197–218.

Gonzalez-Eiras, M. and Niepelt, D. (2015), 'Politico-economic equivalence', *Review of Economic Dynamics* **18**(4), 843–862.

Lindbeck, A. and Weibull, J. W. (1987), 'Balanced-budget redistribution as the outcome of political competition', *Public Choice* **52**, 273–297.

Persson, T. and Tabellini, G. (2000), *Political Economics*, MIT Press, Cambridge, Massachusetts.