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Resource Windfalls and Public Debt: The Role of Political Myopia

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Abstract

We identify an adverse consequence of natural resource windfalls, which is particularly detrimental in advanced democracies. We construct a political economy model with endogenous public debt under exogenous resource windfall shocks, in which political myopia results from reelection prospects. Reelection-seeking politicians, while more accountable toward their electorate, are also more myopic. The latter effect gives rise to a budget deficit bias, with the ensuing debt buildup that is exacerbated by resource windfalls. We find that the positive effect of resource windfalls on debt increases as the restrictions on reelection get laxer. We test the model's predictions using a panel of U.S. states over the period 1963-2007. Our identification strategy rests on constitutionally-entrenched differences in gubernatorial term limits that provide plausibly exogenous cross-sectional and time variation in political time horizon, and geographically-based cross-state differences in natural endowments interacted with the international prices of oil and gas. The empirical findings corroborate the model's predictions. In particular, our baseline estimates indicate that a resource windfall of \$1 induces an increase of approximately $\text{¢}14.7$ in the public debt of states with no gubernatorial term limits.

JEL classifications: Q32, H63, H74

Keywords: Resource windfalls, public debt, political myopia, reelection.

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1 Introduction

Do resource windfalls affect public debt? Understanding the determinants of public debt has been of perennial interest to economists and policy makers. The literature offers a variety of explanations for observed patterns of sovereign debt.¹ Little attention, however, was given to the potential role of resource windfalls.² Yet, major resource windfalls may play a central role in the fiscal decisions of incumbents given their potentially significant short and long term impacts on the fiscal budget and the economy's wealth. In this paper we unravel a link between resource windfalls and public debt that hitherto has been overlooked, illustrating that resource windfalls may give rise to excessive public debt in advanced democracies.

The adverse effects of resource windfalls on public debt rest on political myopia. Far from idiosyncratic, the latter is a characteristic feature of democracies with reelection prospects, in which incumbents' time horizons extend more or less until the coming elections (Buchanan and Wagner 1977). Notably, political myopia yields discrepancies in the planning horizons of politicians and market participants that lead to debt buildup (Buchanan and Wagner 1977, Acharya and Rajan 2013, Aguiar et al. 2014, Rieth 2014). The latter, in turn, may have important macroeconomic implications,³ posing a challenge to democratic economies. Our innovation herein is to interact this phenomenon with major resource windfalls, examining how they exacerbate the myopia-debt nexus. In particular, we ask: facing a resource windfall, will short-sighted politicians use the additional proceeds associated with the windfall to reduce debt, leave it unchanged, or rather exploit the increase in wealth to accumulate it further?

We construct a political economy model of endogenous public debt and political myopia in the presence of resource windfalls. The desire to win the next elections affects incumbents in two ways: first, it shortens their time horizon, turning them more myopic relative to the electorate; second, it induces a measure of accountability, forcing them to act on behalf

¹Explanations are ranging from the exploitation of common-pool resources by competing interest groups (Weingast et al. 1981, Tornell and Lane 1999, Velasco 2000, Krogstrup and Wyplosz 2010), to intergenerational redistribution motives, intra-generational distribution conflicts, and various forms of interactions between voters and politicians (Persson and Svensson 1989, Alesina and Tabellini 1990, Persson and Tabellini 1999, Drazen 2000). These explanations extend also to more local levels. Several studies look into the behavior of state debt, pointing at various economic and political determinants (Poterba 1994, Clingmayer and Wood 1995, Ellis and Schansberg 1999).

²Two exceptions are Manzano and Rigobon (2001), and Arezki and Bruckner (2012). The former illustrate that natural resource abundance in the 1970s led to debt overhang in the 1980s. The latter find that commodity windfalls reduce external debt in democracies.

³For discussions on the potential effects of excessive on debt on economic growth and other macroeconomic indicators, see Reinhart et al. (2012) and reference therein.

of their electorate.⁴ The latter effect (termed “reputation-building” by Besley and Case 1995) encourages a low deficit, as this is rewarded by voters (Brender and Drazen 2008). Conversely, the myopia effect implies that the government’s discount rate exceeds the market interest rate, giving rise to a budget deficit bias and the ensuing public debt buildup. A resource windfall turns the economy wealthier, thereby improving its terms of borrowing. When exploited by myopic (reelection-seeking) politicians, resource windfalls exacerbate the myopia-debt nexus to the extent of increasing public debt, due to their impact on the economy’s wealth (as perceived by potential creditors) and the consequent decrease in the cost of borrowing. The resulting debt increase can give rise to debt-overhang type phenomena (Manzano and Rigobon 2001, Reinhart et al. 2012) and increase the risk of insolvency.

The model’s predictions are corroborated by the empirical analysis. We undertake an empirical investigation of the effect of resource booms on debt via a U.S. state-level analysis. An intra-U.S. perspective is appealing for our purposes for several reasons. First, it provides ample cross-state variation in geologically-based natural endowments of crude oil and natural gas. Second, it represents a setting where state governments are fiscally autonomous, and benefit from the natural resources located in their territories;⁵ importantly, this fiscal autonomy yields substantial cross-state variation in (outstanding) public debt, despite existing balanced budget rules. Third, it provides a relatively homogenous environment with constitutionally-entrenched cross-state differences in political institutions. Specifically, gubernatorial term lengths are largely the same across states; however, gubernatorial term limits differ considerably.⁶ This, in turn, provides institutionally-driven, plausibly exogenous cross-state variation in political myopia levels that map to the framework considered in the model.

The analysis is based on two key measures, namely resource abundance and political myopia. Regarding the latter, Besley and Case (1995) find that the behavior of U.S. governors is consistent with the predictions of reputation-building models. Specifically, in cases of non-binding term limits, U.S. governors implement policies that help them get reelected. Our

⁴Empirical evidence on the disciplining effects of reelection prospects are provided by Besley and Case (1995, 2003), and List and Sturm (2006), among others. Besley (2006) provides a synthesis of the related literature.

⁵These benefits are accrued regardless of whether the natural resources are located on state-owned or federal-owned lands. In the former case state-governments collect severance taxes and royalties. In the latter case they benefit from shared federal revenues that amount to approximately 50% (90% in the case of Alaska) of the royalties paid to the federal government for oil production undertaken on these lands.

⁶Fourteen states have no restrictions on reelection prospects, while the other states have restrictions of varying degrees. We discuss these differences in more detail in the empirical part.

framework shows how this behavior also promotes political short-sightedness (as forcefully argued by Buchanan and Wagner 1977, and others). We follow this insight by allowing governors who have an opportunity to be reelected to weigh short term effects of current policies on reelection probabilities high in their calculations, thereby turning them more myopic compared to governors who are within their last term. Thus, similar to Besley and Case (1995), we look into governor terms directly.⁷ Specifically, we examine the proportion of years within the time period investigated that the governor is not in his/her last term.⁸ Importantly, the variation provided by this measure is primarily based on the exogenous institutional differences in gubernatorial term limits. While states with no term limits are assigned a value of 1 throughout the sample, in the remaining states this measure ranges between zero and one and changes over time. We outline further characteristics of this measure in the empirical section.

Regarding natural resource windfalls, we use the state-level, time-varying resource abundance measure constructed in James (2015b). In effect, this measure is an interaction of two plausibly exogenous measures: the cross-sectional difference in the geologically-based recoverable stocks of crude oil and natural gas, and the international prices of crude oil and natural gas. In addition to its geographically-based characteristics, the usage of recoverable stocks is central to the analysis because: (i) it provides relatively large cross-state variation; (ii) it impacts the economy’s wealth (at least as perceived by potential creditors); (iii) it is highly correlated with changes in oil production and revenues despite being geologically-based, as illustrated by James (2015b). We discuss these points in more detail and provide empirical support for the first two points in the empirical section.

To that end, we assembled a panel of the 48 continental U.S. states over the period 1963-2007, partitioned into 5-year intervals. The latter is done due to two main reasons. First, because the main hypothesis relates to political processes that are expected to take effect during several years. Second, to capture relatively long term trends in the prices of oil and gas, as these affect the market’s perception of the significance of the windfall.⁹ Our

⁷This perspective suggests, therefore, that governors in non-binding terms are both reputation builders (Besley and Case 1995), and politically myopic. While the difference between the two is negligible when it comes to policies with immediate payoffs, such as those that took the focus in Besley and Case (1995) (e.g. taxes), it may play an important role in the case of policies that adopt a long-term perspective, such as those related to public debt. Notably, the latter were not considered by Besley and Case (1995). We further elaborate on this issue when discussing the related literature and later when describing the details of the empirical design.

⁸In the main analysis we consider 5-year time intervals; we discuss this below, as well as in more detail in the empirical part, when describing the estimated model.

⁹This perspective follows Manzano and Rigobon (2001), who argued that a long term increase in the price

identification strategy throughout the analysis rests on the plausible exogeneity of the two key measures, namely, political myopia and natural resource windfalls. Using a panel fixed-effects framework, we test the effect of the interaction of our two measures of interest on changes in the public debt.

We find that when reelection restrictions are laxer resource windfalls increase public debt in an economically meaningful and robust magnitude. Specifically, our baseline estimates indicate that a resource windfall of \$1 induces an increase of approximately $\text{¢}14.7$ in the public debt of states with no gubernatorial term limits. Testing various potential political channels, we find that the budgetary bargaining power of the governor serves as a key transmission channel. We show that the main result is apparent under various tests. First, it is applicable using various time intervals. Second, it is observed using different (production-based) measures of resource windfalls. Last, it is robust to considering different sample restrictions, specifications, and controls.

The next section reviews the related literature and places the current contribution within it. Section 3 presents a model that explains how resource windfalls may generate budget deficits via political impatience. The data, empirical findings, robustness tests, and the role of the risk premium channel are presented in Section 4. Section 5 concludes and the appendices present data and technical details.

2 Related Literature

The paper is related to number of literature strands. First is the literature on the effects of resource booms on development and economic growth. Economists have long noticed that natural resource abundance can turn out to be a blessing as well as a curse. This literature is surveyed by van der Ploeg (2011), Venables (2016), and more recently by van der Ploeg and Poelhekke (2016) who focus on the local effects. Studies that point at determinants related to political institutions are surveyed by Deacon (2011). A more specific channel that may manifest the effects of resource windfalls is public debt. For example, Manzano and Rigobon (2001) illustrate that natural resource abundance may lead to debt overhang. Conversely, Arezki and Bruckner (2012) find that commodity windfalls reduce external debt in democracies.¹⁰ The present paper examines this link from a political economy perspective,

oil (during the 1970s) was perceived by creditors as potential collateral and enabled resource rich economies to accumulate further debt.

¹⁰Notably, other studies that examined the fiscal effects of resource booms, including Bornhorst et al. (2009), Gylfason (2001), James (2015a), Papyrakis and Gerlagh (2007), and Raveh (2013), among others,

suggesting that resource windfalls may affect public debt via an additional channel, namely political myopia. Given the intra-U.S. perspective (which holds the level of democracy constant), our results suggest that resource windfalls may *raise* public debt in democracies, via the political myopia channel. In addition, the model highlights situations in which this positive link may yield a debt overhang, thus pointing at potential adverse effects of resource windfalls in democracies.¹¹

Second is the literature on the myopia-debt nexus. Various papers introduce models that produce this nexus. Acharya and Rajan (2013) use political myopia to explain the paucity of defaults (myopic governments wish to avoid the ensuing short-term consequences). Aguiar et al. (2014) study the effects of government impatience when governments can inflate away some of the debt. Rieth (2014) examines how to constraint the borrowing of myopic governments. Our framework differs from these models by endogeneizing political myopia to the behavior of reelection-seeking politicians. Specifically, the polity-market time discrepancy is an outcome of the efforts exerted by incumbents to maximize their time in office. Nonetheless, the positive association between this discrepancy and debt accumulation remains similar. Empirical studies of the link between political time horizon and public debt include Roubini and Sachs (1989) and Grilli et al. (1991). The former constructed an indicator of political fragmentation in a group of OECD countries, based on the number of parties, and found that government tenure significantly affects public debt. The latter found that longer-lived governments have smaller deficits. Notably, this literature overlooked the potential role of resource windfalls in this. Our analysis shows how resource shocks may interact with political myopia to affect debt, thereby shedding light on an important consequence of political myopia.

Also related is the literature on the fiscal effects of U.S. state institutions. Holtz-Eakin (1988) finds that gubernatorial line item veto power may affect state fiscal behavior under specific political circumstances. Knight (2000) shows that states with supermajority voting requirements have lower taxes. Wagner and Elder (2005) illustrate that states with rule-bound stabilization funds have lower expenditure volatility. Various studies show that the strictness of the balanced budget requirement affects states' general fund surplus (Bohn and

did not consider the case of public debt. Similarly, studies that looked into the role of political institutions, such as Caselli and Cunningham (2009), Robinson et al. (2006), and more recently van der Ploeg (2017), did not consider the case of public debt.

¹¹With the exception of market based mechanisms a-la Dutch disease (Corden and Neary (1982)), the majority of evidence indicates that the adverse effects of natural resources occur primarily in developing economies.

Inman 1996, Crain 2003, Primo 2007). Crain (2003) finds that tax and expenditure limits affect states' spending differentially, depending on their income level. Crain and Crain (1998) indicate that baseline budgeting rules may affect state spending. Primo (2007) illustrates that states with automatic shutdown provisions spend less in per capita terms. Crain and Muris (1995) find that spending is more restrained and taxes are higher in states that have combined spending and tax committees. Crain (2003) and Kearns (1994) show that the length of the budget period matters for understanding state spending. Chen and Malhotra (2007) find that the size of the upper chamber is a positive predictor of state expenditure. Owings and Borck (2000) find that states with less professionalized legislatures have lower per capita government expenditures. Matsusaka (1995) shows that voter initiatives (direct democracy) leads to reduction in the size of state governments. Besley and Case (2003) and Erler (2007) show that states with legislative term limits have higher relative spending levels. Finally, Primo and Snyder (2010) estimate that spending in states with strong party organizations is relatively smaller. In this work our focus is on institutional differences related to gubernatorial term limits, and their role in transmitting effects of resource windfalls to public debt. As part of the analysis, we account for the fiscal effects of the said institutional differences via state fixed effects.

Next is the literature on the political budget cycle. The latter pertains to the notion that electoral cycles may trigger corresponding budget cycles, unravelling a connection between political incentives and public debt. Earlier empirical and theoretical contributions to this literature is surveyed by Drazen (2001). More recent empirical studies provide cross-country evidence. Shi and Svensson (2006) find that government deficit rises in election years. Persson and Tabellini (2003) provide evidence that point at the existence of a political revenue cycle, rather than a budget one. Brender and Drazen (2005) argue that a political budget cycle is a feature of new democracies. Of closer relation to our analysis is the study of Klomp and de Haan (2016) who examine the effects of natural resource booms on spending and taxes in election years.¹² De Haan and Klomp (2013) surveys additional related recent findings. In contrast to this literature, the present work examines variations in binding terms, and exploits an empirical design in which the time intervals include both election and non-election years, and hence smooth cycle-driven effects.

More generally, this literature highlights a puzzling pattern. On one hand incumbents

¹²Notably, they do not consider the case of public debt. Nonetheless, they find that natural resource rents increase public spending and reduce taxes in election years, implying that there is a concurrent increase in public debt. Albeit not considered in our framework, in case an election year raises political myopia, the patterns we find are consistent with these results.

tend to raise deficits in election years (Brender and Drazen 2005, Shi and Svensson 2006). On the other hand, higher deficits in election years are punished at the ballot box (Brender and Drazen 2008). Albeit testing a different empirical setting, to the extent that an election year represents a form of political myopia, our model provides a potential reconciliation for these opposing patterns. Incumbents may choose to increase deficits in election years in case the effect of their political short-sightedness dominates the one induced by their fear of being punished by voters.

Of special relevance to our work is the literature on the political agency problem, originated by Barro (1973), with more recent contributions made by Banks and Sundaram (1998), Coate and Morris (1995), and Besley and Burgess (2002) among others. In these models incumbents exert effort to undertake policies that may help them win the next elections; in case reelection is not possible this effort is abandoned and there is a social cost. The model presented in the next section is developed along the lines of the political agency framework. Our setting adds political myopia to this framework, focusing on the incumbent's view point while ignoring strategic interaction with voters. Specifically, in our setting, the effort exerted under the option of reelection gives rise to political myopia; when this effort is abandoned (i.e. there is no option for reelection) the time horizons of the polity and the market do not differentiate. This perspective yields new predictions of the political agency problem for policies that draw heavily on future generations, such as public debt,¹³ especially when interacted with resource windfalls which exacerbate the undesirable effects of myopia.

This extends to papers that test the validity of the political agency problem by examining the effects of binding term limits on fiscal policies (Besley and Case 1995, 2003, List and Sturm 2006). Indeed, similar to Besley and Case (1995), our model accommodates higher taxes during lame duck terms, but it bears a different (ambiguous) impact on debt as it depends on time preferences.¹⁴ Moreover, public debt received little attention in other studies that examined the effects of term limits on fiscal policies.¹⁵ Our empirical analysis exploits

¹³Notably, it supports the view of Bernhardt et al. (2004), Sieg and Yoon (2017), and Smart and Sturm (2013), among others, by highlighting an additional channel via which term limits can be welfare improving from the perspective of voters.

¹⁴As Besley and Case (1995) did not consider debt, their finding that in non-binding terms taxes and spending are lower leaves the impact on debt open.

¹⁵These include Crain and Oakley (1995), Johnson and Crain (2004), and Klein and Sakurai (2015). Two exceptions are Crain and Tollison (1992), and Nogare and Ricciuti (2011). The first examined the relationship of gubernatorial term limits and state deficits; however, their focus was on time inconsistencies and hence on the volatility of deficits. Nonetheless, we consider their suggested channel in the empirical analysis, finding it does not affect the main results. Using international data, Nogare and Ricciuti (2011) found no impact of term limits on government debt. Our model rationalizes this result, as it highlights the

similar variations to test the implications of political myopia in the political agency problem.

Last, the paper that is closest to the current effort is Raveh and Tsur (2017). These authors examine how economic growth affects public debt via political myopia, taking an intra-U.S. perspective. The present effort differs in two key aspects. First is the treatment effect. Raveh and Tsur (2017) examine the effects of aggregate, national TFP shocks, whereas our current focus is on state-level resource shocks. This yields a substantive difference in the empirical design, as the shocks are mutually exclusive and of different nature. Specifically, the first induces a general effect on the economies of all states, whereas the second is based on cross-sectional differences in natural endowments that affect a specific sub-set of state economies. This connects to the second difference, namely the underlying mechanism. In Raveh and Tsur (2017) economic growth affects public debt via the level of aversion to intergenerational inequality; notably, the common shock does not yield cross-state differences in the risk premium. Conversely, in the current work the effects of resource windfalls affect public debt via their effect on the terms of borrowing.

3 The model

The economy's net wealth equals

$$W = W_0 + R, \tag{3.1}$$

where W_0 is non-resource assets and R denotes the value of the natural resource stock, both expressed as a share of GDP. A resource windfall increases R , hence also W and thereby improves the government's borrowing terms.¹⁶ While the (nonrenewable) resource R will eventually depreciate, the wealth effect is immediate and influences borrowing decisions and the ensuing debt buildup. With αR denoting the annual flow of resource royalties and y_0 representing non-resource income (mainly tax proceeds), assumed constant for simplicity, the government income flow is $y(R) = y_0 + \alpha R$. The government's budget at time t is

$$b(t) = y(R) + x(t), \tag{3.2}$$

ambiguous effect that term limits may have on public debt.

¹⁶By resource windfall we mean the present value of the resource discovery, calculated under the optimal exploitation policy. As our interest in this work is on the effects of this windfall on the government budget policy, we abstract from characterizing the optimal exploitation policy over time.

where $x(t)$ denotes borrowing if positive or budget surplus if negative, expressed as shares of GDP.

Borrowing accumulates as debt, denoted $D(t)$, which evolves in time according to

$$\dot{D}(t) = [r + h(D(t), W)]D(t) + x(t), \quad (3.3)$$

where r is the market interest rate and $h(D, W)$ is the economy's risk premium as viewed by potential creditors. The latter vanishes below some critical debt level $D_c(W) \geq 0$ and for $D > D_c(W)$ satisfies

$$h_D(\cdot) > 0, \quad h_{DD}(\cdot) \geq 0, \quad h_W(\cdot) < 0, \quad h_{WW}(\cdot) \geq 0, \quad \text{and} \quad h_{DW}(\cdot) \leq 0, \quad (3.4)$$

where subscripts D and W indicate the respective partial derivatives. The D -properties of $h(\cdot, W)$ are common (see, e.g., Schmitt-Grohé and Uribe 2003) and the W -properties of $h(D, \cdot)$ reflect wealth effects. The marginal risk-premium cost is

$$\psi(D, W) \equiv \partial(h(D, W)D)/\partial D = h(D, W) + h_D(D, W)D. \quad (3.5)$$

In view of (3.4), $\psi(D, W) = 0$ for $D \leq D_c(W)$ and is increasing and convex in D , and decreasing in W , at $D > D_c(W)$.

Debt cannot exceed the upper bound $\bar{D}(W)$ satisfying

$$[r + h(\bar{D}(W), W)]\bar{D}(W) = y(R). \quad (3.6)$$

At $D(t) = \bar{D}(W)$, the interest payments consume the entire income and any debt above $\bar{D}(W)$ will increase without bound.¹⁷ Debt may be negative (in which case the economy is a net creditor) and is bounded below by some (finite) lower bound $\underline{D} \leq 0$.

The incumbent's preferences while in office are represented by an increasing and strictly concave (instantaneous) utility $u(b(t))$ and the (utility) discount rate ρ , where the latter also represents the time preferences of the electorate (the utility $u(\cdot)$ may not necessarily reflect the electorate's preferences). As soon as political tenure ends, the incumbent's utility, as perceived while in office, reduces to $u(\underline{b})$, where \underline{b} is some minimal (e.g., non-discretionary)

¹⁷Defaults are not allowed in this framework. This assumption is consistent with the empirical analysis (next section), where a federal government regulates the default risk of state governments.

budget.¹⁸ With T representing the end of political tenure, the incumbent's payoff is

$$\int_0^T u(b(t))e^{-\rho t} dt + \int_T^\infty u(\underline{b})e^{-\rho t} dt. \quad (3.7)$$

If reelection is feasible, then T depends on election outcomes and is therefore random, where limits on reelection place limits on the distribution of T . We are particularly interested with a reelection limit in the form of a bound \bar{T} on reelection terms. Accordingly, let $[0, \bar{T}]$ be the period during which reelection is possible. Incumbents that survive this period are entitled to a final (lame duck) term of length \bar{t} (e.g., 4 years). If reelection is banned from the outset, then $\bar{T} = 0$, in which case $T = \bar{t}$ is deterministic. If reelection is feasible, i.e., $\bar{T} > 0$, we distinguish between unlimited reelection, where $\bar{T} = \infty$, and limited reelection, where \bar{T} is finite. For each of these cases we characterize the long-run effects of resource windfalls, considering sequence of governments that share the same preferences.

3.1 Unlimited reelection (infinite \bar{T})

As discussed above, the undesirable consequences of resource windfalls show up via their effects on debt. Because debt payments reduce the budget available for providing public services, voters will dislike excessive debt and this attitude affects their decisions in front of the ballot box, as documented by Brender and Drazen (2008).¹⁹ Consequently, let $M(D(t))$ measure the incumbent's approval rating (by the electorate) when the debt-income ratio is $D(t)$. Winning elections requires that the electorate support exceeds some threshold \underline{M} . The incumbent observes (via opinion polls) the noisy signal $\tilde{M}(D(t)) = M(D(t)) + \varepsilon$, where ε is a random (polling) error with the distribution $F_\varepsilon(\cdot)$. The incumbent, thus, evaluates the probability of losing power at time t (if elections were to be held at that time) by

$$m(D(t)) \equiv Pr\{\tilde{M}(D(t)) \leq \underline{M}\} = Pr\{M(D(t)) + \varepsilon \leq \underline{M}\} = F_\varepsilon(\underline{M} - M(D(t))). \quad (3.8)$$

Thus, $M'(D) < 0$ implies $m'(D) = -F'_\varepsilon(\cdot)M'(D) > 0$.

With time measured continuously,²⁰ $m(D(t))$ constitutes the hazard rate associated with

¹⁸The assumption that upon losing power the politician's utility drops to some lower bound (otherwise viewed as having "ego-rent" while in office) is common in the political agency literature (see, e.g., Besley and Case 1995, Maskin and Tirole 2004, List and Sturm 2006).

¹⁹Brender and Drazen (2008) also find that tax cuts may be punished when undertaken in an election year. In the present work, however, we focus on term limits rather than election years.

²⁰While elections take place in discrete time intervals, politicians constantly check the public support and adjust policy accordingly.

T , i.e., the probability of losing power immediately after t given $T > t$, and induces the political survival probability²¹

$$S(t) \equiv Pr\{T > t\} = e^{-\int_0^t m(D(\tau))d\tau}. \quad (3.9)$$

The distribution and density of T are, respectively,

$$F(t) \equiv 1 - S(t) \quad \text{and} \quad f(t) \equiv F'(t) = m(D(t))S(t). \quad (3.10)$$

Taking expectation of (3.7) with respect to T , using (3.9)-(3.10), gives the expected payoff

$$\int_0^\infty [u(b(t)) + m(D(t))u(\underline{b})/\rho] S(t)e^{-\rho t} dt, \quad (3.11)$$

where it is recalled that $b(t) = y_0 + \alpha R + x(t)$. The optimal policy is the feasible $\{x(t), t \geq 0\}$ that maximizes (3.11) subject to (3.3) and (3.9) given the initial $D(0)$ and $S(0) = 1$. A feasible policy satisfies $y_0 + \alpha R + x(t) \geq \underline{b}$ and $D(t) \in [\underline{D}, \bar{D}(W)]$, where \underline{b} is a minimal (e.g., non-discretionary) budget, $\bar{D}(W)$ is defined in (3.6) and $\underline{D} \leq 0$ is a lower bound on $D(t)$.

Myopia and accountability

The discount factor associated with the expected payoff (3.11) is

$$S(t)e^{-\rho t} = e^{-\int_0^t (\rho + m(D(\tau)))d\tau}$$

and the corresponding discount rate is

$$\rho + m(D(t)). \quad (3.12)$$

In contrast, the electorate's discount rate is ρ . The reelection prospects, thus, increase the incumbent's discount rate by the hazard rate $m(D(t))$. This modification affects in two ways: first, it turns (reelection-seeking) politicians more myopic (compared to their electorate); second, it turns the incumbent's discount rate endogenous, as $m(\cdot)$ depends on the policy. These effects are related to two separate agency problems associated with reelection.

The first is the role of reelection in holding incumbents accountable to their electorate. The policy-dependence (i.e., endogeneity) of $m(\cdot)$ induces such an accountability, as becomes

²¹The hazard rate $m(t) \equiv m(D(t))$ satisfies $m(t)\Delta = Pr\{T \in (t, t + \Delta] | T > t\} = f(t)\Delta / (1 - F(t))$. As $\Delta \rightarrow 0$, $m(t) = f(t) / (1 - F(t)) = -d \ln(1 - F(t)) / dt$, where $F(\cdot) \equiv 1 - S(t)$ and $f(\cdot) = F'(\cdot)$ are the distribution and density of T , respectively. Integrating from zero to t , using $F(0) \equiv 1 - S(0) = 0$, gives (3.9).

apparent when observing the survival probability (3.9). The desire to enhance political survival acts as a disciplining mechanism on incumbents.²² Following Besley and Case (1995), we refer to this effect as “reputation-building”. The second effect is due to the role of $m(\cdot)$ in increasing the incumbent’s discount rate relative to that of the electorate, which gives rise to political myopia; we refer to it as the “myopia” effect. Reelection, thus, induces reputation-building and gives rise to political myopia.

Resource windfalls and debt

Not surprisingly, the myopia effect operates to increase debt due to the time rate discrepancy, as illustrated below. Conversely, reputation-building has an opposite effect on debt, given that $M'(D) < 0$. The effect of reelection prospects on debt is, thus, ambiguous. It turns out, however, that resource windfalls exacerbate the myopia-debt nexus, leaning the overall impact toward more debt. To unravel this interaction we focus on the long run. A steady state occurs when $D(t)$ remains constant. It turns out that:

Proposition 1 *The optimal $D(t)$ process converges monotonically to a steady state.*

Proof. Follows from Properties 1 and 2 of Tsur and Zemel (2016), noting that the current problem falls into the class of problems covered by these properties. ■

The proposition allows focusing attention on long run (steady state) effects of resource windfalls on debt. In a steady state $D(t)$ remains constant, hence also $x(t)$ stays put. Let $\hat{x}(D)$ denote the steady-state borrowing (or budget surplus if negative) when debt is constant at the (not necessarily optimal) value D . From (3.3),

$$\hat{x}(D) = -[r + h(D, W)]D. \tag{3.13}$$

The long run (steady state) budget is

$$\hat{b}(D) = y_0 + \alpha R + \hat{x}(D), \tag{3.14}$$

a larger, positive D means larger $-\hat{x}(D)$,²³ which in turn leaves a smaller share of the budget $\hat{b}(D)$ to finance public services.

²²Accountability may not always be desirable, e.g., when it gives rise to “pandering” to public opinion (Maskin and Tirole 2004), and may include selection effects (Alt et al. 2011, Aruoba et al. 2015). Our focus here is on the disciplining effect of accountability.

²³Minus $\hat{x}(D)$ is the constant flow of debt service payments needed to maintain a constant debt D .

The steady-state survival probability (3.9), evaluated at a (not necessarily optimal) steady state D , becomes $e^{-m(D)t}$ and the expected payoff (3.11) evaluated at a (not necessarily optimal) steady state D reduces to

$$\hat{v}(D) = \frac{u(\hat{b}(D)) + m(D)u(\underline{b})/\rho}{\rho + m(D)}. \quad (3.15)$$

Let us define

$$L(D) = u'(\hat{b}(D)) [\rho + m(D) - r - \psi(D, W)] + m'(D) \left(\frac{u(\underline{b})}{\rho} - \hat{v}(D) \right). \quad (3.16)$$

Notice that $L(D)$ depends on R via $\hat{b}(D)$ (cf. (3.14)) and, recalling (3.1), $h(D, W)$, where the latter affects $\psi(\cdot)$ and $\hat{x}(D)$. Let \hat{D} denote an optimal steady state (ensured to exist by Proposition 1, though not necessarily unique). Then:

Proposition 2 (i) A locally stable, internal steady state $\hat{D} \in (\underline{D}, \bar{D}(W))$ satisfies $L(\hat{D}) = 0$ and $L'(\hat{D}) < 0$. (ii) If $\hat{D} = \bar{D}(W)$ then $L(\bar{D}(W)) \geq 0$. (iii) If $\hat{D} = \underline{D}$ then $L(\underline{D}) \leq 0$.

Proof. Follows from Properties 3 and 4 of Tsur and Zemel (2016), with $L(\cdot)$ specified in Equation (3.4b) (op. cit. p. 643). ■

For internal steady states $\hat{D} \in (\underline{D}, \bar{D}(W))$, Proposition 2 induces the relation $\hat{D}(R)$ and implies (by total differentiating $L(\hat{D}) = 0$ with respect to R) that

$$\hat{D}'(R) = L_R(\hat{D})/(-L'(\hat{D})),$$

where subscript R indicates partial derivative with respect to R . Thus, for internal steady states, $\hat{D}'(R)$ equals in sign to $L_R(\hat{D})$. Using (3.16),

$$\begin{aligned} L_R(\hat{D}) = u''(\hat{b}(\hat{D})) \left(\alpha + \hat{x}_W(\hat{D}) \right) [\rho - r + m(\hat{D}) - \psi(\hat{D}, W)] \\ + u'(\hat{b}(\hat{D}))(-\psi_W(\hat{D}, W)) - m'(\hat{D})\hat{v}_W(\hat{D}), \end{aligned} \quad (3.17)$$

where $\hat{x}_R \equiv \hat{x}_W = -h_W\hat{D} \geq 0$, $\psi_R \equiv \psi_W = h_W + h_{DW}\hat{D} \leq 0$ and $\hat{v}_R \equiv \hat{v}_W = u'(\hat{b})(\alpha + \hat{x}_W)/(\rho + m(\hat{D})) \geq 0$.

At an internal steady state $\hat{D} \in (\underline{D}, \bar{D}(W))$, $L(\hat{D}) = 0$ implies, noting (3.16),

$$\rho + m(\hat{D}) - r - \psi(\hat{D}, W) = m'(\hat{D}) \left[\hat{v}(\hat{D}) - u(\underline{b})/\rho \right] / u'(\hat{b}(\hat{D})).$$

From (3.15), $\hat{v}(\hat{D}) - u(\underline{b})/\rho = [u(\hat{b}(\hat{D})) - u(\underline{b})]/(\rho + m(\hat{D}))$, hence

$$\rho + m(\hat{D}) - r - \psi(\hat{D}, W) = m'(\hat{D}) \frac{u(\hat{b}(\hat{D})) - u(\underline{b})}{u'(\hat{b}(\hat{D}))(\rho + m(\hat{D}))} \geq 0,$$

where the inequality follows from $\hat{b}(\hat{D}) \geq \underline{b}$ and $m'(\hat{D}) \geq 0$. Thus, $L_R(\hat{D})$, specified in (3.17), can be expressed (after some straightforward algebraic manipulations) as

$$L_R(\hat{D}) = u'(\hat{b}(\hat{D}))(-\psi_W(\hat{D}, W)) - \frac{m'(\hat{D})}{\rho + m(\hat{D})} \left(\eta(\hat{b}(\hat{D})) \frac{u(\hat{b}(\hat{D})) - u(\underline{b})}{\hat{b}(\hat{D})} + u'(\hat{b}(\hat{D}))(\alpha + \hat{x}_W(\hat{D})) \right), \quad (3.18)$$

where $\eta(b) \equiv -bu''(b)/u'(b)$ is the relative risk aversion associated with $u(\cdot)$.²⁴

The first term on the on the right-hand side of (3.18) is nonnegative and the term multiplying $m'(\hat{D})$ is nonnegative. The second term (involving $m'(\hat{D})$) stems from the endogeneity of $m(D)$ and is identified with both the reputation-building and myopia effects. The first term is solely due to the myopia effect. Recalling that the sign of $\hat{D}'(R)$ equals the sign of $L_R(\hat{D})$, equation (3.18) illuminates how political myopia encourages debt buildup while reputation-building mitigates this tendency, suggesting that the effect of reelection prospects on debt is ambiguous.

In addition, equation (3.18) also implies that the sign of $\hat{D}'(R)$ may be ambiguous due to the non-negativity of both terms. However, for reputation-building to be effective it must also give rise myopia. To see this suppose $m(D) = \mu_0 + \mu D$, with μ_0 representing the pure myopia effect and μD the reputation-building effect. The magnitude of the reputation-building effect is represented by the magnitude of μ . But larger μ also implies larger $m(D)$, hence larger myopia as well. The pure myopia parameter μ_0 , on the other hand, is independent of reputation building. Thus, exercising reputation-building (second term of (3.18)) necessarily means giving rise to myopia, while myopia (first term of (3.18)) can be independent of reputation-building. When a resource windfall hits, it increases both effects, yet the exacerbation of myopia is likely to dominate due to these properties. This, in turn, yields a positive association between resource windfalls and long run debt. To further clarify this point, we consider the case where the hazard rate is independent of reputation-building and provide a numerical example.

²⁴The wealth effect on the RRA coefficient η is debatable (see, e.g., Arrow and Priebsch 2014, and references therein). A negative wealth effect on η increases $L_R(\cdot)$ (cf. (3.18)), hence increases $\hat{D}'(R)$ as well.

Myopia without accountability

When the political hazard is constant, i.e., $m(D) = \mu_0$ and $m'(D) = 0$, the reputation-building effect (associated with the endogeneity of m) vanishes and only the myopia effect prevails. Under this setting, μ_0 represents (exogenous) institutional settings associated with reelection (e.g., larger μ_0 value may represent laxer restrictions on reelection options). In this case $L(D)$ reduces to

$$L(D) = u'(\hat{b}(D)) (\rho + \mu_0 - r - \psi(D, W))$$

and Proposition 2 implies that an internal steady state $\hat{D} \in (0, \bar{D}(W))$ satisfies

$$\psi(\hat{D}, W) = \rho + \mu_0 - r. \quad (3.19)$$

Because $\psi(D, W)$ increases in D and decreases in $W = W_0 + R$ above the critical debt D_c (cf. (3.4)), and the right-hand side of (3.19) is constant, an internal \hat{D} increases with R . Notably, the extent of this effect increases with μ_0 , representing the extent political myopia. The reason is that in this case, where the political myopia (hazard) is solely due to institutional setting associated with reelection (but independent of debt), the long run debt is determined by (3.19) and is independent of the utility function $u(\cdot)$. The deviation of \hat{D} from the socially optimal long run debt is therefore solely due to the discrepancy between the incumbent's discount rate and the market interest rate. In a general equilibrium a-la Ramsey (1928), $\rho = r$ and debt is solely due to political myopia; otherwise, the $\rho - r$ discrepancy also plays a role.

Numerical assessment

We illustrate possible resource windfalls effects on long run debt for the economy characterized by the iso-elastic utility, linear hazard and linear risk premium functions specified in Table 1. The values $\eta = 2$ and $\rho = 0.03$ are well within commonly used ranges (see, e.g., Dasgupta 2008). The values $y_0 = 0.4$ implies a constant tax income flow of 40 percent of national (or state) income, and the value $\alpha = 0.05$ implies a natural resource income flow (royalties) worth $5 \times R \times 100$ percent of GDP (recalled that R is expressed as a share of GDP). This is the case, for example, when the resource stock R generates 10 percent return in perpetuity and 50 percent of that is paid to the government in the form of royalties.

The value $\delta_0 = 0$ ensures that the risk premium can be positive only above the critical debt level $D_c = 0$. The value $\delta_1 = 0.1$ means that above the critical debt level, a 10 percent

increase in the debt-income ratio increases the interest rate at which the government can borrow by one percent, while $\delta_2 = 0.05$ implies that a resource windfall worth 20 percent of GDP decreases the risk premium by one percent.

Table 1: Functions and parameter values.

Description	Specification and Parameter values
Utility	$u(b) = b^{\eta-1}/(\eta - 1)\eta$, $\eta = 2$
Income	$y_0 + \alpha R$, $y_0 = 0.4$, $\alpha = 0.05$
Discount rate (utility)	$\rho = 0.03$
Hazard rate	$h(D) = \mu_0 + \mu D$ μ_0 and μ vary (specified in the figures)
Interest rate	$r = 0.03$
Risk premium	$h(D, W) = \begin{cases} \max\{0, \delta_0 + \delta_1 D - \delta_2 W\}, & D > D_c \\ 0, & D \leq D_c \end{cases}$ $D_c = 0$, $\delta_0 = 0$, $\delta_1 = 0.1$, $\delta_2 = 0.05$
Minimal budget	$\underline{b} = 0.1$

Figure 1 depicts $\hat{D}(R)$ for the economy specified in Table 1 with and without the reputation-building effect ($\mu > 0$ and $\mu = 0$, respectively), where in both cases the myopia effect is represented by $\mu_0 = 0.15$. In both cases \hat{D} increases with R . As expected, the case with $\mu = 0$ corresponds to higher debt levels, as in this case the mitigating effects of reputation-building vanish.

Importantly, these patterns are not confined to the specific values employed; rather, they hold under a wide range of parameter values. More specifically, in the positive reputation-building case we observe a (weak) positive effect, even though the magnitude of the reputation-building effect ($\mu = 10$) is significantly higher than that of the myopia effect ($\mu_0 = 0.15$). Interestingly, this remains the case for significantly larger values of μ , and also in case $\mu_0 = 0$. In addition, we observe that the extent of the positive effect increases with higher μ_0 , as before.

This illustrates an important point, derived analytically above. Reputation-building is not separable from myopia: even when $\mu = 0$, resource windfalls increase debt, thereby affecting both the reputation-building and the myopia effects. Conversely, myopia can be independent of reputation-building, e.g., when $\mu = 0$. Put together, resource windfalls under

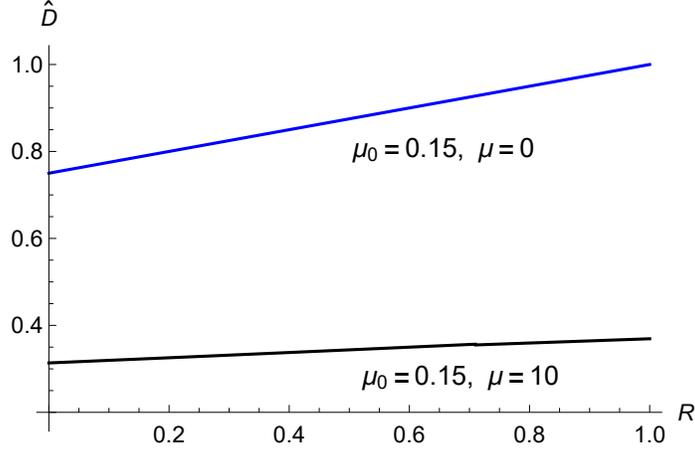


Figure 1: The upper curve depicts long run debt \hat{D} as a function resource windfalls R under myopia effect only ($\mu_0 = 0.15$ and $\mu = 0$). The lower curve depicts $\hat{D}(R)$ under both myopia and reputation-building effects ($\mu = 0.15$ and $\mu = 10$).

reelection tend to increase public debt because they exacerbate the myopia-debt nexus in a way that dominates their potential mitigating effects manifested via accountability.

3.2 No reelection ($\bar{T} = 0$)

When $\bar{T} = 0$, the economy evolves along sequence of lame duck governments, each choosing policy according to

$$\bar{v}(D) = \max_{x(t)} \int_0^{\bar{t}} u(b(t))e^{-\rho t} dt \quad (3.20)$$

subject to (3.3) and feasibility constraints ($b(t) \geq \underline{b}$ and $D(t) \in [\underline{D}, \bar{D}]$), given the initial debt D inherited from the previous administration. When all lame duck governments share the same preferences, the economy evolves along the path corresponding to

$$v_0(D) = \max_{x(t)} \int_0^{\infty} u(b(t))e^{-\rho t} dt \quad (3.21)$$

subject to (3.3) and feasibility constraints, given $D = D(0)$. Similar to the unlimited reelection case ($\bar{T} = \infty$), the optimal debt process corresponding to v_0 approaches a steady state \hat{D}_0 satisfying Proposition 2 with a vanishing hazard ($m(D) = 0$ for all D). The lame duck governors, therefore, are neither myopic nor accountable. The lack of political myopia eliminates the deficit bias that gives rise to debt buildup, with the ensuing undesirable con-

sequences of resource windfalls. Without $m(\cdot)$, its disciplining forces, inducing incumbents to be accountable to their electorate, also disappear.

3.3 Limited reelection (finite $\bar{T} > 0$)

Noting (3.7), the payoff during the reelection period $[0, \bar{T}]$ is

$$\int_0^T u(b(t))e^{-\rho t} dt + \int_T^{\bar{T}} u(\underline{b})e^{-\rho t} dt = \int_0^T u(b(t))e^{-\rho t} dt + e^{-\rho T} u(\underline{b})/\rho - e^{-\rho \bar{T}} u(\underline{b})/\rho.$$

As discussed above, the electorate's support $M(D(t))$ gives rise to the hazard rate $m(D(t)) = F_\varepsilon(\underline{M} - M(D(t)))$ associated with T and the ensuing survival probability $S(t)$, specified in (3.9) and relevant for $t \leq \bar{T}$, and the associated distribution and density, specified in (3.10).²⁵ The expected payoff over $t \in [0, \bar{T}]$ (ignoring the right-most, constant term) is

$$\int_0^{\bar{T}} [u(b(t)) + m_{\bar{T}}(D(t))u(\underline{b})/\rho] S(t)e^{-\rho t} dt. \quad (3.22)$$

Incumbents that survive through the reelection period $[0, \bar{T}]$ are ensured the last (lame duck) term until $\bar{T} + \bar{t}$, with the ensuing payoff $\bar{v}(D(\bar{T}))$, specified in (3.20).

The expected payoff over $[0, \bar{T} + \bar{t}]$ can now be expressed as

$$\int_0^{\bar{T}} [u(b(t)) + m(D(t))u(\underline{b})/\rho] S(t)e^{-\rho t} dt + e^{-\rho \bar{T}} S(\bar{T})\bar{v}(D(\bar{T})). \quad (3.23)$$

The optimal policy is the feasible $\{x(t), t \geq 0\}$ that maximizes the expected payoff subject to (3.3) and (3.9), given the initial $D(0)$ and $S(0) = 1$. Comparing (3.23) and (3.11), we see that the objective of reelection-seeking incumbents under finite \bar{T} differs from that under unlimited reelection (infinite \bar{T}) due to the boundary value at time \bar{T} , namely, $e^{-\rho \bar{T}} S(\bar{T})\bar{v}(D(\bar{T}))$, affecting decisions throughout $t \in [0, \bar{T}]$ (via transversality conditions). Recall that $\bar{v}(D(\bar{T}))$ is the value of lame duck incumbents and lame duck governments are not myopic (they are also not accountable).

The economy evolves along sequence of governments, some seeking reelection and some in their final (lame duck) term, where the frequency of the former increases with \bar{T} . The debt process of such an economy does not converge to a steady state in the long run, but rather fluctuates as political power switches between reelection seeking and lame duck governments.

²⁵See footnote 21. For simplicity we assume the same approval rating function $M(D(t))$ as under unlimited reelection. If the electorate's support depends also on the term limit \bar{T} , then $M(\cdot)$ and the ensuing $m(\cdot)$ will depend on \bar{T} as well.

As resource windfalls increase debt under reelection-seeking governments but not under lame duck governments, a larger \bar{T} will increase the effect of windfalls on debt.

3.4 Discussion

The analysis determines consequences of resource windfalls in the presence of reelection-seeking governments. The desire to enhance political survival induces upon reelection-seeking incumbents a measure of accountability but at the same time turns them more myopic. These two consequences of reelection have opposite effects on debt: accountability mitigates whereas myopia induces debt buildup. Importantly, the magnitude of the myopia effect increases with the width of the polity-market discount rate discrepancy. Resource windfalls exacerbate the myopia effects via their effects on the cost of borrowing.²⁶ Conversely, when reelection is not feasible, either because $\bar{T} = 0$ or the government is in its final term, incumbents are neither accountable nor myopic. Without the latter there is no debt buildup motive to interact with resource windfalls, eliminating the undesirable debt consequences of the latter.

The model delivers two key predictions. First, resource windfalls are likely to increase public debt when reelection is possible. Second, this effect intensifies as the restrictions on reelection get laxer, which in the present context is equivalent to larger \bar{T} (and/or μ_0). The model, thus, yields variations in the effects of resource windfalls on debt both across institutional settings, e.g., term limits, as well as across incumbents' lame duck or reelection-seeking status. We exploit these properties in the empirical analysis below.

The model also identifies the conditions under which the blessing of a resource windfall eventually turn sour. Expression (3.13) illuminates (some of) the potential adverse consequences of debt (see Manzano and Rigobon 2001, Reinhart et al. 2012). The long run (steady state) budget is provided in expression (3.14). Notice that a larger, positive D means larger (in magnitude), negative $\hat{x}(D)$, which in turn leaves a smaller share of the budget $\hat{b}(D)$ to finance public services. Short-sighted politicians will likely fail to see that resource windfalls, while having pronounced benefits in the near and medium terms, will eventually depreciate, either due to exploitation or lower resource prices. As a result, the improved borrowing terms brought about by the windfall will eventually diminish, leaving the economy trapped with a debt burden it cannot sustain, resembling the debt overhang considered by Manzano and Rigobon (2001).

²⁶Notably, their effects on long term debt via their effects on the current fiscal budget are negligible, given that they are based on the current flow of resource rents.

We close this section by pointing out a few aspects that our framework overlooked. The efficacy of myopia in affecting fiscal policy and the ensuing debt depends also on factors such as party control and exogenous constraints on the ability of governments to exercise discretion (see discussion in Besley and Case 1995). Political party, which continues to exist after the governor is gone, may enforce its agenda and restrict the fiscal policies feasible to incumbents. The bargaining power and experience of the executive branch (especially compared to those of the legislative branch) may affect the extent to which fiscal policies can be implemented, regardless of term limits. Finally, governors may have plans for life after governorship, e.g., they may care about their legacy, a particular interest group or the strength of their political party, which can affect their preferences during their lame duck term. We account for these aspects in the empirical analysis, to which we now turn.

4 Empirical analysis

The above model explains how resource windfalls may decrease the risk premium, and consequently increase public debt under political myopia. Moreover, it shows that this tendency is enhanced with the extent of myopia. In this section we provide empirical evidence in support of these predictions. We do so by using a U.S. state-level analysis that exploits cross-state institutional differences affecting the extent of political myopia to estimate the heterogeneous effects of resource windfalls on changes in public debt. We first describe the data, methodology, and identification assumptions; then present the empirical results.

4.1 Data and methodology

We examine a panel of the 48 continental U.S. states over the period 1963-2007.²⁷ We undertake an intra-U.S., cross-state, perspective for several reasons. First, while presenting a relatively homogenous environment, U.S. states provide constitutionally-entrenched differences in gubernatorial term limits that affect the extent of political myopia; importantly, these myopia-affecting institutional differences are representative of varying degrees of \bar{T} and μ_0 in the model. Second, irrespective of states' balance budget rules, there is considerable cross-state variation in states' public debt and changes thereof. Third, there is significant

²⁷We restrict the analysis to pre-2008 data to exclude the potential biasing effects of the post-2007 recession. The earliest year for which regional (state-level) accounts are available is 1963, marking the start year of the sample period. We focus on the 48 continental states due to the scope of the (main) resource measure we employ, as we explain below.

cross-state variation in resource windfalls. Fourth, the fiscally autonomous environment ensures that state governments benefit from their natural endowments to a considerable, and economically meaningful extent. Last, in such a setting whereby states are essentially price takers, r is taken as given, consistent with the setting in the model. These features allow identifying the causal link running from resource booms to debt accumulation via political myopia. We discuss each of these components in more detail.

The extent of political myopia, which as stated in Section 3 stems from the short time horizon of politicians relative to ordinary market participants, depends on gubernatorial term limits. The latter provides considerable institutional variation across U.S. states. In 14 states governors can be reelected indefinitely,²⁸ while the remaining states have some restriction on the number of eligible terms.²⁹ Importantly, there is no concurrent cross-state variation in term lengths, fixing the level of government durability.³⁰ Our main conjecture, following the model, is that having no restriction on the option to reelect increases the time rate of discount of politicians due to their reputation-building behavior. Conversely, facing some restrictions, which at some point limit the option to reelect, decreases the time rate of discount of politicians as they have no incentive to exert efforts to maintain a political reputation. Consequently, these restrictions may on one hand exacerbate the political agency problem (by exerting no effort), but on the other hand lead to less myopic politicians with a planning horizon that is similar to their electorate's.³¹ This, in turn, provides plausibly exogenous cross-state variation in the extent of political myopia.

Hence, similar to Besley and Case (1995, 2003) and List and Sturm (2006) we consider governors' last terms. In effect, we examine the proportion of years within the inspected time interval in which the governor was not in his/her last term.³² Therefore, the closer

²⁸These states are CT, IA, ID, IL, MA, MN, ND, NH, NY, TX, UT, VT, WA and WI.

²⁹There are various restrictions. For instance, some states require waiting a full term, following two consecutive terms, before becoming an eligible candidate again (e.g., NJ and NM). Other states grant eligibility for eight out of sixteen years (e.g., MT, WY). In another group candidates are eligible for two consecutive terms only (e.g. CA, CO).

³⁰With the exception of NH and VT, which have shorter, two-year terms. The analysis captures this difference via the state fixed effects, yet we in addition note that results are robust to the exclusion of these two states.

³¹Following Crain and Tollison (1992), an alternative view can be that having term restrictions may manifest time inconsistency effects. If, for instance, the incumbent realizes that he/she can be replaced in an upcoming election by a candidate from the opposing party, he/she may increase deficit while still in office in an attempt to affect political outcomes in the following term. We address this option in a later sub-section, illustrating that it does not affect the main results.

³²The role of time intervals in the empirical design, described briefly in Section 1, is further outlined below in the discussion over the estimated model.

its value is to 1, the greater is the extent of political myopia. In the group of states that have no gubernatorial term limits this measure takes the value of 1 in all cases. However, in the group of states that have some restrictions this measure provides variation both across states as well as within them, having a mean of 0.62 and a standard deviation of 0.37. This is illustrated in Figure 2, which presents the distribution of this measure across U.S. states.

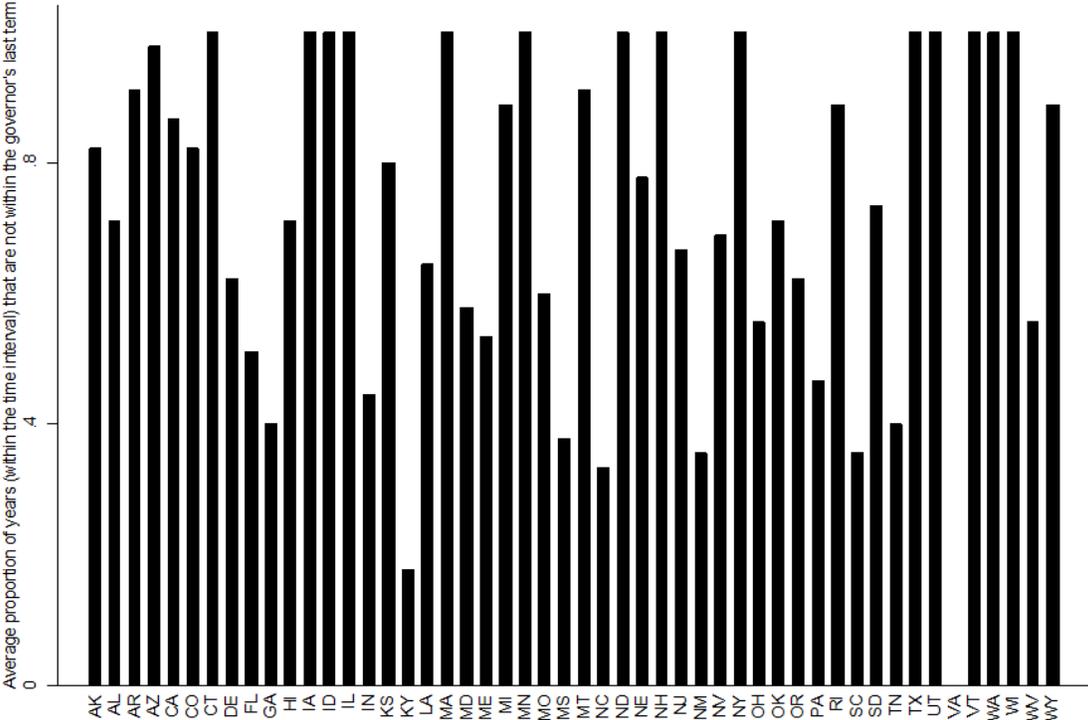


Figure 2: The proportion of years within the main panel’s 5-year intervals that the governor is not in his/her last term, averaged over the period 1963-2007. Source: National Governors Association.

This measure, hence, exploits the full extent of (the cross-sectional and time) variation related to state differences in gubernatorial term limits, accounting for the two key dimensions highlighted by the model, namely governors’ status (lame duck or not), and states’ institutions (the extent of reelection restrictions). At the cross-section, the variation is based on the cross-state (exogenous) institutional differences. Across time (within-states) the variation is based on governors’ status. The latter is also primarily based on the state-specific institutional setting, which sets a fixed limit on the possible share of lame duck years in each time

interval; however, it may also be endogenous to policy implementation.³³ Notably, this does not affect the hypothesis tested based on the underlying assumption that myopia-related behavior is triggered by reelection prospects (i.e. irrespective of the extent to which policy is successfully implemented, and of other characteristics of the governor).

Concerning public debt, virtually all states issue debt to finance expenditures, regardless of existing balanced budget rules (Krol 1997). Importantly, there is a large cross-state variation in debt levels. The distribution of real public debt per capita across states for our sample period is plotted in Figure 3.³⁴ The range is quite wide, going from as low as about \$370 to higher than \$5000. The average real public debt per capita is approximately \$1240, with a standard deviation of \$945. We exploit this variation in the analysis.

Last is the measure of resource windfalls. We exploit the measure constructed in James (2015b). This measure is based on the interaction of two plausibly exogenous variables. The first is the cross-sectional difference in geologically-based recoverable stocks of crude oil and natural gas. This data is derived from the U.S. Geological Survey at a province level, which James (2015b) aggregates to the state level.³⁵ The second is the international prices of crude oil and natural gas. Their interaction provides the (weighted) average state resource endowment, which is then normalized by state personal income, averaged over 1958-2008.

This measure is appealing for our purposes for several reasons. First, it provides plausibly exogenous variation in resource windfalls across states as well as within them. Second, it provides ample cross-state variation; specifically, given the usage of recoverable stocks, only four states have zero natural endowments (and hence no windfalls throughout the sample period).³⁶ The average natural endowment ranges from none (e.g. DE) to about 0.7 of state income (WY), with a mean of 0.02 and a standard deviation of 0.06. This is illustrated in Figure 4, which plots the average level of this measure across U.S. states. Third, as we show in the initial analysis below, it affects the cost of borrowing faced by state governments.³⁷

³³For example, there are instances where values are relatively high (e.g. close to 1), despite having some term restrictions. In such cases governors keep having opportunities to be reelected because they do not make it to a lame duck term, and hence get replaced beforehand. This may be evident of unsuccessful policy implementation.

³⁴As illustrated in Figure 3, AK is an outlier with an average debt per capita that is more than twice that of the state with the second highest average level (CT). As described below, the main analysis excludes AK. Nonetheless, we later show that the main results hold under its inclusion.

³⁵This measure excludes AK and HI. This restricts the (main) empirical analysis to the 48 continental states.

³⁶These states are DE, ME, NH, RI. Nonetheless, several more states have positive, but close to zero natural endowments, as illustrated in Figure 4.

³⁷A corollary is that variations in this measure across relatively long periods, equivalent to the time intervals we examine, affect the economy's wealth as perceived by potential creditors.

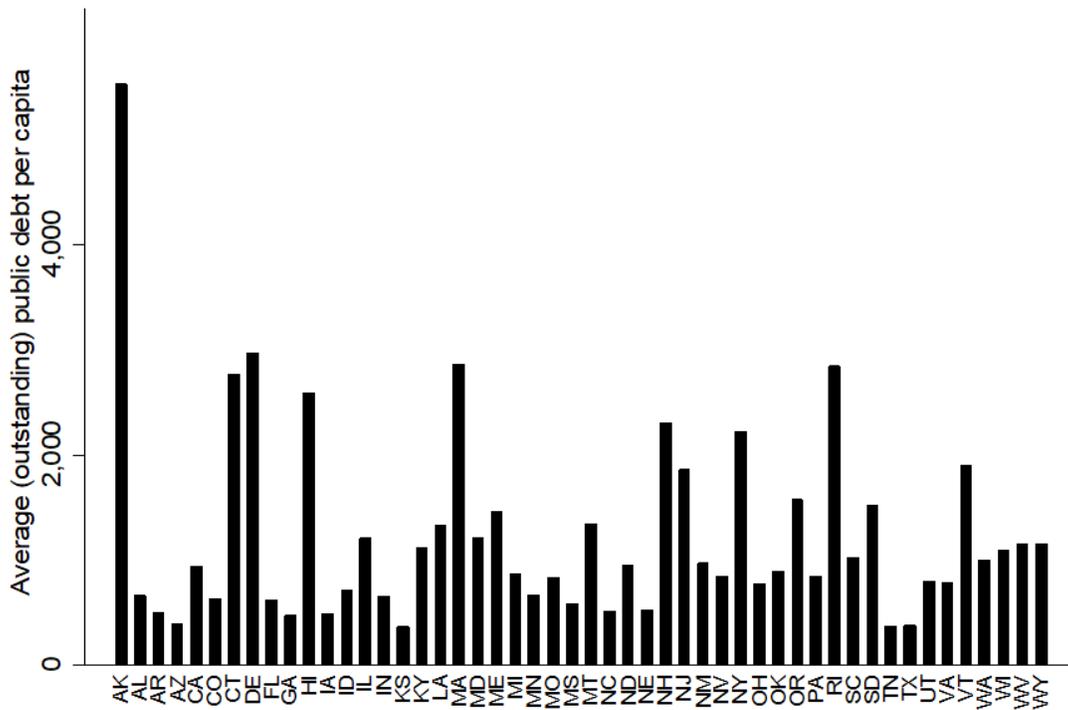


Figure 3: Average (outstanding) real public debt per capita across U.S. states over the period 1963-2007. Source: U.S. Census Bureau.

Last, despite being geologically-based, it is highly correlated with changes in oil production and revenues, as illustrated by James (2015b).³⁸

Using these measures, we estimate the heterogeneous effects of resource windfalls on public debt, across levels of political myopia. Our identification strategy rests on the plausible exogeneity of the two main measures, namely political myopia and resource windfalls, as described above. Based on that, we focus primarily at their interaction, using a panel fixed-effects framework. Hence, throughout the analysis, we estimate models of the following type, for state i , at time period (5-year) t :

$$O_{i,t} = \alpha + \beta(O)_{i,t(1)} + \gamma(myopia)_{i,t} + \delta(windfall)_{i,t} + \theta(myopia * windfall)_{i,t} + \mu(\mathbf{X})_{i,t-1} + v_t + \eta_i + \epsilon_{i,t}, \quad (4.1)$$

³⁸Indeed, we also test production-based measures of resource windfalls for robustness, presented later in the analysis, that point at similar patterns.

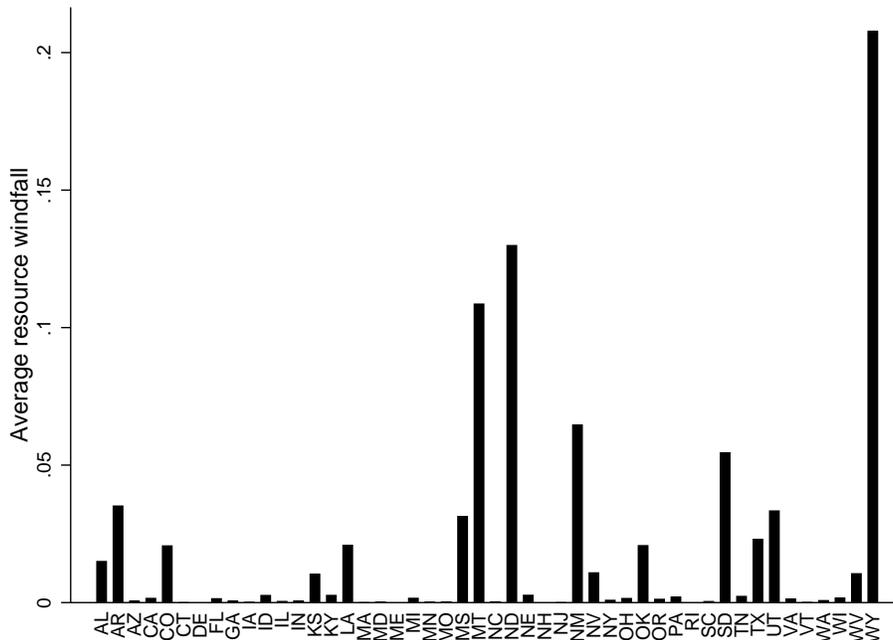


Figure 4: Average resource windfall as share of state income over the sample period (1963-2007), across U.S. states, derived from James (2015). AK and HI are excluded. See the Data Appendix for a more detailed description of this variable.

where O is either real interest payments per capita (initial analysis), or real public debt per capita (main analysis).³⁹ Notice that the dependent variable is the average level of O during the time period t . The notation $t(1)$ refers to the first year in period t . Hence, the initial level of O , in each period, is included as a control. This addition captures convergence and is equivalent to testing a specification in which the dependent variable is in changes, while exploiting the full sample.⁴⁰

In addition, *myopia* is the political myopia measure (described above), and *windfall* is the resource windfall (described above). \mathbf{X} represents a vector of controls that unless otherwise specified includes (initially) the natural logarithm of real per capita GSP;⁴¹ controls under

³⁹Given the said potential link between resource shocks and growth, we focus on per capita terms. Unlike normalizing by GSP, the denominator in this case is less responsive to windfalls, which provides a better focus on the changes in debt.

⁴⁰More specifically, an alternative specification may examine the dependent variable in changes (between $t - 1$ and t), with its level control in $t - 1$ included as a control. As noted, this is qualitatively equivalent to the current setting, yet with the cost of losing one period. Nonetheless, we note that results are qualitatively similar under this case.

⁴¹We consider the intra-U.S. environment to be relatively homogenous, and hence keep the inclusion of fur-

this vector enter at $t-1$ to mitigate endogeneity concerns. Finally, v and η are time and state fixed effects, respectively, controlling for time and state invariant phenomena such as changes in the oil price or the fiscal affecting cross-state institutional differences discussed in Section 2. Our focus throughout the (main) analysis is primarily on the parameter θ , which provides an estimate of the effect of resource windfalls on changes in public debt, via political myopia. Standard errors are clustered by state in all specifications. The data Appendix outlines the variables included in the analyses and their sources. Table A1 provides descriptive statistics for the complete sample.

Notably, a time period (t) represents a 5-year interval. This means that within the panel’s sample, 1963-2007, we have 9 time observations each representing the averages of each of the said variables within the corresponding time interval. We do so for two main reasons. First, because our hypothesis relates to medium-term political processes that are expected to take effect during several years. A 5-year interval ensures that there is at least one state-election within each interval, and that elected governors have at least one year to create changes in their states’ public debt. Second, a 5-year interval enables examining medium-term resource shocks that map to the definition considered in the model. Namely, shocks that politicians and creditors may regard as producing a potential stream of income over a prolonged period of time, which in turn affect the risk premium. This, in effect, follows the approach of Manzano and Rigobon (2001), who argued that the long term change in the oil price during the 1970s altered the risk premium of resource rich economies. Nonetheless, in a later sub-section we show that the main results are not sensitive to the choice of the time-interval.

4.2 Initial analysis: The risk premium function

The theoretical analysis assumes that the risk premium is positively affected by public debt, and negatively associated with the national wealth. In addition, it crucially assumes that substantial resource windfalls are positively associated with the economy’s wealth. Put together, the framework points at a negative association between resource shocks and the risk premium. In this initial analysis we test whether these patterns are borne in our data.

To do so we estimate a version of Equation (4.1), where O is real per capita interest payments, \mathbf{X} includes real per capita public debt, and *myopia* and its interaction are excluded. In this case, δ is indicative of the relationship between resource windfalls and the risk

ther, potentially endogenous controls to a minimum, assuming the bulk of relevant cross-state heterogeneity is captured via income differences.

premium; we interpret the interest payments as such because public debt is held constant.

Results are presented in Table 2. The (precise) estimates in Column 1 indicate that the windfall is negatively associated with the risk premium, whereas debt is positively associated with it, as conjectured.⁴² These baseline results support the setting adopted in the analytical framework. Importantly, they indicate that the resource windfalls we examine are sufficiently substantial to alter the risk premium.

Table 2: Resource windfalls and the cost of borrowing; 1963-2007 (5-year intervals)

Dependent variable: The average real state interest payments per capita in period t	(1)	(2)	(3)	(4)
	Baseline	Dynamic version	Interaction	Output based measure
Windfall	-23.61*** (7.85)	-13.51** (6.09)	-1.18 (10.85)	
Debt	0.017*** (0.005)	0.021*** (0.004)	0.019*** (0.005)	0.019*** (0.004)
Debt x Windfall			-11.26** (4.53)	
Interest ($t-1$)		0.8*** (0.09)		
Windfall, output based				-13.85** (6.83)
State fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
R-squared, within	0.31	0.71	0.32	0.29
Observations	432	384	432	432

Notes: Standard errors are robust, clustered by state, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t , and the initial level of the dependent variable (i.e. at the first year of period t). Sample includes the 48 continental U.S. states and covers the period of 1963-2007 in 5-year intervals. The dependent variable ('Interest') is the average real state interest payments per capita in period t . 'Windfall' and 'Windfall, output based' denote the resource windfall measures described in the text. 'Debt' is the average real state debt per capita. For further information on variables see data Appendix.

The remaining columns provide some robustness tests to these results. Column 2 estimates a dynamic version of the baseline case, yielding similar results. Column 3 looks into the interaction of the resource windfall with public debt. The negative and significant coefficient on this interaction indicates that interest payments on public debt are negatively

⁴²The difference in the magnitudes are because of the different normalizations. The windfall is normalized by total income, whereas debt is in per capita terms. Normalizing the latter by GSP yields an estimate substantially larger than that on the windfall, as resources are only a fraction of wealth. Nonetheless, our focus in this case is on the sign and preciseness, hence we keep the per capita normalization of debt to maintain consistency with the remaining analysis.

affected by resource windfalls. Column 4 tests a different windfall measure, in which the cross-sectional difference in natural endowments is based on production levels rather than stocks. In effect, this measure is the interaction between the international price of crude oil and the GSP share of the mining sector in the initial year of the sample (1963), assumed to be pre-determined. The results in this case are qualitatively similar to the benchmark one, in sign, significance, and magnitude.

4.3 Baseline results

Next, we turn to the main analysis. We estimate various versions of Equation (4.1), with O representing real per capita public debt. Results appear in Table 3. We start with examining the separate effects of *windfall* and *myopia* on public debt. Hence, in Column 1 *myopia* and its interaction are excluded. This case yields a negative, non-significant δ . Resource windfalls do not bear a clear direct effect on public debt; nonetheless, the negative sign is largely consistent with Arezki and Bruckner (2012) who found that commodity shocks negatively affect external debt in democracies, using a cross-country panel.

In Column 2 *myopia* is added (without its interaction). The estimates indicate that in addition to *windfall*, *myopia* as well does not appear to be correlated with debt. This result is consistent with the model that finds an ambiguous effect of reelection prospects on changes in public debt, given the two conflicting effects of reputation-building and political myopia. In addition, this is consistent with Nogare and Ricciuti (2011) who also found no clear association between term limits and public debt under a cross-country framework.

Column 3 represents the complete, baseline specification in which the interaction term of interest is added. The results provide support for our main hypothesis. The coefficient θ is positive and statistically significant. When reelection restrictions are laxer resource windfalls increase public debt, consistent with the key prediction of the model. In addition, the magnitude is economically meaningful. Over a period of five years, a resource windfall equivalent to 1% of state income induces an increase of approximately 0.35% (\$4.6) in the average real per capita public debt of states with no gubernatorial term limits. Under their average GSP and per capita public debt levels, these estimates suggest that a resource windfall of \$1 increases the public debt of these states by approximately $\text{¢}14.7$.

In Column 4 we test the applicability of the mechanism in the states that have some term restrictions. The continuous nature of *myopia* provides ample variation across states that have values that are less than 1. This enables testing whether similar patterns are observed in the absence of the states with no gubernatorial term limits. Hence, we restrict the sample

Table 3: Resource windfalls and public debt; 1963-2007 (5-year intervals)

Dependent variable: The average real state debt per capita in period t	(1)	(2)	(3)	(4)	(5)
	Initial Analysis		Main Result		
	No myopia	Myopia	Baseline	Restricted sample: Myopia	Restricted sample: Windfall
Windfall	-189.62 (140.64)	-194.94 (144.64)	-146.72 (125.83)	-99.88 (117.89)	-62.99 (109.64)
Myopia		76.99 (121.53)	171.49 (129.89)	200.87 (133.89)	71.13 (110.32)
Myopia x Windfall			459.22*** (159.71)	438.64** (184.29)	322.54** (149.27)
State fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared, within	0.41	0.41	0.42	0.45	0.43
Observations	432	432	432	306	396

Notes: Standard errors are robust, clustered by state, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t, and the initial level of the dependent variable (i.e. at the first year of period t). Sample includes the 48 continental U.S. states and covers the period of 1963-2007 in 5-year intervals. In Regression 4 the sample excludes the states with no restrictions on the number of governors' terms; namely: CT, IA, ID, IL, MA, MN, ND, NH, NY, TX, UT, VT, WA, WI. In Regression 5 the sample excludes the states with zero windfalls through the sample period; namely, DE, ME, NH, RI. The dependent variable is the average real state debt per capita in period t. 'Windfall' denotes the resource windfall measure described in the text. 'Myopia' is the proportion of years (within the time interval) in which the governor is not in his/her last term. For further information on variables see data Appendix.

to the (34) states that have some term restrictions. Interestingly, the estimated θ is similar in sign and significance to that estimated in Column 3.

In Column 5 we restrict the sample to the (44) states that have some positive natural endowment. This yields a sample in which shifts in the prices of oil and gas affects all states to at least some extent,⁴³ testing whether the observed patterns are driven by states with strictly zero endowments (and changes in thereof) during the sample period. The estimated θ in this case indicates that the main result is apparent in the restricted sample, albeit with a smaller magnitude.

4.4 Robustness tests

The previous sub-section laid out the benchmark, main results. Next, we test the robustness of these to the main aspects of the empirical design. We consider various competing

⁴³This is primarily because the two are highly correlated across time.

explanations, time interval lengths, measures of resource windfalls, and specifications of the empirical model.

4.4.1 Political mechanisms

The main analysis examines the effects of resource windfalls on debt via political myopia. The latter, however, represents one dimension of institutional differences. This sub-section explores the role of other potential political mechanisms in this. As in the main analysis, the description and sources of the additional measures considered in this part are outlined in the Appendix; Table A1 provides descriptive statistics. Results appear in Table 4. All estimations follow the baseline specification (Column 3, Table 3). To minimize concerns related to multi-collinearity, we consider each political channel separately. Importantly, each case includes an interaction of the inspected political measure with *windfall*, to examine its role in manifesting the effects of resource shocks. We focus the discussion on these additional interaction terms.

First, we consider the role of the governor’s party affiliation. Besley and Case (1995) and Persson and Svensson (1989) indicate that party affiliation is an important indicator for whether a binding term limit affects the fiscal behavior of governors. To test that, we add an indicator for the party affiliation of the governor. The indicator takes the value 0 (1) if the governor is affiliated with Republican (Democratic) Party; otherwise, it takes the value 0.5. The results in Column 1 indicate that θ is similar to that estimated in the baseline case, whereas the coefficient on the additional interaction term is non-significant. Albeit decreasing the magnitude of θ , these results indicate that the party affiliation of the governor does not play a key role in explaining the effects of resource windfalls.

Second, in the model we assume that it is the head of the executive branch that holds the primary budgeting power; conversely, the legislative branch provides a system of checks and balances. Nonetheless, the latter possesses strong bargaining powers, and hence in cases where the executive and legislative branches do not align governors may find it more challenging to raise debt. To address that we add a measure for this alignment: the fraction of legislators that have a common party affiliation with the governor.⁴⁴ Results are presented in Column 2. The results on θ and the additional interaction term indicate that political alignment between the executive and legislative branches does not play a key role in this.

Third, we touch on additional relevant aspects of the legislative branch. Owings and Borck (2000) indicate that legislative professionalism is important for understanding state

⁴⁴NE is excluded, due to its non-partisan legislature.

Table 4: Political channels; 1963-2007 (5-year intervals)

Dependent variable: The average real state debt per capita in period t	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Governor's party affiliation	Legislator- Governor party match	Legislature salary	Budgets passed	Ranney Index	Divided government	Congress- Governor party match
Myopia x Windfall	315.96* (187.45)	537.01*** (199.63)	174.12* (107.01)	446.89*** (149.41)	422.42** (196.43)	472.8*** (160.09)	458.14*** (161.81)
GovParty x Windfall	224.64 (179.21)						
LegParty x Windfall		3.45 (3.09)					
LegSalary x Windfall			-23.24** (10.39)				
Budgets x Windfall				49.32*** (17.91)			
Ranney x Windfall					360.64 (814.85)		
DivGvt x Windfall						-81.97 (284.21)	
ConParty x Windfall							119.59 (169.33)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, within	0.43	0.42	0.47	0.43	0.42	0.42	0.42
Observations	432	423	336	432	423	423	432

Notes: Standard errors are robust, clustered by state, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t , the initial level of the dependent variable (i.e. at the first year of period t), and the separate components of the interaction term. Sample includes the 48 continental U.S. states and covers the period of 1963-2007 in 5-year intervals. In Columns 2, 5, 6 NE is excluded. In Column 3 the first two time intervals (1963-1972) are excluded. Dependent variable is the average real state debt per capita in period t . 'Windfall' denotes the resource windfall measure described in the text. 'Myopia' is the proportion of years (within the time interval) in which the governor is not in his/her last term. Other controls include: 'GovParty': the party with which the governor is affiliated; 'LegParty': the fraction of legislators that have a common party affiliation with the governor; 'LegSalary': real average legislator salary (available from 1971); 'Budgets': the number of budgets that the governor passed; 'Ranney': Ranney Index of Electoral Competition; 'DivGvt': an indicator for whether state government is divided. 'ConParty': the extent to which the state's congress representatives are affiliated with the same party as the governor. For further information on variables see data Appendix.

budgets. In addition, Kousser and Phillips (2012) note that part-time legislatures may increase the budgetary bargaining power of governors. Both points may affect our proposed mechanism. To address them, we add a measure of the average real annual salary of legislators.⁴⁵ The results in Column 3 show that part-time legislators, or rather the relative bargaining power of the governor, are important for understanding the underlying political processes via which resource windfalls affect public debt.⁴⁶

⁴⁵This data series is available from 1971, excluding the first two time intervals.

⁴⁶Notably, the main effect remains applicable yet that the magnitude and relative preciseness of the estimated θ decreases. Nonetheless, the comparison of this outcome to the baseline case is not straight

Fourth, we dig deeper into the role of the bargaining power of the governor. More experienced governors are expected to be more established and hence possess relatively stronger budgetary bargaining power (Kousser and Phillips (2012)). To account for that we add a measure that captures the number of budgets that the governor has overseen.⁴⁷ Results appear in Column 4. The results are reminiscent of those observed in the previous case; namely, the governor’s relative bargaining is important for transmitting the effects of resource windfalls on public debt.

Fifth, we look into the extent of electoral competition. This relates to Crain and Tollison (1992) who suggest that states’ debt may be affected by a time inconsistency effect where the governor in office may wish, for instance, to inherit a larger deficit to its successor in case he/she expects a party switch. We examine the role of this potential channel by controlling for state electoral competition, via the standard Ranney measure of electoral competitiveness (Ranney (1976)).⁴⁸ The results in Column 5 suggest that electoral competition is not a key underlying channel.

Sixth, we consider the consequences of a divided government. Kraus et al. (2013) find that under a divided government the executive branch presents a more conservative revenue (and hence, debt) forecasts. Alt and Lowry (2013) show that divided governments are less able to react to revenue shocks that lead to budget deficits. To address this, we add a binary indicator for whether the government is divided.⁴⁹ This indicator takes the value 1 in case the governorship and the two chambers of legislature are not controlled by the same party. The results in Column 6 show that the extent to which state governments are divided does not explain the effects of resource windfalls on debt.

Last, we examine the role of political ties between the governor and the state’s representatives in the U.S. Congress. Hodler and Raschky (2014) show that political ties between a region and the ruler may lead to regional favoritism. Knight (2002) illustrates that states’ political placement in Congress (e.g. representatives heading central committees) affects the amount and nature of federal support they receive. Hence, the extent to which the governor is politically aligned with state representatives in the U.S. Congress may affect his/her fiscal behavior. To address this, we include a measure that gives the extent to which state

forward as the sample is significantly restricted under the current estimation.

⁴⁷If a governor leaves and comes back, the budgets he/she oversaw in the past are also counted.

⁴⁸This measure varies between 0.5 and 1, with higher values representing higher levels of competitiveness. We employ a four-year moving average of it. Note that NE is excluded from the sample due to its non-partisan legislature.

⁴⁹NE is excluded, due to its non-partisan legislature.

representatives in the U.S. Congress are affiliated with the same party as the governor. The measure is computed as the interaction of the fraction of years (within the time interval) that the governor is affiliated with the Democratic Party and the average share (within the time interval) of state representatives in the U.S. Congress that are affiliated with the Democratic Party. A higher (lower) measure points at stronger ties via the Democratic (Republican) party. The results in Column 7 indicate that political ties between the local and national executive branches do not play a central role in this.

Put together, the results point at the relative importance of the budgetary bargaining power of the governor. Facing a resource windfall, myopic governors are more able to alter the state's debt when they have greater past experience with fiscal budgets, and when the legislature employs relatively less full-time workers.

4.4.2 Time intervals

The benchmark analysis examined the case of 5-year time intervals, based on the notions that effects of myopia on political agendas and the significance of windfalls may sink-in, and hence be observed, over the course of several years. A key question is whether, and to what extent, the main results are dependent on this. Are differential effects of resource shocks viewed over shorter time spans? Are they also applicable over longer time horizons? To test this, we examine the main specification as per Equation (4.1), illustrated via Column 3 of Table 3, under different time intervals.

Specifically, we test the cases of 3-year, 8-year, 10-year, and 15-year intervals, representing both relatively shorter and significantly larger time spans. The results of each are presented in Columns 1-4 of Table 5, respectively. All cases follow the benchmark specification; in each, the variables are averaged over the corresponding time interval (t).

The estimated θ in each case remains positive and significant, suggesting that the main patterns observed are not sensitive to the choice of the time interval. Interestingly, its magnitude is largely increasing with the length of the time interval. For instance, focusing on the 15-year case, the magnitude is about 50% greater than that estimated under the 5-year, benchmark case. This, in turn, suggests that the preferences of politicians are dependent on the more general, long term trend, and that the main result is not driven by business cycle phenomena, but rather by longer term patterns.

Table 5: Different time intervals; 1963-2007

Dependent variable: The average real state debt per capita in period t	(1)	(2)	(3)	(4)
	3-year intervals	8-year intervals	10-year intervals	15-year intervals
Myopia x Windfall	359.93** (139.57)	782.64*** (208.29)	616.71** (269.3)	641.06** (250.13)
State fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
R-squared, within	0.38	0.4	0.58	0.8
Observations	720	288	240	144

Notes: Standard errors are robust, clustered by state, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t , the initial level of the dependent variable (i.e. at the first year of period t), and the separate components of the interaction term. Sample includes the 48 continental U.S. states and covers the period of 1963-2007 in different intervals (as outlined in each regression). The dependent variable is the average real state debt per capita in period t . 'Windfall' denotes the resource windfall measure described in the text. 'Myopia' is the proportion of years (within the time interval) in which the governor is not in his/her last term. For further information on variables see data Appendix.

4.4.3 Windfall measures

The analysis so far used the resource windfall measure of James (2015b). Next, we test two additional measures for robustness. The first, output-based, is the interaction between the GSP share of the mining sector in the initial year (1963) and the international price of crude oil. The second is the state income share from severance taxes.⁵⁰ The first measure is similar to the baseline one with the difference of examining production based cross-sectional differences in natural endowments. The second measure provides a more direct observation over states' income from natural resources. With the exception of using these measures, in lieu of the main one used so far, the specifications estimated follow the baseline one as per Column 3 of Table 3.

Results are presented in Table 6. Columns 1-3 (4-6) test the first (second) measure, and follow Columns 3-5 of Table 3 in terms of the sample examined. Notably, in all cases the estimated θ is positive and significant, indicating that the main result is robust to examining different measures of resource windfalls.

4.4.4 Additional tests

We undertake various additional robustness tests to the main specification. Results of this sub-section appear in Table 7. With the exception of specific additions, discussed separately

⁵⁰U.S.states levy severance taxes on the exploitation of natural resources.

Table 6: Different measures of resource windfalls; 1963-2007 (5-year intervals)

Dependent variable: The average real state debt per capita in period t	(1)	(2)	(3)	(4)	(5)	(6)
	Output based			Severance tax income		
	Full sample	Restricted sample: Myopia	Restricted sample: Windfall	Full sample	Restricted sample: Myopia	Restricted sample: Windfall
Myopia x Windfall (output based)	91.93** (45.19)	104.79** (40.72)	74.01** (38.38)			
Myopia x Windfall (tax based)				1.65** (0.66)	1.68*** (0.61)	1.35** (0.54)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.42	0.45	0.33	0.42	0.47	0.34
Observations	432	306	396	432	306	396

Notes: Standard errors are robust, clustered by state, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t , the initial level of the dependent variable (i.e. at the first year of period t), and the separate components of the interaction terms. Sample includes the 48 continental U.S. states and covers the period of 1963-2007 in 5-year intervals. In Regressions 2 and 5 the sample excludes the states with no restrictions on the number of governors' terms; namely: CT, IA, ID, IL, MA, MN, ND, NH, NY, TX, UT, VT, WA, WI. In Regressions 3 and 6 the sample excludes the states with zero windfalls through the sample period; namely: DE, ME, NH, RI. The dependent variable is the average real state debt per capita in period t . 'Windfall (output and tax based)' denote the resource windfall measures described in the text. 'Myopia' is the proportion of years (within the time interval) in which the governor is not in his/her last term. For further information on variables see data Appendix.

in each test, we follow the main specification, as per Column 3 of Table 3, in all cases. First, we make two (separate) additions to the model. First, we add state-specific time trends (Column 1), and second we follow a two-way clustering method where standard errors are assumed to be correlated within states and years (Column 2). The former case contributes to controlling for time trends that may be specific to certain states which could, in turn, affect public debt (for instance, continuous divergent changes in local prices and wages). The latter takes a more conservative perspective on the measure of the standard errors and preciseness of the estimates. The results in both cases indicate that the main effect is maintained.

Second, we examine a restricted sample, in which we exclude California, New York, and Texas from the sample (Column 3). This restriction tests the robustness of the key results to the exclusion of the three largest states. The latter provides a more careful examination of the previously discussed assumption that states are essentially price takers that take r as given. The estimated θ indicates that the main result is robust to this exclusion.

Third, we examine the case where AK and HI are included in the sample. These states are excluded from the main analysis due to the measure of resource windfalls employed. Hence, in this case we use the output-based windfalls measure described in the previous sub-

Table 7: Additional tests; 1963-2007 (5-year intervals)

Dependent variable: The average real state debt per capita in period t	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	State-specific time trends	Two-way clustering	CA, NY, and TX excluded	AK and HI included	Average tax rates	Pooled OLS	Heterogeneity Analysis
Myopia x Windfall	475.31*** (177.96)	483.19*** (142.47)	483.31** (196.3)		430.84*** (176.87)	471.93** (197.75)	472.22** (161.54)
Myopia x Windfall (output based)				108.98** (50.69)			
Myopia x Windfall x Noterm							336.14** (139.72)
State fixed effects	Yes	Yes	Yes	Yes	Yes	No	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, within	0.44	0.46	0.42	0.49	0.43	0.32	0.43
Observations	432	432	405	450	432	432	432

Notes: Standard errors are robust, clustered by state in Columns 1, 3, 4, 5, 6, and 7 and by state and year in Column 2, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include an intercept, the average natural logarithm of real per capita GSP in period t, the initial level of the dependent variable (i.e. at the first year of period t), and the separate components of the interaction term. Sample includes the 48 continental U.S. states (except Column 3, where CA, NY, and TX are excluded, and in Column 4, where AK and HI are included), and covers the period of 1963-2007 in 5-year intervals. The dependent variable is the average real state debt per capita in period t. 'Windfall' and 'Windfall, output based' denote the resource windfall measures described in the text. 'Myopia' is the proportion of years (within the time interval) in which the governor is not in his/her last term. 'Noterm' is a state-dummy variable that captures the 14 states with no gubernatorial term limits; namely, CT, IA, ID, IL, MA, MN, ND, NH, NY, TX, UT, VT, WA and WI. Column 1 includes in addition state-specific time trends. Column 5 includes in addition average tax rates. All regressions also include all the separate components (including separated interacted pairs) of the interactions reported. For further information on variables see data Appendix.

section (under which all the 50 U.S. states are covered), in lieu of the baseline measure. The estimated θ in Column 4 indicates that the main result holds in a slightly higher magnitude than that estimated in Column 1 of Table 6 (in which AK and HI were excluded).

Fourth, we test the role of state tax rates. The model suggests that tax policies can be relevant for understanding the effects of windfalls on debt. Hence, we consider average state tax rates, calculated as the ratio of state tax revenues to GSP. Thus, in Column 5 we add average tax rates to the specification. The estimated θ remains stable in its significance, sign, and magnitude, indicating that main result is robust to controlling for this choice variable.

Last, we consider the cross-sectional perspective. The model indicates that the size of \bar{T} may affect the extent to which resource windfalls affect debt. To examine this more explicitly, we undertake two tests. First, we estimate the model without state fixed effects (Column 6); this eliminates the within-state perspective, and provides a clearer observation over the cross-sectional differences. Second, we undertake a more direct heterogeneity analysis across state-levels of \bar{T} (Column 7); specifically, we interact our interaction term of interest with

a state-dummy that captures the aforementioned 14 states that have no gubernatorial term limits and estimate the baseline specification with its inclusion (together with its separate components, and their interacted pairs). The results indicate that the cross-sectional institutional differences may indeed play a central role. Specifically, in Column 6 the main result remains to hold, with an increased magnitude, and in Column 7 we notice that the extent to which resources increase debt increases substantially in states with no gubernatorial term limits.

5 Conclusion

This work examined how resource windfalls may affect public debt via political impatience. We offered a political economy model of endogenous public debt under exogenous resource windfalls, in which reelection prospects give rise to political accountability but at the same time shorten the time horizon of incumbents. The latter (myopia) effect induces a budget deficit bias that is reinforced by resource windfalls due to their (negative) effect on the cost of borrowing. Notably, this feedback effect was shown to intensify with the magnitude of myopia, evaluated by the discrepancy between the electorate's and incumbent's discount rates, potentially yielding a debt overhang.

The model's predictions were tested empirically via a panel of the 48 continental U.S. states over the period 1963-2007. An intra-U.S., cross-state perspective enabled examining a relatively homogenous environment in which differences in political myopia were captured via institutional differences in gubernatorial term limits, and differences in natural endowments were captured via geologically-based differences in recoverable stocks of oil and gas. Our two key identification assumptions rested on the (exogenous) constitutionally-entrenched cross state differences affecting political myopia, and the plausible exogeneity of the geographic-based resource windfalls measure.

Under these circumstances we examined the effects of resource windfalls on changes in states' debt across states' myopia levels. The empirical results corroborated the theoretical prediction that resource windfalls exacerbate states' deficits for reelection-seeking incumbents relative to lame duck governors. These patterns were found to be robust, persistent, and significant. In addition, the analysis indicated that governors' budgetary bargaining power is a potentially important transmission channel.

The results shed light on the interaction of political myopia and resource windfalls. Myopic politicians exploit the features of public debt based on political incentives. This work

suggested that they may similarly exploit the features of resource windfalls. Myopia, however, represents a specific characteristic of political agents. Examining whether additional aspects of political incentives may shape the way that windfalls-based surpluses are handled by political agents is left for future research.

Appendix

We use an annual-based state-level panel that, unless otherwise specified, covers the 48 continental U.S. states over the period 1963-2007. Unless otherwise specified, the panel is based on 5-year intervals; real terms are in 2009 prices. Descriptive statistics for all variables appear in Table A1.

Variable definitions

Real state debt per capita: Real state (outstanding) debt, divided by state population. Source: U.S. Census Bureau.

Real state interest payments per capita: Real state interest payments, divided by state population. Source: U.S. Census Bureau.

Windfall: Recoverable state stocks of oil and natural gas (cross-sectional) interacted with the international price of crude oil and natural gas at time t , and normalized by the average state income (averaged over 1958-2008). AK and HI are excluded. Source: James (2015b).

Windfall, output based: The GSP share of the mining sector in 1963 interacted with the international price of crude oil at time t . Source: U.S. Bureau of Economic Analysis.

Windfall, tax based: Real state severance tax income per capita. Source: U.S. Census Bureau.

Myopia: The proportion of years (within the time interval) in which the governor is not in his/her last term. Source: National Governors Association.

Real GSP per capita: Real GSP, divided by state population. Source: U.S. Census Bureau.

Party affiliation of governor: An indicator for the party of the governor; 0 = Republican, 1 = Democrat, 0.5 = non-major party governor. Source: Marty and Grossman (2016).

Legislator-governor party match: The fraction of legislatures that have a common party affiliation with the governor. NE is excluded. Source: Marty and Grossman (2016).

Budgets overseen: The number of budgets that the governor has overseen. If a governor leaves and comes back, the budgets he/she oversaw in the past are also counted. Source: Marty and Grossman (2016).

Ranney Index: Ranney measure of electoral competitiveness (Ranney (1976)). Four-year moving average. Varies between 0.5 and 1; higher values representing higher levels of competitiveness. NE is excluded. Source: Marty and Grossman (2016).

Divided government: A binary indicator for whether the two chambers of legislature and governorship are not all controlled by the same party; 0 = same party controls all three institutions. NE is excluded. Source: Marty and Grossman (2016).

Legislator salary: Real legislator salary (available from 1971). Source: Marty and Grossman (2016).

Average tax rates: GSP share of tax revenues. Source: U.S. Census Bureau.

Congress-governor party match: The extent to which the state U.S. Congress representatives are affiliated with the same party as the governor. Computed as the interaction of the fraction of years (within the time interval) that the governor is affiliated with the Democratic Party and the average share (within the time interval) of U.S. Congress members that are affiliated with the Democratic Party. Source: Marty and Grossman (2016).

Table 8: Descriptive statistics

	Mean	Std. Dev.	Min.	Max.
Real state debt per capita	1242.51	945.61	368.37	5525.41
Myopia	0.72	0.45	0	1
GSP share of state debt	0.03	0.03	0.00	0.21
Real GSP per capita	31281.08	10951.71	11351.48	110865.71
Democratic representatives in the U.S. lower house	4.68	5.57	0	33
Democratic representatives in the U.S. upper house	0.99	0.75	0	2
Windfall	0.02	0.06	0	0.7
Windfall, output based	0.001	0.002	0	0.12
Windfall, tax based	46.69	144.24	0	1634.83
Interest payments per capita	67.98	101.16	0.22	1110.76
Party affiliation of governor	0.55	0.49	0	1
Legislator-governor party match	55.11	20.76	0	100
Number of budgets passed by governor	2.79	2.62	0	15
Ranney Index	0.85	0.12	0.51	1
Divided government	0.23	0.42	0	1
Legislator salary (\$ thousands)	55.81	47.02	0	254.94
Average tax rates	0.06	0.02	0.02	0.34

Notes: See Appendix for detailed description of variables.

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