Public debt and the political economy of reforms*

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November 10, 2021

Abstract

How do electoral incentives influence the choice to experiment with a policy reform that generates uncertain future benefits? We answer this question in a two-period model of redistributive politics with a policy reform that involves a mixture of private and public benefits. We show that the intertemporal tradeoff between current policy costs and future benefits creates an incentive for politicians to use public debt to smooth governmental spending across periods. The higher the share of policy benefits that are in the form of a public good, the higher the level of available debt-related spending on targeted policies that is necessary. We also examine hard and soft debt limits. We find that (i) both limits reduce the political success of the reform and (ii) soft limits dominate hard limits with respect to equilibrium efficiency of reform provision. Finally, we illustrate empirically the mechanisms highlighted in the model.

Keywords: Political Competition; Public Debt; Reforms; Redistributive Politics; Debt and Spending Limits.
JEL classification: C72; D72; D78; H6.

*We thank Enriqueta Aragonès, Laurent Bouton, Micael Castanheira, Davide Cantoni, Guillaume Cheikbossian, Antonio Ciccone, Eduardo Davila, Philipp Denter, Philippe De Donder, Matthias Doepke, Allan Drazen, Clemens Fuest, Vincenzo Galasso, Catarina Goulão, Renato Gomez, Hans Peter Grüner, Matthias Hertweck, Roland Hodler, Eckhard Janeba, Paul Klein, Yukio Koriyama, Dan Kovenock, Michel Le Breton, Alessandro Lizzeri, Aniol Llorente-Saguer, Mickael Melki, Ralf Meisenzahl, Jean-Baptiste Michau, Massimo Morelli, Salvatore Nunnari, Andreas Peichl, Eugenio Peluso, Eduardo Perez, Facundo Piguillem, Mattias Polborn, Niklas Potrafke, Anasuya Raj, Alessandro Riboni, Nicolas Sahuguet, Maik Schneider, Klaus Schmidt, Guido Tabellini, Michèle Tertilt, Karine Van Der Straeten, Ngo Van Long, and Galina Zudenkova for very helpful comments, as well as seminar and conference participants at Bocconi University, Munich University, University Carlos III Madrid, Toulouse School of Economics, Mannheim University, École polytechnique, Transatlantic Theory Workshop 2019, SAET 2019, PET 2019, "Political Economy conference" in ECARES 2017, CESifo Area Conference on Public Sector Economics 2016, Workshop "Political Economy: Theory meets Empirics" 2015 in Konstanz, LAGV 2015, and the Verein für Socialpolitik 2015. We thank Andrew Lonsdale for his outstanding research assistance. The first author gratefully acknowledges the Investissements d'Avenir (ANR-11-IDEX-0003/Labex Ecodec/ANR-11-LABX-0047), ANR-19-CE41-0011-01 and ANR-20-CE41-0013-01 for financial support. The second author gratefully acknowledges the Collaborative Research Center 884 for financial support. The usual disclaimer applies.

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1 Introduction

In this paper, we investigate how electoral incentives influence the choice to experiment with a policy reform that requires a current investment and generates uncertain future benefits. Many policy reforms involve a tradeoff between current costs and uncertain benefits in the future. Examples include R&D, military weapons systems, and infrastructure. In this context, what determines whether efficient reforms are implemented in the political process? A key to answering this evergreen question is to understand under which circumstances electoral incentives can stand in the way of reforms (e.g., Rodrik (1996), Persson and Tabellini (2000) or Drazen (2000)). Since the reform involves an intertemporal tradeoff between its current costs and uncertain future benefits, an important electoral consideration is the ability to use public debt to smooth governmental resource constraints across periods. How do the characteristics of the reform's uncertain benefits *and* the ability to raise public debt affect the electoral incentives to experiment with the reform?

Our main contribution is to show that because electoral competition occurs, to a considerable degree, through the targeting of electoral favors to subsets of voters in order to gain their support, the decision to experiment with the reform should be influenced by how this decision affects the ability to target resources. In particular, our analysis identifies two important determinants of reform implementation in the political process: (i) the role of the nature of the benefits a reform generates, i.e. whether the reform generates resources that can be used to further redistribute (private good nature) or delivers non-rival and non-excludable benefits (public good nature);[1] and (ii) the interaction between debt limit policies and the decision to implement beneficial reforms. These results highlight a new view on the tradeoff between targeted pork-barrel spending, which does not increase aggregate welfare, and efficient policies such as investing in a beneficial reform. If efficient policies create benefits in future electoral cycles, then allowing enough debt-related spending on targeted policies may be necessary to incentivize investment in these policies, and the higher the share of policy benefits that are in the form of a public good, the higher the level of available debt-related spending on targeted policies that is necessary.

Beginning with the nature of the reform's benefits, future benefits of a reform may feature a mix of pure-public good benefits and private-good spillovers: a portion of the reform benefits consist of an increase in the endowment of the economy and the remaining portion of the benefits are of a public good nature. By way of illustration, starting from a situation with deficient enforcement of property and civil rights, consider a reform of the legal system

[1] Several empirical studies have look at the relationship between the nature of the benefits delivered by the political process and institutional features of the polity like electoral rules or the appointment rules for public officials; see Gagliarducci, Nannicini and Naticchioni (2011), Funk and Gathmann (2013), or Martinez-Bravo (2014).

that ensures efficient and universal enforcement of these rights. This is what is usually termed establishing the rule of law.[2] By decreasing uncertainty for investors, such a reform will lead to an increase in the economy's GDP,[3] which in our case corresponds to an increase in the endowment of the economy. Besides that there will be a general increase in well-being beyond the increase in the endowment: everybody will feel safer in such a functioning legal environment. This second kind of benefit has the properties of a public good in the sense that it is non-rival and non-excludable.[4] When the benefits result in an increase in the endowment that can be taxed, the benefits can potentially be redistributed to specific voters. In the case where the benefits have a public good nature, a politician that decides to make the reform cannot shuffle the benefits derived by the voters from it. A first insight from our analysis is that the characteristics of the reform's uncertain benefits, i.e. the reform's ratio of private to public good gains, is a key determinant of whether the political process stands in the way of an efficient reform.

On the interaction of reform implementation with public debt, note that without the ability to use public debt to smooth the cost of the reform, politicians can only target voters with resources from the current period. This creates a disadvantage for a reforming candidate, who loses a share of these targetable resources because they incur the cost of the reform in the current period. In contrast, the use of public debt allows politicians to utilize future resources in the current period's targeting of resources to voters. This gives a competitive edge to a reforming candidate, since her advantage lies in the future where the benefits of the reform occur. Indeed, our results show that allowing a reformer to make up for her loss in targeting capacity via debt-related spending on targeted policies is crucial for the implementation of the reform in the political process. In particular, we find that (i) both hard and soft debt limits reduce the political success of the reform but (ii) soft limits dominate hard limits with respect to equilibrium efficiency of reform provision.

Our analysis involves a two-period model of redistributive politics that extends Lizzeri (1999)[5] to allow for a policy reform that requires a current investment and generates uncertain future benefits, where we allow the reform's second-period benefits to feature a mix of pure-public good benefits and private-good spillovers. That is, a portion of the reform benefits consist of an increase in the endowment of the economy and the remaining portion of

[2] See, for instance, La Porta, de Silanes and Shleifer (2008), Besley and Persson (2011), and Acemoglu and Robinson (2012).

[3] Rodrik, Subramanian and Trebbi (2004) and Djankov, McLiesh and Shleifer (2007) provide empirical support for this claim.

[4] Excluding some people from access to the legal system would mean a failure to establish the rule of law.

[5] Using the model of Lizzeri (1999) is particularly compelling for our analysis: (1) the model shows the effect of electoral competition on policy outcomes without any pre-imposed heterogeneity, (2) it derives political turnover endogenously as the outcome of the electoral game, and (3) there are no *ad hoc* assumptions on the shape of the pork-barrel distributions (see our discussion in Section 2).

the benefits are of a public good nature. Two politicians compete for election in each period. They do so by targeting available resources to subsets of voters at the expense of others. This tactical redistribution does not imply any efficiency gain. In the first period, politicians also choose the level of public debt *and* we introduce the option to experiment with the reform. The reform is efficient in the sense that it costs resources in the first period but yields higher expected benefits in the second period. In line with the political economy literature (e.g., Lizzeri and Persico (2001)), we assume that benefits that have a private good nature can be targeted to individual voters whereas targeting is precluded for the public good part of the reform. Intuitively, resources left in the future cannot be targeted to specific voters due to electoral uncertainty between the two periods.[6]

To illustrate empirically the importance of debt and targeted transfers in facilitating reforms in the form of public investment, we perform a descriptive analysis of trends in levels of debt, public investment, and targeted transfers for a number of OECD countries since 1995. This analysis reveals a tendency for public investment and targeted transfers to decline when debt levels rise. This observation is consistent with the notion that limitations on the feasibility of going into debt correspond with a lower incidence of reforms. This relationship is further strengthened where we show that higher (respectively lower) levels of "debt capacity" – measured as a distance between the level of debt in the previous period and its mean level of debt over the whole period – lead to above average (respectively below average) levels of public investment and targeted spending. Evidence from our empirical analysis also favors the conclusion that debt limit policies reduce the ability for governments to implement reforms: we divide our sample into Eurozone and non-Eurozone states and take advantage of the fact that the former set of countries is subject to a 60% limit on domestic debt-to-GDP levels, which was first introduced by the Maastricht Treaty in the 1990s and later enshrined by the Stability and Growth Pact. This exercise reveals a stronger negative relationship between debt capacity and our two dependent variables of interest – public investment and targeted transfers – among Eurozone countries compared to the non-Eurozone states in our sample. Finally, within Eurozone we compare the countries that faced a hard debt limit – defined as having a mean debt-to-GDP ratio above the 60% Maastricht Treaty ceiling during this period – to the other countries. In line with our theoretical analysis we find that countries that were subject to a hard debt limit are governed by a stronger negative relationship between debt capacity and public investment and targeted transfers with respect to the countries with softer debt limit.

[6]This electoral uncertainty is not an artefact of the assumption that politicians are unable to commit about second-period transfers. As shown in Lizzeri (1999), allowing candidates to commit does not change the electoral incentives since a candidate who commits to future transfers can only make promises about her own future behaviour, not about ones made by the other candidate.

Outline. The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 describes the formal framework. Our main results are presented in Section 4, where we solve for the equilibrium of the game, and in Section 5 where we study the implications of constitutional limits on debt and spending. Section 6 illustrate empirically the forces highlighted in our results. The last section contains concluding remarks. We relegate the proofs to the Appendix.

2 Related literature

Our work builds on the game-theoretic literature on the divide-the-dollar game. Following Myerson (1993), this literature features models of political competition in which a policy proposal specifies how a cake of a given size should be distributed among voters.[7] Our model differs from these models in that policy proposals affect the size of the cake that is available for redistribution.[8] Lizzeri and Persico (2001; 2005) characterize political equilibria under the assumption that politicians face a choice between an efficient public good and pork-barrel redistribution. In their static framework, they show that targeted pork-barrel spending stands against the efficient policy of providing a public good that creates a net gain in utility.[9] In contrast, we consider an efficient policy that is of a dynamic nature in the sense that its benefits only occur in the next electoral cycle. For such policies, we show that allowing more debt-related targeted spending can actually increase the probability of implementing the efficient policy. This provides a new view on the effects of targeted spending which until now has mainly been shown to disincentive efficient spending on public goods in the same electoral cycle.

Extending Myerson (1993)'s setup to a dynamic model, Lizzeri (1999) shows that in a two-period model of divide-the-dollar electoral competition, candidates will always raise the maximal debt. Our analysis builds on Lizzeri (1999) by studying the interaction between debt and reform in such a redistributive politics setup. This setup allows to distill the pure effect of electoral competition on policy outcomes, because it does not impose any exogenous heterogeneity on politicians or voters. Furthermore, it derives political turnover endogenously as the outcome of the electoral game. In contrast, the literature on strategic

[7]Contributions to this literature include Laslier and Picard (2002), Roberson (2006), Sahuguet and Persico (2006), Carbonell-Nicolau and Ok (2007), Kovenock and Roberson (2008; 2009), or Eguia and Nicolò (2019). See Kovenock and Roberson (2012) for a review.

[8]Some related papers that endogenize the size of the redistributive pie are Ueda (1998), Bierbrauer and Boyer (2016), and Boyer, Konrad and Roberson (2017), however these papers are static and do not study the interaction between debt and reforms.

[9]Roberson (2008) adds the possibility to provide different public good to different districts. Crutzen and Sahuguet (2009) allow for inefficiencies in the process of collecting resources.

debt has derived the tendency of the political process to accumulate debt from partisan preferences combined with the exogenously imposed threat that a currently ruling government is replaced in the future. Alesina and Tabellini (1990) show that a currently ruling party that has different spending objectives than a potential future incumbent uses debt to tie its successor's hands.[10] Recently there has been a revival of the literature on the political economy of public debt.[11] Battaglini and Coate (2008) introduce Barro (1979)'s tax smoothing setup of public debt into an infinite horizon model of legislative bargaining. They show that, when an electoral district is not sure to remain in the governing coalition, the incentive of politicians to spend pork on their own district leads to the use of public debt even when this means accepting higher tax distortions in the future.[12] In that sense, investing into low public debt is an efficient dynamic policy whose benefits only occur in the future. By its very nature, it is the only such policy that cannot be incentivized by a higher use of public debt. We add an important aspect to this literature by establishing this incentivizing effect of public debt for all other efficient dynamic policies that have costs today and benefits in the future.

We also complement the existing literature on political economy of reforms. In this paper, we shut down the channels that the previous literature has identified as impediments to reform.[13] Our objective is to show how efficient reforms and public debt interact in a setup of electoral competition, absent all the previously identified channels. For observers

[10] Other pioneer papers in this line of research are Persson and Svensson (1989), Aghion and Bolton (1990) and Tabellini and Alesina (1990). See Martimort (2001) for an extension of these models to an optimal income taxation setup.

[11] See Yared (2019), Alesina and Passalacqua (2016), and Battaglini (2011) for recent reviews of this literature.

[12] See Barseghyan and Battaglini (2016) for a recent application of the legislative bargaining model investigating public debt in a growth setup. Further papers with different setups are Yared (2010), Drazen and Ilzetzki (2011), Song, Storesletten and Zilibotti (2012), Maskin and Tirole (2019), Azzimonti, de Francisco and Quadrini (2014), and Müller, Storesletten and Zilibotti (2016).

[13] In contrast to Fernandez and Rodrik (1991) and Cukierman and Tommasi (1998), our analysis does not link the benefits and costs of reform to specific voters. Consequently, we also do not consider problems of asymmetric information in compensating losers of the reform as in Grüner (2002). Furthermore, we have no uncertainty regarding appropriate timing of the reform as in Laban and Sturzenegger (1994a; 1994b) and Mondino, Sturzenegger and Tommasi (1996). Reforms do not fail because of insufficient technical knowledge by decision makers as in Caselli and Morelli (2004) and Mattozzi and Merlo (2015). We also exclude powerful vested interest that could block reform as in Olson (1982), Benhabib and Rustichini (1996) and Gehlbach and Malesky (2010). There is no conflict between different groups about who will bear the costs of reform as in Alesina and Drazen (1991), Drazen and Grilli (1993) and Hsieh (2000). Finally, the success of the reform does not depend on the competence of politicians as in Prato and Wolton (2014) or Bowen, Chan, Dube and Lambert (2016). Inefficiencies of the political process to pursue efficient investment have been investigated in several setups, see, e.g., Besley and Coate (1998), Battaglini and Coate (2007), Azzimonti, Sarte and Soares (2009), Battaglini, Nunnari and Palfrey (2012), and Azzimonti (2015).

of the public policy debates throughout the Great Recession, understanding the intertwined relationship between debt and reform is crucial for policy issues.[14] The only previous papers that have looked at public debt in combination with reforms do not model electoral competition. Specifically, Beetsma and Debrun (2004; 2007) rely on the assumption of an exogenous probability of change in political power. They do not consider a feedback of the decisions on debt and reform on the electoral outcome. As we show in our model, these forces of political competition are crucial to understanding the interaction between debt and reforms. Ribeiro and Beetsma (2008) provides an important first step towards endogenizing political turnover. However, they still need to add a final period with exogenous probability of change in power. Furthermore, one politician is forced to run a reform platform and she cannot decide not to reform, while her opponent is exogenously set to run a no-reform platform. This precludes to see the workings of the forces of political competition that we establish in this paper.[15]

Constitutional limits on debt and spending limits are a popular response to debt crisis and are present in many jurisdictions.[16] Recent papers using alternative models make progress on our understanding of the role of fiscal rules constraining debt on the outcome of the political process.[17] Azzimonti, Battaglini and Coate (2016) analyze the impact of a balanced budget rule that requires that legislators do not run deficits in the setup of Battaglini and Coate (2008).[18] They show that imposing a balanced budget rule reduces existing debt levels with beneficial long run effects because it reduces the revenues that must be devoted to servicing the debt. Cunha and Ornelas (2018) investigate the tradeoff between intense political turnover and unrestricted access to debt. In particular they show that strict limits on government borrowing can exacerbate political economy distortions by making a political compromise unsustainable. Piguillem and Riboni (2020) and Coate and Milton (2019) study the implications for fiscal policy if it is possible for politicians to override the rules with enough supports among elected politicians or in the electorate. Finally, Bouton, Lizzeri and

[14] Müller, Storesletten and Zilibotti (2019) provide an important analysis of positive and normative implications of interacting sovereign debt dynamics and structural reforms.

[15] The importance of considering these forces can be seen in Esslinger and Mueller (2015) (see also Chapter 4 of Esslinger (2016, University of Mannheim)) who do not model electoral competition either. They show how the interaction between future investments and public debt can be impaired when the forces of electoral competition are taken out of the picture.

[16] For instance, most U.S. states have a balanced-budget rule and the Stability Pact in the European Union limits gross government debt to sixty percent of GDP. Germany adopted in 2009 a constitutional rule referred to as the debt brake that requires the federal and state governments to run balanced budgets from 2016 and 2020 onwards respectively (see Janeba (2012) for details). See Rose (2010) and Schaechter, Kinda, Budina and Weber (2012) for reviews of balanced-budget rules and debt limits.

[17] For the optimality of rules see, e.g., Amador, Werning and Angeletos (2006), Halac and Yared (2014), or Halac and Yared (2019).

[18] Halac and Yared (2018) study the design of fiscal rules in a global economy in which individual rules affect global interest rates.

Persico (2020) are interested in the interaction between debt and entitlements. One of their main results is to show that it may be beneficial to relax a constraint on debt, and always to limit but not eliminate entitlements. In our context, first-period debt limits decrease the maximum level of targetable resources in the first period, and consequently increase the maximum level of targetable resources in the second period. As the maximum level of targetable resources in the first period decreases, the opportunity cost of implementing the policy in the first period increases. Thus, we find that the introduction of first-period debt limits always decreases the equilibrium probability with which the efficient policy is implemented. As a result, in political competition in which reform is of a dynamic nature, allowing enough debt-related pork-barrel spending may be necessary to incentivize candidates to choose the reform policy.

3 The model

Consider a two-period redistributive politics game with policy investment that is described as follows.

The electorate. There are two periods and a continuum of voters of measure one. All voters are ex-ante homogeneous. They are risk-neutral, live for the two periods, and have a discount factor equal to 1. There are two goods, money and a public good. Voters have linear utility over both goods and the marginal utility of money is normalized to one.[19] In each period, each voter is endowed with one unit of money which is perfectly divisible.

Political process. In each of the two periods, denoted $t \in \{1, 2\}$, there is an election in which voters choose between two candidates. The set of candidates is the same for both periods. One candidate is denoted by A, the other by B. Each candidate $i \in \{A, B\}$ is purely office-motivated and maximizes their vote share in each period.

Platforms. In each period, each candidate announces a binding platform involving transfers and, in the first period, there is the possibility of experimenting with a policy with uncertain benefits. If the policy is implemented, then the policy costs are incurred and the value of the (uncertain) second-period policy benefits are realized.

We also allow the policy's second-period benefits to feature a mix of pure-public good benefits and private-good spillovers: a portion of the reform benefits consist of an increase in the endowment of the economy and the remaining portion of the benefits are of a public good

[19] Our main results extend directly to the case of a quasi-linear utility function that is concave in public good consumption.

nature. Formally, a fraction $\lambda \in [0, 1]$ of the policy benefits are in the form of private-good benefits. The remaining part $(1 - \lambda)$ of the benefits are in the form of pure public-good benefits. Hence, for $\lambda = 0$, we have the case of a pure-public good. For $\lambda = 1$ on the other hand, the policy benefits are in the form of a private good and increase the second-period per-capita endowment of the economy. Note that it is impossible for politicians to affect the distribution, across voters, of the fraction $(1 - \lambda)$ of policy utility derived from the public-good component of the gains. This is often referred to as the non-targetable part of the policy in the redistributive politics literature (e.g., Lizzeri and Persico (2001)). In contrast, the fraction λ of policy utility from the private goods component of the gains is targetable and can be redistributed among voters in the political process. Because the proportion λ of policy utility may, potentially, be redistributed across voters, we refer to λ also as the degree of targetability of policy benefits.

Candidate i's first-period platform p_1^i has three elements: a possibly random decision of whether or not to enact the policy,[20] a level of public debt, and promises of taxes and transfers to each individual voter, and we examine each of these three components of the first-period platform in further detail below. In the case that the policy is implemented, both the level of public debt and the promises of taxes and transfers may be contingent on the realized state of the uncertain policy benefits. Conditional on the observable outcome of the first-period's election and resulting policy benefits and debt level, candidate i's second-period platform p_2^i consists of promises of taxes and transfers to each individual voter.

1. Policy. We denote by c the per capita cost and by e the realization of the per capita benefit from the policy, where the discrete random variable $\widetilde{e}$ is distributed according to a probability mass function Γ_e with the set of possible values $\mathcal{E}$, a finite subset of $\mathbb{R}_+$.[21] We use the notation $e = \emptyset$ to denote that the policy was not implemented, and we focus on the case that the parameters $E_{\Gamma_e}(e)$ and c satisfy the following two conditions:

$$1 > E_{\Gamma_e}(e) - c > 0, \tag{A1}$$

$$1 > c. \tag{A2}$$

Assumption $(A1)$ states that the average net policy benefits $E_{\Gamma_e}(e) - c$ are large enough that the policy should always be implemented from an *ex-ante* efficiency perspective. Furthermore, $(A1)$ states that the average net policy benefits $E_{\Gamma_e}(e) - c$ are less than the (per period) endowment of the economy. Thus, our focus is on policies with net benefits that

[20]A mixed strategy in this game could in principle be a very complicated object. We focus on the case that candidates only mix over the decision to implement the reform which generates an associated debt level and distribution of transfers. This convention follows Lizzeri and Persico (2001), and as we show, contingent on the reform choice, debt is always deterministic in equilibrium.

[21]Note that the case of certain policy benefits is a special case of our model.

are, independently of redistributive politics considerations, neither so high that they would always be provided in the political process nor so low that they would never be provided in the political process. Assumption ($A2$) ensures that there is enough first-period endowment to finance the policy, i.e. implementing the policy does not require a second-period debt obligation.

Let $\iota_i \in \{0,1\}$ be a policy position indicator function, where $\iota_i = 1$ if candidate i implements the policy. In the following, we let $\beta_i \in [0,1]$ denote the probability that candidate i implements the policy. Finally, let $\iota(e)$ denote the first-period policy choice resulting from the first-period's political process and realization of $e \in \mathcal{E} \cup \emptyset$, where $\iota(\emptyset) = 0$ and $\iota(e) = 1$ for all $e \in \mathcal{E}$.

2. Debt. Government debt is financed by borrowing from abroad and there is no possibility of default.[22] The size of the deficit in the first period is interpreted as the fraction of the average voter's second-period resources that is pledged to the repayment of the debt. We also allow for the possibility that the government runs a surplus.

The natural limit on debt corresponds to the total resources that can be mobilized to repay debt. Let $\delta_i(e)$ denote the debt level resulting from candidate i's first-period platform when the realized policy benefit level is $e \in \mathcal{E} \cup \emptyset$. If candidate i implements the policy ($\iota_i = 1$) and the realized policy benefit level is $e \in \mathcal{E}$, then the maximal amount of resources that can be transferred from the second period to the first period increases by λe, and feasibility of the debt level requires that $\delta_i(e) \in [-1+c, 1+\lambda e]$. If candidate i does not implement the policy ($\iota_i = 0$ and $e = \emptyset$), then feasibility of the debt level requires that $\delta_i(\emptyset) \in [-1, 1]$. Given the outcome of the first-period's political process, it will also be useful to let $\delta(e)$ denote the realized debt level of the economy conditional on the realization of policy benefits e generated by the winning candidate's first-period policy position and to let $\mathcal{S}_{pd}$ denote the set of feasible policy and debt states $(e, \delta(e))$:

$$\mathcal{S}_{pd} = \{(e, \delta(e)) | e \in \mathcal{E} \cup \emptyset \ \& \ \delta(e) \in [-1 + \iota(e)c, 1 + \iota(e)\lambda e]\}.$$

3. Redistribution. In the analysis that follows, we focus on the voters' endowments of the private good net any taxes or transfers in each period $t \in \{1, 2\}$, which we refer to as the period t *net endowment* and which must be weakly positive. Note that, because each voter is endowed with one unit of money in each period, a period t net endowment in the interval $[0, 1]$ corresponds to a tax on the voter's endowment of one unit of money, and a net endowment greater than 1 corresponds to a positive transfer to a voter.

We follow Myerson (1993) and assume that, conditional on the policy state $e \in \mathcal{E} \cup \emptyset$, the period t net endowments that candidate i offers to different voters are *i.i.d.* random variables

[22] The implications of considering the distortions generated by a default on debt in a similar setup are treated in Chapter 3 of Esslinger (2016, University of Mannheim). An overview of key issues in the economics of sovereign debt is provided by Aguiar and Amador (2014).

distributed according to the cumulative distribution functions $F_{i,1}(\cdot|e)$ and $F_{i,2}(\cdot|e,\delta(e))$, in periods 1 and 2 respectively. We appeal to the law of large numbers for large economies and interpret $F_{i,1}(x|e)$ and $F_{i,2}(x|e,\delta(e))$ not only as the probability that any particular individual receives an offer weakly smaller than x, but also as the population share of voters who receive such an offer.

Because there are $|\mathcal{E}|$ possible policy states and first-period redistribution may be contingent on the realized policy state, each candidate i's first-period net endowment offer to an arbitrary voter is a random $(|\mathcal{E}|+1)$-tuple, denoted by $\{\widetilde{x}_{i,1}(e)\}_{e\in\mathcal{E}\cup\emptyset}$ for candidate i. For any policy state $e \in \mathcal{E}\cup\emptyset$, $\widetilde{x}_{i,1}(e)$ denotes the random variable corresponding to candidate i's first-period net endowment offer to an arbitrary voter in policy state e. Let $P_{i,1}$ denote the $(|\mathcal{E}|+1)$-variate joint distribution of candidate i's first-period state-contingent net endowment offers, with the set of univariate marginal distributions $\{F_{i,1}(x|e)\}_{e\in\mathcal{E}\cup\emptyset}$ where $F_{i,1}(x|e)$ denotes candidate i's cumulative distribution of first-period net endowment offers conditional on the policy state e.

Let $P^{\mathcal{E}}_{i,1}(\mathbf{x})$ denote the $|\mathcal{E}|$-variate marginal distribution of $P_{i,1}(\mathbf{x})$ corresponding to the state-contingent net endowment offers for the policy states in $\mathcal{E}$. At times we will be interested in the random variable formed by taking the expectation with respect to the policy state e of a random draw of an $|\mathcal{E}|$-tuple, $\{\widetilde{x}_{i,1}(e)\}_{e\in\mathcal{E}}$, from $P^{\mathcal{E}}_{i,1}(\mathbf{x})$, which we denote by $\widetilde{x}^{\Gamma_e}_{i,1}$ where

$$\widetilde{x}^{\Gamma_e}_{i,1} := \sum_{e\in\mathcal{E}} \Gamma_e(e)\widetilde{x}_{i,1}(e). \tag{1}$$

Note that the cumulative distribution of $\widetilde{x}^{\Gamma_e}_{i,1}$, denoted $F_{x^{\Gamma_e}_{i,1}}(x)$, is calculated as the measure of the support of $P^{\mathcal{E}}_{i,1}$ below the hyperplane defined by $\sum_{e\in\mathcal{E}} \Gamma_e(e)\widetilde{x}_{i,1}(e) \leq x$.

Given the policy and debt state $(e,\delta(e)) \in \mathcal{S}_{pd}$, each candidate i's second-period net endowment offer to an arbitrary voter is a random variable $\widetilde{x}_{i,2}(e,\delta(e))$. Let $F_{i,2}(\cdot|e,\delta(e))$ denote candidate i's cumulative distribution of second-period net endowment offers contingent on the state $(e,\delta(e))$. Across all possible realizations of $(e,\delta(e)) \in \mathcal{S}_{pd}$, the complete set of candidate i's second-period net endowment offers is denoted by $\{\widetilde{x}_{i,2}(e,\delta(e))\}_{(e,\delta(e))\in\mathcal{S}_{pd}}$ with the corresponding set of cumulative distributions of second-period net endowment offers $\{F_{i,2}(\cdot|e,\delta(e))\}_{(e,\delta(e))\in\mathcal{S}_{pd}}$.[23]

[23]Because a behavior strategy in an extensive-form game specifies a probability distribution over the possible actions at each information set, each candidate's platform specifies a parametric family of cumulative distributions of second-period net endowment offers $\{F_{i,2}(\cdot|e,\delta(e))\}_{(e,\delta(e))\in\mathcal{S}_{pd}}$. Note that because the probability distributions specified by a behavior strategy are independent at each node, the second-period net endowment offers are independently distributed across states. This is markedly different than the random $(|\mathcal{E}|+1)$-tuple of first-period net endowment offers which may feature an endogenous correlation structure.

Feasible platforms. Recall that each candidate i's first-period platform p_1^i consists of a possibly random decision of whether or not to enact the policy, $\beta_i \in [0,1]$, and $(|\mathcal{E}|+1)$-tuples – one dimension for each possible realization of the policy state e – of public debt levels, $\{\delta_i(e)\}_{e\in\mathcal{E}\cup\emptyset}$, and net endowment offers for each voter, $\{\widetilde{x}_{i,1}(e)\}_{e\in\mathcal{E}\cup\emptyset}$. Where the $(|\mathcal{E}|+1)$-tuple of net endowment offers is jointly distributed according to $P_{i,1}$. Hence,[24]

$$p_1^i := \{\beta_i, \{\widetilde{x}_{i,1}(e), \delta_i(e)\}_{e\in\mathcal{E}\cup\emptyset}\}\,.$$

Given the policy and debt state $(e, \delta(e)) \in \mathcal{S}_{pd}$, candidate i's second-period platform $p_2^i(e,\delta(e))$ is a random variable $\widetilde{x}_{i,2}(e,\delta(e))$ with conditional cumulative distribution function $F_{i,2}(\cdot|e,\delta(e))$. It will also be useful to define the complete set of candidate i's second-period platforms for all possible realizations of $(e,\delta(e)) \in \mathcal{S}_{pd}$ as

$$p_2^i := \{\widetilde{x}_{i,2}(e,\delta(e))\}_{(e,\delta(e))\in\mathcal{S}_{pd}}\,.$$

Platforms are feasible if they satisfy the following budget constraints. For all $e \in \mathcal{E}\cup\emptyset$, the first-period budget constraint is:

$$\int_0^{+\infty} x dF_{i,1}(x|e) = E_{F_{i,1}|e}(x) \leq 1 + \delta_i(e) - \iota_i c. \tag{2}$$

Given the outcome of the first-period's political process, i.e. $(e,\delta(e)) \in \mathcal{S}_{pd}$, the second-period budget constraint is:

$$\int_0^{+\infty} x dF_{i,2}(x|e,\delta(e)) = E_{F_{i,2}|e,\delta(e)}(x) \leq 1 + \iota(e)\lambda e - \delta(e). \tag{3}$$

In the first period, the additional resources that can on average be given by candidate i to each voter depend on the endowment, the resources transferred from the future by debt $\delta_i(e)$, and the costs $\iota_i c$ that have to be paid in the case that the policy is implemented $(\iota_i = 1)$. Given the outcome of the first-period's political process, the realized debt level of the economy $\delta(e)$ – which is conditional on the level of policy benefits e – must be repaid in the second period. However, when the policy is implemented, the portion of the policy benefits that are in the form of private-good benefits, $\iota(e)\lambda e$, increase the amount of resources that can be redistributed across voters. In the second period, each voter also receives utility $\iota(e)(1-\lambda)e$ from the public-good component of policy benefits.

[24]Note that because it is always optimal for each candidate to choose budget-balancing platforms, it follows that in all equilibria we know that for each realization of the policy benefit e the debt level $\delta(e)$ follows directly from ι_i and $F_{i,1}(x|e)$. However, it is possible that a candidate does not choose a budget-balancing platform and thus, we include the debt level $\delta(e)$ as part of the first-period platform.

Timing. The timing of the game is summarized as follows:

Period 1:

Stage 1 Each vote-share maximizing candidate $i = \{A, B\}$ announces a first-period platform p_1^i.

Stage 2 Each voter observes each candidate i's realized policy position ι_i. If $\iota_i = 0$, then each voter also observes: (i) candidate i's debt level $\delta_i(\emptyset)$ and (ii) a first-period net endowment offer $x_{i,1}(\emptyset)$. Otherwise, if $\iota_i = 1$, then each voter observes: (i) an $|\mathcal{E}|$-tuple of state-contingent debt levels $\{\delta_i(e)\}_{e\in\mathcal{E}}$ and (ii) an $|\mathcal{E}|$-tuple of policy state-contingent net endowment offers $\{x_{i,1}(e)\}_{e\in\mathcal{E}}$. Each voter casts a first-period vote for the candidate that provides the higher first-period expected continuation utility, with ties broken by fair randomization. The candidate with the higher first-period vote share wins the first-period election.

Stage 3 The platform of the winner of the first-period election is implemented. In the event that the winner of the first-period election chose to enact the policy, the value of the policy benefit $e \in \mathcal{E}$ is observed, and the winning candidate's first-period state-contingent transfers are made. If the winner of the the first-period election chose not to enact the policy, then the state is $e = \emptyset$ and the corresponding transfers are made.

Given the observable state of policy and debt $(e, \delta(e)) \in \mathcal{S}_{pd}$ from the first-period's political process, there are two stages in period 2:

Period 2:

Stage 1 Each candidate $i \in \{A, B\}$ announces a second-period platform $p_2^i(e, \delta(e))$.

Stage 2 Each voter observes, for each candidate i, a second-period net endowment offer $x_{i,2}(e, \delta(e))$ and then votes for the candidate that provides the higher second-period local utility, with ties broken by fair randomization. The candidate with the higher second-period vote share wins the second-period election.

Strategies, Vote shares, and Equilibrium. In this two-period redistributive-politics model with policy investment, for each candidate i a strategy, which is denoted by $\{p_1^i, p_2^i\}$, consists of the combination of a first-period platform p_1^i and the complete set of candidate i's second-period platforms p_2^i, which specifies a second-period platform $p_2^i(e, \delta(e))$ for each possible realization of $(e, \delta(e)) \in \mathcal{S}_2$.

Given the richness of the strategy space, the detailed computation of the vote shares is relegated to Appendix A.

In this two-period redistributive-politics game with policy investment, a subgame perfect Nash equilibrium is characterized by a pair of platforms for each candidate, $\{p_1^i, p_2^i\}_{i=A,B}$, such that in all subgames the restriction of the strategy profile to the subgame is a Nash equilibrium.

4 Equilibrium characterization

Theorem 1 below provides a characterization of the subgame perfect equilibrium strategies of this two-period game (with a chance move). In the statement of Theorem 1, it will be useful to define H as $H := 2c - (1+\lambda)E_{\Gamma_e}(e)$. Note that H is a function of λ, c, and $E_{\Gamma_e}(e)$. Furthermore, holding c and $E_{\Gamma_e}(e)$ constant, if the fraction λ of private policy benefits is sufficiently high, then $H \leq 0$. Similarly, if the fraction λ of private policy benefits is sufficiently low, then $H > 0$.

Theorem 1 *The probability that the policy is implemented in a subgame perfect equilibrium is characterized as follows. There are two cases labeled **(I.)** and **(II.)**.*

(I.) *If $H \leq 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1$ and for each realization of the policy state $e \in \mathcal{E}$ announce the maximum feasible debt: $\delta^*(e) = 1+\lambda e$.*

(II.) *If $H > 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1 - \frac{1}{2}H(< 1)$, and for each realization of the policy state $e \in \mathcal{E} \cup \emptyset$ announce the maximum feasible debt: $\delta^*(e) = 1 + \iota(e)\lambda e$*

A complete characterization of the equilibrium net endowment offers is gathered in Corollary 1. We first provide an intuition for the underlying interactions between the decision to reform and to raise public debt, and the implications for the chance of a beneficial reform going through the political process.

Decision to reform. When only a share λ of the reform benefits translates into an increase in the second-period endowment, then the natural debt limit under reform increases only by λe compared to no-reform. This means that through using public debt, the reformer can only make the part $\lambda E_{\Gamma_e}(e)$ of expected reform benefits targetable to first-period voters. For the remaining part, she is forced through the public good nature of these benefits to offer them equally across all voters. However, Part (I.) in Theorem 1 covers the case where targetability λ is high enough so that the expected additional debt that a reformer can raise covers the disadvantage coming from the reform costs: the reformer has more to offer in total even if she is partly forced to distribute this bigger pie in an egalitarian way. The question then is, if the efficiency gain combined with increased debt capacity is enough to compensate the first-period cost savings of the non-reformer.

For the case $\lambda E_{\Gamma_e}(e) < c$, a no-reform candidate has more resources available in the first period for targeting voters. Specifically, the additional per-capita amount available to him equals the difference between the reform costs and the part of the future benefits that can be transferred to the present through debt, $c - \lambda E_{\Gamma_e}(e)$. On the other hand, in case of reform everyone expects a boost in future utility through the public good benefits of the reform. More specifically, each voter expects additional utility $e - \lambda E_{\Gamma_e}(e)$ in case of reform. Since the reform is efficient in the sense that the expected benefits $E_{\Gamma_e}(e)$ are greater than costs c, the additional public good utility, $E_{\Gamma_e}(e) - \lambda E_{\Gamma_e}(e)$, surmounts the loss in targetable resources in the first period, $c - \lambda E_{\Gamma_e}(e)$. However, these public good benefits cannot be targeted. Hence the additional public good utility must be high enough so that the non-reformer cannot convince a majority to vote for her. In particular, she should not be able through her advantage in targetability to make at least half of the voters as well off as under reform. This is exactly the condition of Theorem 1: $E_{\Gamma_e}(e) - \lambda E_{\Gamma_e}(e) \geq 2(c - \lambda E_{\Gamma_e}(e)) \Leftrightarrow H \leq 0$. The factor "2" on the right hand side of this inequality is explained by the fact that in order to win a majority through targeting, a candidate can promise very low offers to $\frac{1}{2}$ of the voters in order to offer attractive benefits the other half. If the condition $E_{\Gamma_e}(e) - \lambda E_{\Gamma_e}(e) > 2(\bar{c} - \lambda E_{\Gamma_e}(e))$ is fulfilled as in Part (I.) of Theorem 1, the efficiency gain of the reform is thus high enough to trump the targetability advantage of the non-reformer.

In Part (II.) of Theorem 1, the additional public good utility under reform is not enough to compensate for the fact that a no-reform candidate has more targetable resources in the first period. We therefore interpret $H = 2(c - \lambda E_{\Gamma_e}(e)) - (E_{\Gamma_e}(e) - \lambda E_{\Gamma_e}(e)) > 0$ as the net targeting advantage of *not* doing the reform. If $H > 0$, the additional targetable resources of a non-reformer is enough to outweigh the efficiency gains from reform and the reform cannot be offered with probability 1 in equilibrium. This means that we get a failure of the political process to deliver the efficient outcome. Notice that even with a net targeting advantage of no-reform, the reform will still be offered with positive probability in equilibrium as long as it is efficient in expectation, i.e. $E_{\Gamma_e}(e) - c > 0$. The reason for this will be discussed when we interpret the equilibrium transfer distributions below.

Decision to raise debt. The fact that both candidates raise the maximum debt follows the political forces highlighted in Lizzeri (1999). Whatever amount of resources is left in the future is not targetable to first-period voters. A candidate that does not run the maximal debt is therefore forced to offer an egalitarian distribution for the resources that she leaves in the future. This goes against the incentive to skew the distribution of resources in order to gain the electoral support of the voters that are treated favorably in the process of redistribution. The electoral uncertainty is not an artefact of the assumption that politicians are unable to commit about second-period transfers. Lizzeri (1999) shows that allowing candidates to commit does not change the electoral incentives to run debt: a candidate who commits to future transfers can only make promises about her own future behaviour, not about ones made by the other candidate. This implies that if a candidate does not run the maximal deficit, there is still an element of redistributive uncertainty concerning the second period outcome. This uncertainty is enough to implies that voters' views on the outcome of the future elections are relatively egalitarian.

An important insight from Theorem 1 is that the ability to raise higher debt under reform ensures the implementation of the reform with certainty only when the benefits of the reform are mainly of a private good nature. In the opposite case, when the nature of the reform is such that only a small part of the reform benefits have a private good aspect, a large share of the reform benefits are non-targetable to begin with cannot be targeted to first-period voters through the use of debt. Therefore, we are getting into the trade-off between efficient (non-targetable) public good spending and targetable transfer spending. This trade-off is at the core of the static setup of Lizzeri and Persico (2001) which we discuss below.

The complete equilibrium characterization, in particular what pork-barrel spending looks like in equilibrium, is summarized in following corollary.

Corollary 1 *The set of subgame perfect equilibrium is completely characterized as follows.*

First Period

*In the first period, there are two cases labeled **(I.)** and **(II.)**.*

(I.) *If $H \leq 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1$ and for each realization of the policy state $e \in \mathcal{E}$:*

- **(i)** *announce the maximum feasible debt: $\delta^*(e) = 1 + \lambda e$, and*
- **(ii)** *choose an $(|\mathcal{E}|+1)$-variate joint distribution $P_1^*(\mathbf{x})$ of first-period net endowments such that the random variable $\widetilde{x}_1^{\Gamma_e}$ is uniformly distributed on the interval $[0, 4 + 2\lambda E_{\Gamma_e}(e) - 2c]$ and for each possible policy state e the random variable $\widetilde{x}_1^*(e)$ satisfies first-period budget balancing as defined in equation (2).*[25]

[25] Because $e = \emptyset$ arises with probability 0 when $\beta^* = 1$, in case (I.) any feasible specification of first-period transfers may be used to complete the specification of a strategy for the policy state $e = \emptyset$.

(II.) *If $H > 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1 - \frac{1}{2}H(< 1)$ and for each realization of the policy state $e \in \mathcal{E} \cup \emptyset$:*

(i) *announce the maximum feasible debt: $\delta^*(e) = 1 + \iota(e)\lambda e$, and*

(ii) *choose an $(|\mathcal{E}|+1)$-variate joint distribution $P_{i,1}^*(\mathbf{x})$ of first-period net endowments such that:*

$$F_1^*(x|e = \emptyset) = \begin{cases} 0, & \text{if } x \leq 0, \\ \frac{1}{2}\left(\frac{x}{H}\right), & \text{if } 0 \leq x \leq H, \\ \frac{1}{2}, & \text{if } H \leq x \leq 4 - H, \\ \frac{1}{2}\left(1 + \frac{x-4+H}{H}\right), & \text{if } 4 - H \leq x \leq 4, \\ 1, & \text{if } x \geq 4. \end{cases} \tag{4}$$

and for $e \neq \emptyset$, the random variable $\widetilde{x}_1^{\Gamma_e}$ is uniformly distributed on the interval $[0, 4 + 2\lambda E_{\Gamma_e}(e) - 2c]$ such that for each possible policy state e the random variable $\widetilde{x}_1^*(e)$ satisfies first-period budget balancing as defined in equation (2).

Second Period

In the unique subgame perfect equilibrium, each candidate i's complete set of second-period platforms p_2^i is characterized as follows. For each possible second-period state $(e, \delta(e)) \in \mathcal{S}_{pd}$, each candidate chooses the second-period platform $p_2^*(e, \delta(e))$ that uniformly distributes net endowments on the interval $[0, 2(1 + \iota(e)\lambda e - \delta(e))]$.

Along any equilibrium path, the equilibrium debt level is $\delta^*(e) = 1 + \iota(e)\lambda e$ and the equilibrium distribution of second-period net endowments is degenerate with all mass placed on the net endowment 0.

We now provide intuition for shape of the equilibrium transfer distributions.

Second Period equilibrium transfer distributions. In the second period, all that candidates can compete over is redistributing all available *targetable* resources. The amount of targetable resources is increased by the reform benefits with private good character, in the case that the reform was implemented in the first period, and it is decreased by any debt that has to be repaid. Therefore, in the second period we are back to a static version of the divide-the-dollar game where the average resources available for making transfer offers are given by the resources left. If all second-period targetable resources are necessary for debt repayment, both candidates' offer distribution are degenerated on the net endowment

0. If some resources are left, the equilibrium offer distribution is uniform on distributes net endowments on the interval $[0, 2(1 + \iota(e)\lambda e - \delta(e))]$.

The crucial feature of the second-period election is the uncertainty for voters regarding the outcome of the process of redistributive politics. Given a uniform distribution on $[0, 2(1+\iota(e)\lambda e - \delta(e))]$, in period 2 each voter expects to get the average of such distribution in the case of no-reform. In case of reform, each voter expects, on top of the transfer offer, the public good utility $(1-\lambda)e$. For the analysis of the first period, this expectation about future utility fully captures how a voter evaluates the future effects of a proposed policy. However, the equilibrium distribution implies that some voters are treated very well and others are treated very badly. The politicians have an incentive to "cultivate favored minorities" as in Myerson (1993). This uncertainty is the driving force behind the electoral incentives to do the reform and accumulate debt in the first period.

First Period equilibrium transfer distributions. When the reform has mainly private good benefits, the candidates can target these benefits to particular voters in the first period: the reform is implemented with certainty and maximal debt is raised. Therefore, both candidates compete on redistributing the same amount of resources in the first period. The form of the transfer distribution follows the insight of Myerson (1993).

When the reform has mainly public good benefits, the efficiency gain of doing the reform cannot compensate for the targeting disadvantage of having to cover the reform costs. Nevertheless, the reform will still be implemented with positive probability. The underlying mechanism has been analyzed by Lizzeri and Persico (2001) in a static setup. By still playing the reform strategy with some probability, a candidate can use the efficiency gain of the reform to force her opponent to concentrate half of her offers on relatively "expensive" voters: these voters can be convinced to vote against the reform by receiving at least a transfer that fully cover the utility loss from the no-reform decision plus an additional transfer by the reforming candidate. This will give the reforming candidate an advantage if her opponent were to never offer the reform. As can be seen from Corollary 1, the distribution offered in case of no-reform $F_1^*(x|e = \emptyset)$ has a disconnected support with an upper and a lower part. The upper part starts where any transfer on this part will ensure the vote of any voters and corresponds to the offers made to the expensive voters: the expected utility loss $(1-\lambda)E_{\Gamma_e}(e)$ from not implementing the reform plus the best transfer offered by the reforming candidate $4 - 2(c - \lambda E_{\Gamma_e}(e))$.

When the net targeting advantage H of the non-reformer decreases, the probability of reform goes up. Ceteris paribus, H decreases when the targetability λ of reform benefits goes up. That is, the more private good aspects a reform has, the more public debt can help in overcoming the reformer's targeting disadvantage from financing the reform costs and the higher the chance of the reform to be implemented in electoral competition. On the other hand, if a reform has a high share of public good benefits, then public debt, which can only transfer the private good aspects to the present, cannot overcome the targeting disadvantage of the reformer completely. For the same efficiency gain, such reform will therefore be implemented with lower probability as an electoral outcome.

5 Budget constraint equilibrium characterization: hard and soft constitutional limits on debt

With uncertain policy benefits, a natural issue that arises is how "soft" debt and spending limits, in which the constraint holds only in expectation across the set of possible policy states (i.e. *ex ante* binding), compare with "hard" debt limits, in which the constraint holds for each realized state of policy benefits (i.e. *ex post* binding). We compare debt limits and spending limits and show that in equilibrium both hard and soft variations of these limits reduce the success of the reform in the political process. Furthermore, we find that it is possible to map any hard debt limit into an equivalent hard spending limit, and correspondingly, map any soft debt limit into an equivalent soft spending limit. That is, holding constant the variation of the limit (i.e. hard or soft) there is no difference between debt limits and spendings with regard to equilibrium efficiency of reform provision. However, we find that in equilibrium the probability that the reform is implemented with soft limits is (weakly) higher than with hard limits.

We first focus on hard debt limits which must be satisfied with probability one. Once we have characterized equilibrium for the case of a hard debt limit, we then examine the remaining case of a soft debt limit, where a soft limit which must only hold on average across the set of policy states. The soft and hard variations of the debt constraint are formally defined as follows. Recall that each candidate i's first-period platform p_1^i specifies candidate i's level of public debt contingent on the realization of the policy state $\{\delta_i(e)\}_{e\in\mathcal{E}\cup\emptyset}$ and consider the case that debt is constrained to be below a level of $\overline{\delta}$. A hard debt limit of $\overline{\delta} > 0$ requires that for each player i and each policy state $e \in \mathcal{E} \cup \emptyset$

$$\delta_i(e) \leq \overline{\delta}$$

whereas a soft debt limit of $\overline{\delta} > 0$ requires that for each player i

$$\delta_i(\emptyset) \leq \overline{\delta} \quad \text{and} \quad E_{\Gamma_e}(\delta_i(e)) \leq \overline{\delta}.$$

Hard constitutional limit on debt. Suppose that debt is constrained to be below a level of $\overline{\delta} > 0$. For a hard debt limit, the maximum feasible debt for any $e \in \mathcal{E} \cup \emptyset$ is:[26]

$$\widehat{\delta}^d(e) = \min\{\overline{\delta}, 1 + \iota(e)\lambda e\}. \tag{5}$$

In the case that the candidates utilize the maximum feasible debt, let B^d_{NP} denote the first-period budget when the policy is not implemented, let $B^d_P(e)$ denote the first-period budget when the policy is implemented and the policy state is $e \in \mathcal{E}$, and let B^d_P denote the expectation of the first-period budget when the policy is implemented, where:

$$B^d_{NP} = 1 + \widehat{\delta}^d(\emptyset), \quad B^d_P(e) = 1 + \widehat{\delta}^d(e) - c, \quad B^d_P = E_{\Gamma_e}(B^d_P(e)) = 1 + E_{\Gamma_e}(\widehat{\delta}^d(e)) - c. \tag{6}$$

Note that because $\widehat{\delta}^d(\emptyset) = \min\{\overline{\delta}, 1\}$, it follows that $B^d_{NP} = 1 + \min\{\overline{\delta}, 1\}$. Similarly, because $\widehat{\delta}^d(e) = \min\{\overline{\delta}, 1 + \lambda e\}$ for all $e \in \mathcal{E}$, it follows that $B^d_P = 1 + E_{\Gamma_e}(\min\{\overline{\delta}, 1 + \lambda e\}) - c$.

With a hard debt limit of $\overline{\delta}$, the first-period budget constraint for a candidate i with the maximum feasible debt, i.e. $\widehat{\delta}^d(e) = \min\{\overline{\delta}, 1 + \iota(e)\lambda e\}$, is modified as follows. For all $e \in \mathcal{E} \cup \emptyset$:

$$\int_0^{+\infty} x dF_{i,1}(x|e) = E_{F_{i,1|e}}(x) \leq \iota_i B^d_P(e) + (1 - \iota_i) B^d_{NP}. \tag{7}$$

For Theorem 2, we also define

$$\widehat{H}^d := 2B^d_{NP} - 2B^d_P - 1 - E_{\Gamma_e}(e - \widehat{\delta}^d(e)). \tag{8}$$

Theorem 2 *Given a hard debt constraint of $\overline{\delta} > 0$, the set of subgame perfect equilibria is completely characterized as follows. In the first period, there are two cases labeled **(I.)** and **(II.)**.*

(I.) *If $\widehat{H}^d \leq 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1$ and for each realization of the policy state $e \in \mathcal{E}$ announce the maximum feasible debt: $\widehat{\delta}^d(e) = \min\{\overline{\delta}, 1 + \lambda e\}$.*

(II.) *If $\widehat{H}^d > 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1 - \frac{\widehat{H}^d}{B^d_{NP}} (< 1)$ and for each realization of the policy state $e \in \mathcal{E} \cup \emptyset$ announce the maximum feasible debt: $\widehat{\delta}^d(e) = \min\{\overline{\delta}, 1 + \iota(e)\lambda e\}$.*

The complete characterization of the equilibrium transfer distributions is provided in Appendix A.

We have seen in Theorem 1 that the nature of reform benefits and the availability of public debt are crucial determinants of the success of reforms in the political process. For

[26] Note that if $\overline{\delta} > 1 + \lambda \overline{e}$ then it follows that the hard debt limit is non-binding.

intuition on Theorem 2, the following Corollary examines how the debt limit interacts with the likelihood of the policy being offered in the special case that the policy has only private-good benefits (i.e. $\lambda = 1$).

Corollary 2 *Suppose that the reform benefits are of a private good nature, i.e.* $\lambda = 1$*, in which case* $\widehat{H}^d = 2\left(c - \overline{\delta} + 1\right) - \left(E_{\Gamma_e}(e) - \overline{\delta} + 1\right)$.

(I.) *When the hard debt limit is such that* $\widehat{H}^d \leq 0$*, then in the unique subgame perfect equilibrium both candidates choose a first-period platform* p_1^* *that implements the policy with probability* $\beta^* = 1$ *and announce the maximal feasible debt.*

(II.) *When the hard debt limit is restrictive enough such that* $\widehat{H}^d > 0$*, then in the unique subgame perfect equilibrium both candidates choose a first-period platform* p_1^* *that implements the policy with probability* $1 - \frac{1}{2}\widehat{H}^d (< 1)$ *and announce the maximal feasible debt.*

Comparing these results to Theorem 1, we see that restricting public debt has a similar effect as increasing the proportion of reform benefits with public good nature. In particular, even if now the full reform benefits are potentially targetable, any reform benefits that have to be left in the future due to the debt limit acquire the characteristics of a non-targetable public good from the point of view of first-period voters. The amount $E_{\Gamma_e}(e) - \overline{\delta} + 1$ corresponds to the part of future reform benefits that cannot be transferred to the present. Since the outcome of future redistribution is uncertain, these resources cannot be skewed to specific voters. On the contrary, each voter expects the same amount $E_{\Gamma_e}(e) - \overline{\delta} + 1$ of additional second-period transfers under reform. The part $E_{\Gamma_e}(e) - \overline{\delta} + 1$ of the reform benefits that has to be left in the future is just like a public good whose benefits cannot be targeted. The difference to Theorem 1 is that if more debt was allowed, this part could also be targeted to first period voters. For the case of Theorem 1, the public good characteristic was given through the nature of the reform and could not be changed. Here, in contrast, it is created through the debt limit combined with future electoral uncertainty.

Through this analogy we get the same case distinction as before. If the hard debt limit is not too restrictive such that enough future reform benefits can be targeted to first period voters, the cost-saving advantage of the non-reformer is overcome and reform is implemented with certainty in the political equilibrium. On the other hand, if the hard debt limit becomes too restrictive, the no-reformer has a net targeting advantage. Due to its efficiency gain the reform will still be implemented with some probability for the same reason as discussed for Theorem 1. However, the reform will no longer be implemented with certainty and the political process fails to deliver the efficient outcome.

To sum up, the results in this subsection point to a new view on the trade-off between targeted pork-barrel spending and efficient spending decisions, like the financing of a beneficial reform. In particular, when the reform is of a *dynamic* nature, allowing enough debt-related pork-barrel spending might be necessary to incentivize the reform in political competition. Whereas this result shows that imposing a limit – in a world without preexisting limits – is hurting the chance of the reform, it opens the question on the benefits or costs of relaxing the debt limit keeping the existence of a limit. As the following Corollary shows the answer depends on how restrictive initially the debt limit is.

Corollary 3 (I.) *When the hard debt limit is such that* $0 < \overline{\delta} < 1$*, then an increase in* $\overline{\delta}$ *weakly decreases the probability with which the policy is implemented* $(1 - \frac{1}{2}\widehat{H}^d)$*.*

(II.) *When the debt limit is such that* $1 \leq \overline{\delta} < 1 + \lambda\overline{e}$*, then an increase in* $\overline{\delta}$ *weakly increases the probability with which the policy is implemented* $(1 - \frac{1}{2}\widehat{H}^d)$*.*

The proof of Corollary 3 follows directly from the expression for $\widehat{H}^d$ in equation (8), and is thus, omitted. It is interesting to notice that weakening the debt limit has a non-monotonic impact on the reform chances: in an environment where debt is tightly constrained ($\overline{\delta} < 1$) – corresponding to the situation where politicians are forced to run a surplus – relaxing marginally this constraint is making the reform more likely to be implemented. On the opposite, when the initial constraint is less tight ($\overline{\delta} \geq 1$) – corresponding to the situation where politicians can run debt but are precluded to draw all resources to the first period – relaxing the debt limit is helping the reform chances.

Below, we examine the relationship between a hard debt limit and a soft debt limit. Before turning to this comparison, we clarify the link between debt and spending limits.

Debt versus spending limits. We can directly map our results on debt limits into spending limits. Formally, for a given a hard debt limit of $\overline{\delta} \leq 1+\lambda\overline{e}$, we can construct an equivalent hard spending limit. Consider the policy-dependent hard spending limit $\overline{S}(e)$ which for each $e \in \mathcal{E} \cup \emptyset$ is defined as

$$\overline{S}(e) := 1 + \overline{\delta} - \iota(e)c. \tag{9}$$

Note that for the policy-dependent hard spending limit $\overline{S}(e)$, the first-period budgets with the hard spending limit are the exact same as the corresponding first-period budgets with the hard debt limit, B^d_{NP} and $B^d_P(e)$ respectively. Thus, it follows that the set of subgame perfect equilibria with the hard spending limit are characterized by Theorem 2 and the success of the reform in the political process is equally likely with the hard debt limit $\overline{\delta}$ as with the corresponding policy-dependent hard spending limit $\overline{S}(e)$ defined in equation (9). In the case of a soft debt limit developed below, a similar extension applies to the construct of an equivalent soft spending limit.

Soft constitutional limit on debt. Suppose that debt is constrained to be below a level of $\overline{\delta} > 0$ and recall that a soft debt limit requires that for each candidate i

$$\delta_i(\emptyset) \leq \overline{\delta} \quad \text{and} \quad E_{\Gamma_e}(\delta_i(e)) \leq \overline{\delta}. \tag{10}$$

For example, consider the case that in the event that candidate i implements the policy, candidate i's set of policy-state contingent public debt levels $\{\widehat{\delta}_i^{\eta}(e)\}_{e\in\mathcal{E}}$ bring forward a constant fraction $\eta \in (0,1)$ of the second-period endowment and realized policy benefits, subject to feasibility with respect to the soft debt limit. In this case, candidate i's policy-state contingent public debt levels may be defined, for each $e \in \mathcal{E} \cup \emptyset$ as:

$$\widehat{\delta}_i^{\eta}(e) = [1 - \iota(e)] \min\left\{\overline{\delta}, \eta\right\} + \iota(e)\eta\,[1 + \lambda e] \tag{11}$$

where $E_{\Gamma_e}(\widehat{\delta}_i^{\eta}(e)) \leq \overline{\delta}$.

If η is given by $\eta^* := \frac{\min\{\overline{\delta}, 1+\lambda E_{\Gamma_e}(e)\}}{1+\lambda E_{\Gamma_e}(e)}$, then it follows that candidate i's set of policy-state contingent public debt levels $\{\widehat{\delta}_i^{\eta*}(e)\}_{e\in\mathcal{E}\cup\emptyset}$ defined by equation (11) satisfy the soft debt limit condition in equation (10), $E_{\Gamma_e}(\widehat{\delta}_i^{\eta*}(e)) \leq \overline{\delta}$. In particular, if $\overline{\delta} < 1 + \lambda E_{\Gamma_e}(e)$ then $\eta^* = \frac{\overline{\delta}}{1+\lambda E_{\Gamma_e}(e)} < 1$ and $E_{\Gamma_e}(\widehat{\delta}_i^{\eta*}(e)) = \overline{\delta}$, but if $\overline{\delta} \geq 1 + \lambda E_{\Gamma_e}(e)$ then $\eta^* = 1$ and $E_{\Gamma_e}(\widehat{\delta}_i^{\eta*}(e)) \leq \overline{\delta}$.

Next, note that the set of policy-state contingent public debt levels $\{\widehat{\delta}_i^{\eta*}(e)\}_{e\in\mathcal{E}}$ may not be feasible under the corresponding hard debt limit. That is, with a soft debt limit the candidates may be able to smooth the debt constraint $\overline{\delta}$ over the set of policy states in ways that are not feasible with a hard debt constraint. From the maximum feasible debt expression in equation (5) the hard debt limit is binding for policy states $e > \frac{\overline{\delta}-1}{\lambda}$ and non-binding for policy states $e < \frac{\overline{\delta}-1}{\lambda}$. Thus, if the debt constraint $\overline{\delta}$ satisfies $\overline{\delta} \in (1 + \lambda E_{\Gamma_e}(e), 1 + \lambda \overline{e})$, then $\eta* = 1$ and for each realization of the policy state $e \in \mathcal{E}$ such that $e \in (\frac{\overline{\delta}-1}{\lambda}, \overline{e})$ it follows that $\widehat{\delta}_i^{\eta*}(e) > \overline{\delta}$.

In the case that the candidates use platforms in which (i) when the policy is not implemented the soft debt limit is binding for all $\overline{\delta} < 1$ and (ii) when the policy is implemented the soft debt limit is binding for all $\overline{\delta} < 1 + \lambda E_{\Gamma_e}(e)$, let B_{NP}^{sd} denote the first-period budget when the policy is not implemented and let B_P^{sd} denote the expectation of the first-period budget when the policy is implemented, where:

$$B_{NP}^{sd} = 1 + \min\{\overline{\delta}, 1\} \quad \text{and} \quad B_P^{sd} = 1 + \min\{\overline{\delta}, 1 + \lambda E_{\Gamma_e}(e)\} - c. \tag{12}$$

Given $\overline{\delta}$, the constraint on the average first-period budget for a candidate i is:

$$(1 - \iota_i)E_{F_{i,1|e=\emptyset}}(x) + \iota_i E_{\Gamma_e}[E_{F_{i,1|e}}(x)] \leq (1 - \iota_i)B_{NP}^{sd} + \iota_i B_P^{sd}. \tag{13}$$

and the corresponding expression for $\widehat{H}^d$ becomes

$$\widehat{H}^{sd} := 2B_{NP}^{sd} - 2B_P^{sd} - 1 - E_{\Gamma_e}(e) + \min\{\overline{\delta}, 1 + \lambda E_{\Gamma_e}(e)\}. \tag{14}$$

Theorem 3 *Given a soft debt constraint of $\overline{\delta} > 0$, the set of subgame perfect equilibria is completely characterized as follows. In the first period, there are two cases labeled **(I.)** and **(II.)**.*

(I.) *If $\widehat{H}^{sd} \leq 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1$ and announce the maximum feasible average debt:* $\min\{\overline{\delta}, 1 + \lambda E_{\Gamma_e}(e)\}$.

(II.) *If $\widehat{H}^{sd} > 0$, then in the unique subgame perfect equilibrium both candidates choose a first-period platform p_1^* that implements the policy with probability $\beta^* = 1 - \frac{\widehat{H}^{sd}}{B_{NP}^{sd}} (< 1)$ and announce the maximum feasible average debt:* $\min\{\overline{\delta}, 1 + \iota(e)\lambda E_{\Gamma_e}(e)\}$.

The complete characterization of equilibrium transfer distributions is provided in Appendix A. The intuition for the results matches the one developed below Theorem 2 with the notable difference that what matters now is the expectation across the set of possible policy states. The following result compares the efficiency of policy provision with soft and hard debt limits.

Proposition 1 **(I.)** *For all debt constraints $\overline{\delta} > 0$, the equilibrium probability that the policy is implemented under the soft debt limit is at least as high as under the hard debt limit.*

(II.) *For any $\overline{\delta} > 0$ such that $\widehat{H}^{sd} > 0$ the equilibrium probability that the policy is implemented under the soft debt limit is strictly higher than under the hard debt limit if and only if* $\min\{\overline{\delta}, 1 + \lambda E_{\Gamma_e}(e)\} > E_{\Gamma_e}(\min\{\overline{\delta}, 1 + \lambda e\})$.

Proposition 1 shows that there is a range of parameters for which the equilibrium probability that the policy is implemented under the soft debt limit is strictly higher than under the hard debt limit. Note that this corresponds exactly to the portion of the parameter region in which the debt constraint $\overline{\delta}$ satisfies $\overline{\delta} \in (1 + \lambda E_{\Gamma_e}(e), 1 + \lambda\overline{e})$ and the set of policy-state contingent public debt levels $\{\widehat{\delta}_i^{\eta *}(e)\}_{e \in \mathcal{E}}$ were feasible under the soft debt limit but not under the hard debt limit.[27] To the extent that high-risk high-reward policies increase the

[27] In a related application of soft and hard budget constraints, Hwang, Koh and Lu (2021) examine a two-player strategic-form contest involving a continuum of component contests. Rather than endowing the players with an exogenous budget, in their model, the players' budgets are endogenous. In the baseline case, the players face a "soft" budget constraint on the average amount of resources that may be allocated across the set of component contests. They also examine an extension in which the players face a "hard" constraint on the maximum level of resources that a player may allocate to each of the component contests. In applying their model to the redistributive politics framework of Myerson (1993), Hwang et al. (2021) find an equivalence between the "soft" budget constraint on the average transfers and the "hard" budget constraint on the maximum transfer to any individual voter. In contrast to a constraint on the transfers to individual voters, our formulation of hard and soft constraints are with respect to the uncertain policy state. In this

maximum value of policy benefits $\bar{e}$, this difference in the efficiency of soft versus hard debt limits is more likely to arise for high-risk high-reward policies.

6 Empirical regularities

We discuss stylized facts that our theory may help organize.

On the importance of debt and targeted transfers in facilitating reforms. Our results show that the importance of debt and targeted transfers in increasing the chance of beneficial reforms going through the political process. As a first step, we proxy the reforms by the OECD measure of public investment. OECD (2021d) describes this variable as "investment in R&D, military weapons systems, transport infrastructure and public buildings such as schools and hospitals." This indicator should therefore encompass forms of public investment with targeted benefits as well as those that are similar to a public good in nature. Our measure of targeted transfers corresponds to the OECD (2021b) measure of government spending on housing and community amenities. It is comprised of government spending in the following areas: Housing development, Community development, Water supply, Street lighting, R&D housing and community amenities. We chose this variable as a measure of targetable government spending as we would expect this category of expenditure to be relatively easily directed towards specific localities or constituencies, with the resulting benefits largely confined to these groups of intended recipients. We then perform a descriptive analysis of trends in levels of debt, public investment, and targeted transfers for a number of OECD countries since 1995 (US, UK, France, Germany, Italy, Ireland, Spain, Portugal, Norway, Sweden). This first analysis reveals a tendency for public investment and targeted transfers to decline when debt levels rise (see Online Appendix C): this is particularly the cases for countries that saw a spike of debt after the 2008 crisis (e.g., US, UK, Ireland, Portugal, Spain) and to a lesser extend for countries that did not see such sharp increase (e.g. Norway, Sweden, Germany).[28]

For several reasons, however, we cannot conclude from this description analysis a causal link between increases in debt and increases in government investment or targeted spending.[29]

context, we find that both variations of debt limits reduce the equilibrium probability with which the efficient policy is implemented. However, there exists a portion of the parameter space, with sufficiently moderate debt levels, in which soft constraints dominate hard constraints with respect to equilibrium efficiency of policy provision.

[28]In the current debate on fiscal rules in the EU and in line with these results, Francova, Hitaj, Goossen, Kraemer, Lenarcic and Palaiodimos (2021) point out that after the global financial crisis efforts to comply with fiscal rules might have discouraged public investment.

[29]Undesired growth of a country's debt-to-GDP ratio due to external economic forces, or political pressures

To refine our analysis, we proceed by considering a country's "capacity" to go into debt rather than its level of debt directly. We investigate whether, as our theoretical model predicts, public investment and targeted transfers rise when such capacity is high and fall when taking on further debt is no longer feasible. A plausible measure of this capacity is obtained by first looking at a given country over an extended time-frame and considering, at each point in the interval, how far debt and investment/spending levels are relative to the country's mean levels over the entire period. This process is referred to as "de-meaning." Given that spending decisions taken over a particular calendar year should reflect the level of debt registered going into that year, we consider the relationship between the de-meaned level of debt in the preceding year and the de-meaned levels of public investment and targeted transfers in the current period. The lagged level of de-meaned debt thus serves as our measure of a country's debt capacity for a given calendar year. We assume that a country which sat below its mean level of debt in the previous period (i.e. a country with high debt capacity) has a greater ability to draw upon debt for reform purposes in the existing period.[30] In such cases, we expect to observe higher levels of public investment and targeted spending than when the country's lagged debt level is below its average.

To investigate the aforementioned relationships, we plot the de-meaned versions of our key indicators in Figure 1 below for unbalanced panels of OECD countries from 1995-2019. From these plots, we see that a country that is below its mean level of debt over the period under consideration is more likely to undertake higher-than-average levels of public investment and targeted spending in the following year.[31] This could suggest that, when going into debt is not a salient economic or political concern, politicians are more able to undertake important reforms by using debt to transfer resources across periods. Consequently, higher-than-average levels of debt (i.e., when debt is no longer a feasible "tool") would limit their ability to do so moving forward.

On the role of debt limits. Another key takeaway from our theoretical analysis concerns the investment-restricting impacts of sovereign debt limits: our model highlights that the imposition of debt limits reduces the probability of reform, as governments affected by the policy face reductions in their capacity to take on debt for such purposes. This dynamic reflects the notion of a "policy-straight jacket" outlined in Guiso, Herrera, Morelli and Sonno (2019), which characterizes the lack of discretionary fiscal policy space among Eurozone countries due to a number of fiscal rules governing the Euro area. One such regulation, the

calling for fiscal consolidation when debt levels are high, are two examples of barriers to identification that blur the perceived relationship between these variables.

[30]This would be due, for example, to more fiscal liberty or less political opposition.

[31]These relationships are further confirmed by our econometric analysis in the Online Appendix D, where we run two-way fixed effects regressions while controlling for several relevant variables.

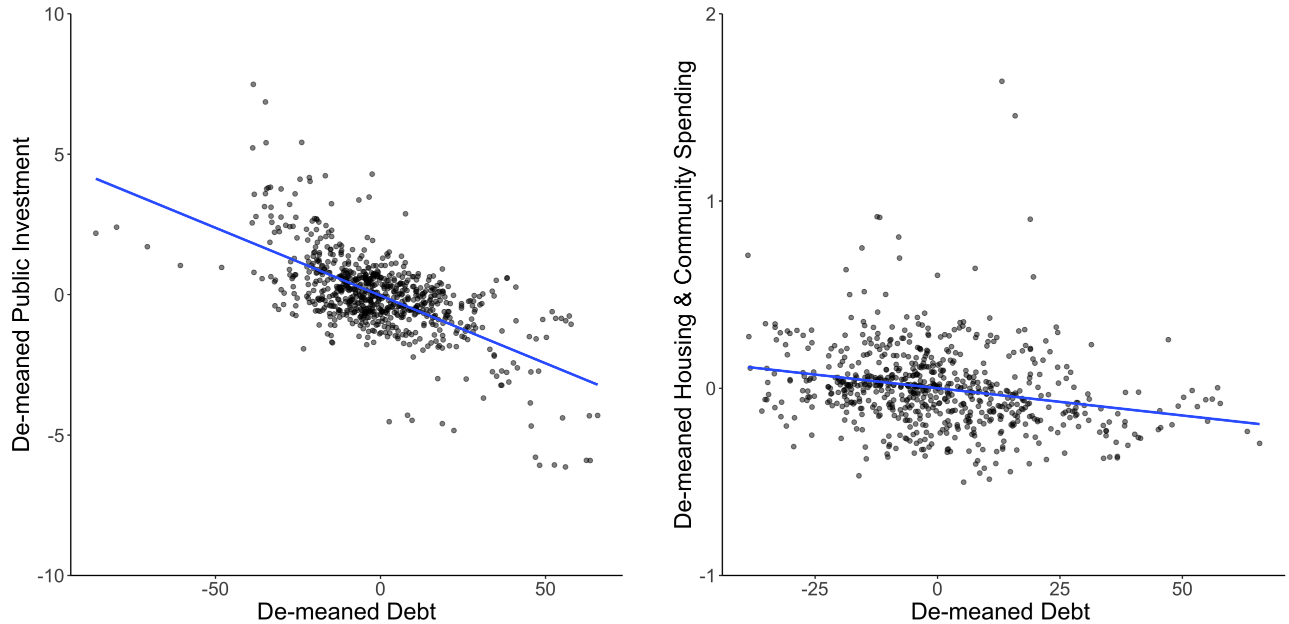

Figure 1: Relationship between debt and reforms

Notes: This figure shows the relationship between the "de-meaned" levels of (lagged) government debt and the two expenditure indicators under consideration, public investment as a percentage of GDP (left) and spending on housing and community amenities as a percentage of GDP (right) across unbalanced panels of OECD countries from 1995 to 2019.
Source: See Table 1.

60% limit on sovereign debt levels outlined by the Maastricht Treaty and later enshrined in the Stability and Growth Pact, allows us to draw empirical support for our hypothesis by dividing the sample into Eurozone and non-Eurozone countries.[32]

We present our de-meaned analysis for these two sub-sets of countries to determine whether the negative relationships between debt capacity and both public investment and targeted transfers appear stronger for members of the Eurozone. The results of this analysis for the public investment (top row) and targeted transfer (bottom row) variables are shown in Figure 2 below. The plots for the Eurozone member states are displayed in the left-hand column, while those for non-Eurozone countries are shown on the right. From this figure, it is clear that the subset of Eurozone countries experiences more pronounced inverse relationships between both pairs of variables under consideration.[33] These observations thus provide suggestive evidence of the reform-reducing role of debt limits.

[32]The list of the Eurozone member states in our data can be found in Table 1.

[33]These relationships are further confirmed in the econometric analysis undertaken in the Online Appendix D, where we find statistically significant negative coefficient estimates when interacting a Eurozone dummy variable with our debt variable.

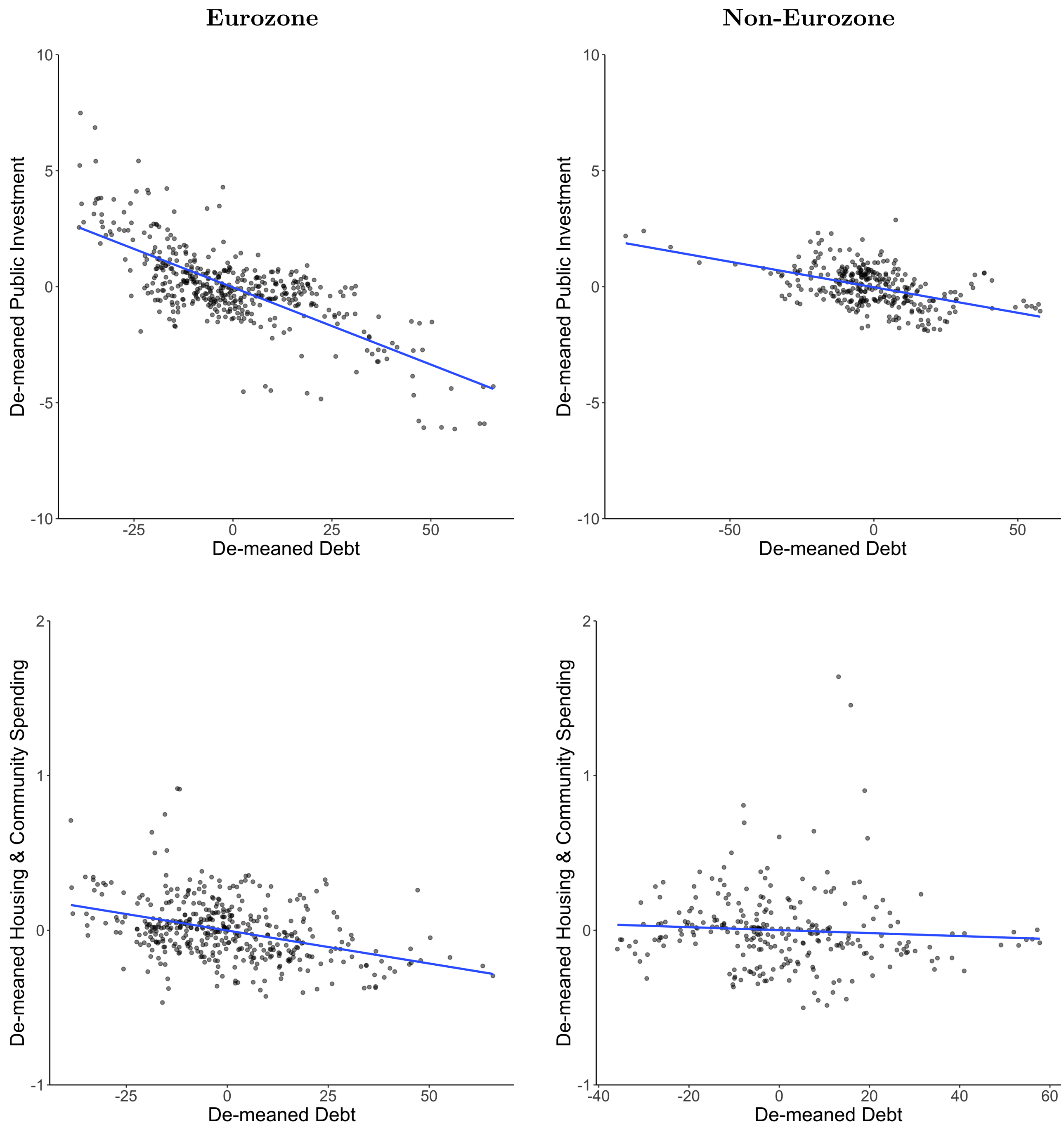

Figure 2: Relationship between debt and reforms: Eurozone and Non-Eurozone

Notes: This figure shows the relationship between the "de-meaned" levels of (lagged) government debt and the two expenditure indicators under consideration, public investment as a percentage of GDP (top row) and spending on housing and community amenities as a percentage of GDP (bottom row) across unbalanced panels of Eurozone (left column) and non-Eurozone (right column) OECD countries, from 1995 to 2019. The blue line shows a linear fit.

Source: See Table 1.

Hard and soft debt limits. Finally, we focus on the sample of Eurozone countries and look at the countries that faced, on average, a hard debt limit (due to having a mean debt-to-GDP ratio above the 60% Maastricht Treaty ceiling) during this period, and those that faced a soft debt limit (due to having a mean debt level below this threshold).[34] Our theoretical analysis points toward a stronger reduction of public investment and targeted transfers for countries facing harder debt limit. Figure 3 displays our de-meaned analysis for the public investment (top row) and housing and community amenities (bottom row) variables. Countries that were subject to a hard debt limit on average are shown in the left column, while those experiencing a soft limit are displayed in the right column. From this figure, it is clear that the former subset of countries are governed by a stronger negative relationship between debt capacity and public investment/targeted transfers, which aligns with the conclusions of our theoretical analysis.

[34]Our categorization of the Eurozone countries according to this criteria can be found in Table 1.

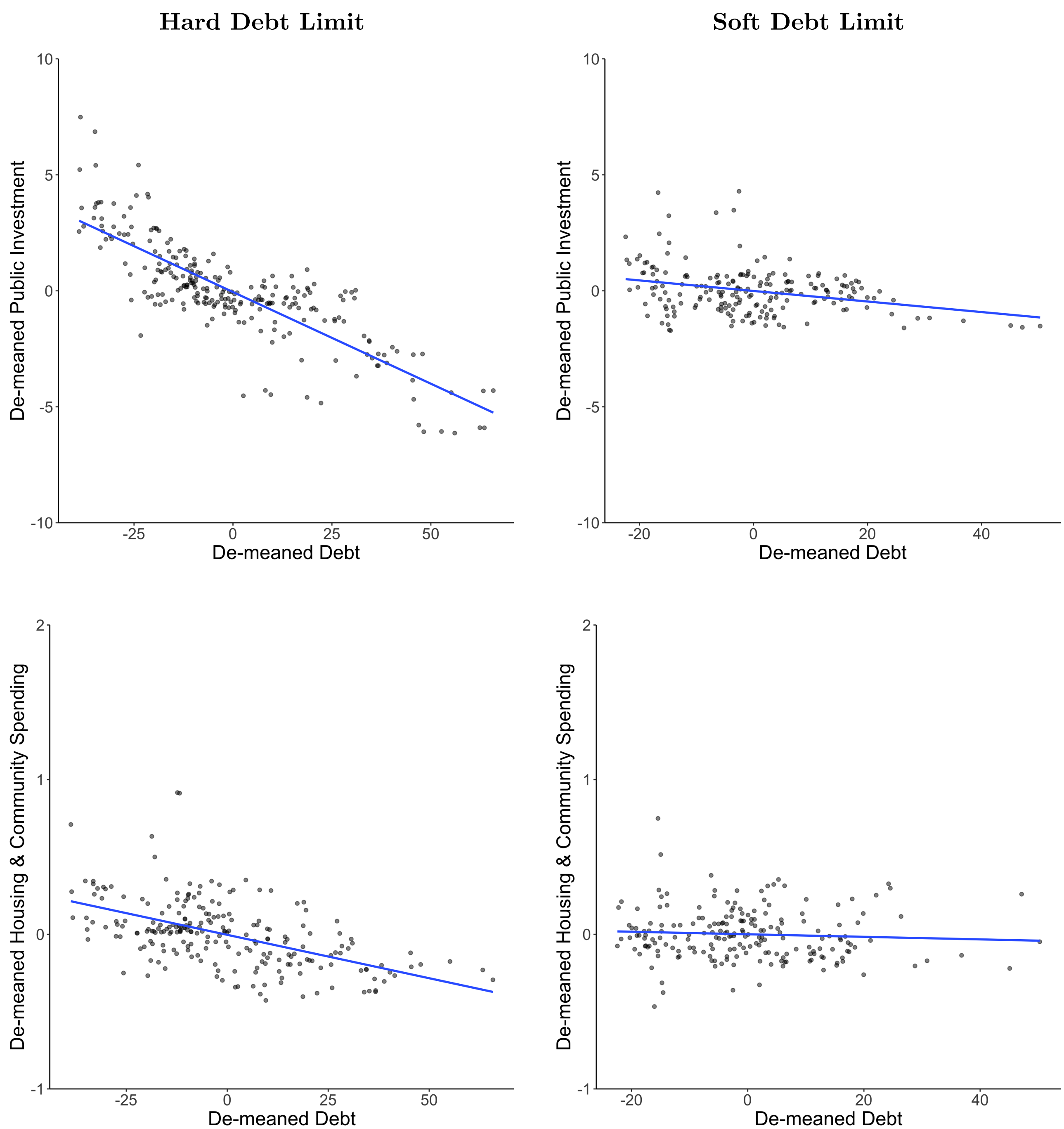

Figure 3: Relationship between debt and reforms within the Eurozone: Hard and soft debt limits

Notes: This figure shows the relationship between the "de-meaned" levels of (lagged) government debt and the two expenditure indicators under consideration, public investment as a percentage of GDP (top row) and spending on housing and community amenities as a percentage of GDP (bottom row) across unbalanced panels of Eurozone countries from 1995 to 2019. Countries with average debt-to-GDP ratios above the 60% Maastricht limit are shown in the left column, while those with average debt-to-GDP ratios below this threshold are displayed on the right.
Source: See Table 1.

7 Concluding remarks

In this paper we show that the decision to raise public debt is decisive in shaping the electoral incentives for implementing a reform. We prove that the reform is always implemented when sufficient debt can be raised. This is the case if enough reform benefits are of a private good nature that translate into an increase in the future endowment and can potentially be transferred to the present by debt. We also show that restricting the use of public debt hampers the chances of a reform to go through the political process. Our results point towards a new evaluation of the trade-off between targeted spending and efficient spending decisions: enough debt-related targeted spending might be necessary to incentivize efficient spending on dynamic policies whose benefits only accrue in the next electoral cycle. This result implies that constitutional restrictions on public debt and spending might be a hurdle for the implementation of reforms by politicians.

Our results are relevant and provide a warning to the empirical literature that analyzes what are the determinants of reforms going through the political process without considering debt and measures of targeted transfers. Whereas we do not claim the identification of causal effects in our empirical analysis, our results point towards interesting relationships between debt and reforms that may open avenue for future work.

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