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**Public education, accountability, and
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Public education, accountability, and yardstick competition in a federal system

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Abstract

Against the backdrop of a growing national and international accountability movement in education outcomes, this study sets up a simple model of yardstick competition with incumbent-disciplining effects through voters comparing performance measures of public education both across nations and federal states. It implies a potential strategic dilemma where a single top-performance state can block reform measures that could benefit low-performance states more than would do for itself. The linchpin predictions of the model are tested by analyzing announcement effects of student achievement tests on vote and popularity (VP) functions of German national and state government incumbents.

JEL classification: H75, H77, I28

Keywords: Yardstick competition, public education, VP-functions

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1 Introduction

In general, the formal education system of a federal political system acts as the primary source of literacy and numeracy acquisition. Literacy and, in particular, numeracy significantly determine labor market outcomes of individuals; see, e.g., Charette and Meng (1998). In reality, we observe hybrid forms of federal governance in public education, i.e., forms that are neither strictly decentralized nor strictly centralized. Political decisions on educational standards in a federation of jurisdictions are generally taken in a parliamentary chamber representing the second tier jurisdictions. In an international context, this is for example the Senate of Canada for Canada or the *Bundesrat* for Germany.

Recently, Germany reformed its federal structures in 2006 to a less standardized organization of the formal education system. Major parts of decision-making authorities have been allocated from the upper-tier government (*Bund*) to the lower-tier governments of federal states (*Laender*). For public schooling an implication is decentralization and an imminent heterogeneity with regard to some structural cornerstones such as tracking norms or the classification of education levels. The opposite applies, for example, to Switzerland, where the advisory board of education directors in the 26 cantons¹ opted for a reform designed to “harmonize” and standardize existing cantonal education practices. The so-called HarmoS reform program was enacted in 2009 in the form of a legally binding state treaty. Among others, it defines superordinate targets for compulsory schooling, sets out guidelines of quality assurance, and decrees mandatory educational standards across cantons. Thus, while Switzerland moves away from a purely decentralized form of federal governance of the education system, Germany seems to move towards it. Actually, more than ever in its post-war history German education seems to consist of 16 states sharing the same cultural and legal system but pursuing idiosyncratic education policies (Schulte 2004, Wössmann 2010).

According to Goldin and Katz (2001) the high school movement, establishing the United States 20th century leadership in human capital (Goldin 2001, 2003) by rigor-

¹*Schweizerische Konferenz der kantonalen Erziehungsdirektoren* (EDK).

ously expanding secondary school to the masses and spreading over the Western world in the post-war decades, will be replaced by an extensive accountability movement of education in the 21st century. Against this background of growing accountability, transparency, benchmarking, and yardstick competition both at the provincial or federal and national level, the question of optimal allocation of public education responsibilities has not been thoroughly addressed in the economic literature. In particular, it is unclear whether a federal government should decide for either one of the polar forms of governance (centralized or decentralized) or for a hybrid form of governance, where some rights that are more or less residual in nature are left at either the government or the provincial level.

Our study addresses this question from a political economy perspective for a two-tiered government in a representative democracy. To this end we set up a simple model of political yardstick competition (Salmon 1987, Besley and Case 1995, Sand-Zantman 2004, Bodenstein and Ursprung 2005) with a Salmon-Mechanism both at the upper-tier as well as at the lower-tier government level. In our model voters are assumed to compare performance measures of public education both across nations and across federal states. Voting is supposed to be the main incentive mechanism to discipline incumbents with regard to an efficient education policy. This is achieved by voters appraising incumbent governments' relative performances. The model results in a strategic dilemma as a single state belonging to the top flight in terms of its students' test achievements can block Pareto-improving policies if they imply lost grounds in the pecking order for this particular state. We find evidence for the central drivers behind this finding, i.e., for relative performances in student achievement tests impacting on vote and popularity (VP) functions of German national and state government incumbents.

The remainder of the paper is structured as follows. Section 2 describes the route from yardstick competition to strategic dilemma for the hybrid form of federal governance in German public education policy and sets out our model. The empirical strategy and findings are outlined and discussed in Section 3. Finally, Section 4 discusses and concludes.

2 From yardstick competition to strategic dilemma

2.1 The international accountability movement

In the following, we consider the national extensions of the OECD Programme of International Student Assessment (PISA) studies to illustrate the international accountability movement, in particular, at the sub-national level of federally organized nations. The PISA studies underlies a standardized test of 15-year-olds' literacy in reading, math, and science. As of 2000, the OECD repeated the test every three years. In Germany, the national extensions of the worldwide test are referred to as PISA-E or *Laendervergleich*. They test the cognitive achievement of representative samples of 15-year-old students as a general rule also in math, science, and reading literacy. Habitually, the national extensions use the same tests as the international PISA study. The sample size of the German extension of the PISA test is several times the one of the international test comprising two overlapping samples of 15-year-olds and ninth graders. Each sample covers about 40,000 students made of state samples ranging from 1,600 to 5,000 students for the 16 German federal states. Results are published several months after the international test results. Performance at the state-level is measured on a standardized scale as is the case at the supra-national level. For any OECD nation participating in PISA and/or testing at the level of state or province, scores for each subject and year are for the sake of comparability centered to an OECD mean of 500 and a standard deviation of 100.

In general, models of yardstick competition (Salmon 1987, Besley and Case 1995, Sand-Zantman 2004, Bodenstein and Ursprung 2005) assume voters to make comparisons between jurisdictions. In this type of models voting is the main incentive mechanism to discipline incumbents with regard to an efficient policy, for example, to an efficient education policy. Voters discipline incumbent governments by appraising their relative performance. This mechanism requires transparency, in the sense that voters can gain access to information about what other incumbents are doing and the corresponding achievements of some other entities' students to serve as a benchmark for their own incumbent government's policy. These entities can be nations or federal entities such as

federal states or provinces. As regards the OECD PISA test and its regional extensions, full information on student achievement even just at the state-level is generally rather the exception than the rule in an international comparison of federally organized countries (Table 1). Frequently also confidentiality requirements preclude the use of student-level data across states as is the case for German *Laender*. Yet, for example, in Germany *Laender*-comparing PISA-E tests are widely published and extensively discussed in the media and in political debates (Tillmann *et al.* 2008, Pütz 2008).

Table 1. National extensions of PISA test participation of OECD countries 2000-2006

	GER	BEL	AUS	CH	CAN	BRA	AUL	MEX
No. federal entities	16	3	9	26	10	26	8	32
PISA-E tested entities								
All types of schools	14-16	2	–	12-14	10	–	8	32
High schools	16	2	–	12-14	10	–	8	32
Coverage (minimum)	87.5%	66.7%	0%	53.8%	100%	0%	100%	100%

Notes:

GER – Germany, BEL – Belgium, AUS – Austria, CH – Switzerland, CAN – Canada, BRA – Brazil, AUL – Australia, MEX – Mexico; PISA-E – national extension of PISA test

Brazil participated in PISA, although it is not an OECD economy; considered are only countries (a) with federally organized public education sectors and (b) for which public education is the primary form of education (for all type of schools).

2.2 Hybrid forms of federal governance: Germany

In this subsection we give a brief overview of the highly idiosyncratic federal structures of secondary education policy in Germany. This might seem at odds with official political parameters as school policy is formally under exclusive *Laender* jurisdiction through the constitutional premise of *Laender* “cultural sovereignty” (*Kulturhoheit*) according to Article 30 of the German Basic Law (*Grundgesetz*). Additionally, Article 79(iii) stipulates that the federal character of the German Republic, Article 20(i), can not be altered even not by constitutional amendment. However, Article 70 of the Basic Law states that the *Laender* have the ability to exercise governmental responsibilities only as far as the Basic

Law does not provide or allow for any other arrangements or confer legislative power to the federal government. Thus, in fact, German (secondary) education policy is a “matter of subsidiarity” coined by non-constitutional institutional arrangements (Niemann 2009) bypassing to some extent the federal division of responsibilities (Erk 2003, p. 310). Hence, modification of the cultural sovereignty and the putatively exclusive jurisdiction of states is possible through implementation and legal interpretation which is justified e.g. by extra-constitutional moral principles. Erk (2003) sees the emergence of an “all-German” education policy in a system of exclusive provincial jurisdiction in four major circumstances: the rather artificial coming-into-being of German states, a strong public demand for harmonization and standardization following patterns of path dependency,² no ethno-linguistic diversity (as given, for example, for Switzerland, Belgium, Spain, and Canada), and –similar to Austria and Australia– no distinct provincial “identity” in general. Against this backdrop, some critical political scientists refer to the German form of federalism as an “interlocking system of functional federalism”, a “federal state with a non-federal society” or even a “unitary federal state” (Erk 2003, Niemann 2009). In the context of contemporary German education policy, labels like “co-operative cultural federalism” or federal governance with a federal government endowed with “participatory rights” are quite convenient among political scientists.

Regarding the finance of education, Germany originally installed a separate system (*Trennsystem*) for *Laender* and *Bund*. Nevertheless, up to the late 1950s the unwritten extra-constitutional principles of “federal friendly behavior” (*bundesfreundliches Verhalten*) and “federal comity” (*Bundestreue*) given through Federal Constitutional Court (*Bundesverfassungsgericht*) rulings guided education policy in practice. In 1955, the fiscal scheme changed to financial equalization (*Länderfinanzausgleich*), where income tax, corporate income tax, and value added tax revenues are both horizontally shared among

²German education policy before World War II can be divided into three regimes (Niemann 2009): exclusive authority of the *Laender* during the German Empire (1871-1919), followed by a first nationwide framework of education policy in the Weimar Republic (1919-1933) and a complete abusive centralization during the Nazi regime. After the German defeat, some schools started teaching again on the basis of the relatively centralized Weimar principles at the end of the year 1945, that is, before the allies’ efforts to restructure the German education system following principles of democratization and re-education took effect.

the *Laender* and vertically between *Laender* and *Bund*.

Interestingly, Erk (2003) notes that in the same year the 1948/49 founded Standing Conference of Ministers of Education and Cultural Affairs (KMK)³ dropped the parts of its charter that contained the adherence to the clear-cut division of responsibilities of *Laender* and *Bund* in all its decisions. *De jure*, KMK resolutions and recommendations are formally not legally binding for *Laender* but require state legislation to be put into practice. However, since decisions are based on the principle of unanimity, they have *de facto* applicability. Many committees, commissions, and agreements followed in the German post-war history (Erk 2003, p. 303-313). Most of them implied a standardization of the input side of education across states. For example, the Düsseldorf Agreement of 1955 standardized educational assessment, timing and duration of the study year, curricula and recognition of qualifications in order to ease the substantial state-to-state migration at the time. In 1969 by transforming the existing federal Ministry of Scientific Research into the Ministry of Education and Science (BMBF) the federal government created a ministry in a policy area where it officially does not have a constitutional jurisdiction. One year later, the *Bund-Laender-Kommission für Bildungsplanung und Forschungsförderung* (BLK) established. It was the first official joint body of decision-making as it included the federal government as partner of the *Laender*. Since the time, the focus of concerted education policy of *Laender* and *Bund* has been on educational planning and the joint promotion, organization, and evaluation of nationwide pilot projects. In early 1991 the Western structures of the education system were imposed on the newly created East German *Laender*. Since the second half of the 1990s, joint educational planning efforts have led to a series of output-oriented education standards across *Laender*. In the first half of the 2000s, on initiative of the KMK the *Laender* and the federal government established a central agency of monitoring compliance with education standards (Institute for Educational Progress, IQB) and committed themselves to systematically evaluating the output side, i.e., in particular, student performance in standardized assessments. In

³The Standing Conference unites the ministers and senators of the states responsible for education, higher education and research as well as cultural affairs. It was founded on the initiative of representatives of all the zones of occupation in 1948/49, i.e. before the Federal Republic of Germany was actually constituted.

mid-2006 the first stage of reform of German federalism (*Föderalismusreform*) dissolved the *Bund-Laender* joint task (“*Gemeinschaftsaufgabe*”) of education planning including the suspension of financial support from the federal government, e.g. for the construction of school buildings. In the present paper, we will focus on the first half of the 2000s up to 2006, which witnessed a regime of hybrid decision-making in German education policy.

Summing up the status quo for our period of analysis, the federal structure of the German education system is coined by collective decision-making with institutionalized veto power of each federal state. The federal level (e.g. through the BMBF) mainly has its competences in coordinating educational planning in cooperation with the *Laender*. Decision-making in education policy at the federal level requires consensus among each of the federal states. Thus, overarching decision-making is formally highly vulnerable to the veto power of each single state in the German Council, i.e. the house of the German parliament that represents the lower-tier state governments (*Bundesrat*) and in committees, i.e., in particular, in the KMK and in the Conference of the Prime Ministers (MPK) of the *Laender*. Additionally, it can be influenced by the formal veto points of (constitutional) courts in the *Laender*; see Niemann (2009, p. 5). A final caveat concerns indirect hybrid decision making through a supranational channel: Although the European Commission (EC) follows a so-called ‘soft law’ strategy, which seeks to protect national sovereignty and to keep EC influence as low as possible, it is the German federal government (Article 32(i), Basic Law) that represents German interests in Brussels, including education. Obviously, this circumstance counteracts the formal supremacy of states in this policy area; see Walkenhorst (2005). In sum, the usual policy process consists of proposals made at the federal government and/or centralized committee level and/or indirectly by an adopted recommendation at the supranational level. In any case, proposals require an unanimity vote by the *Laender* to get approved.⁴

For our period of analysis a prominent example of a non-approved policy is the proposed nationwide dilution of the tripartite German school structure planned to be com-

⁴Note, the (empirical) political and education science literature sees no evidence of partisan issues, in the sense of states whose governments belong to the same party as the federal government always aligning with it, in the German case (Erk 2003, Zierer 2012).

plemented by the introduction of a comprehensive school (*Gesamtschule*) track across states. The existing tripartite system separates students fairly early, usually at the age of 10 or 11 years, according to their abilities in different school types. Its opponents, thus, display it as prone to inequity. Niemann (2009) argues that this proposal, representing an indirect recommendation of the OECD, actually is an example for a proposal implicitly stemming from the indirect supranational channel described above. Modifying or even abolishing the tripartite system was not approved by the state of Bavaria and, hence, not uniformly realized at the federal level. An example of unanimously approved policies are binding education standards for intermediate school graduation (*Mittlere Reife*) in subjects reading, math, and first foreign language in 2004. The standards have been extended to subjects physics, chemistry, and biology as well as to secondary general schools and primary school leavers in 2005. Another example is the approval of the German orthography reform passed by the KMK in 1995. It was enacted –after some individual adjustment period for some states– nationwide as of the end of 2006. A substantial program with total costs amounting to approximately four billion Euros that was approved by all states and realized nationwide from 2003 to 2011 is the all-day school program (*Ganztagsschulprogramm*). It required, among others, the massive construction of canteens and re-arrangements of public transport for students in some of the *Laender*. A further unanimously approved policy is the reform of the KMK and its operating range in 2004 with its cornerstones output-orientation, streamlining of core administrative tasks and processes, and centralizing competences of international and European Union wide student exchange. Also the joint initiative of *Bund* and *Laender* to test the female muslim teacher’s scarf wearing ban (originating in legal action at the administrative court of the state of Baden-Württemberg) at the *Bundesverfassungsgericht* in 2003 is an example. It was seen as necessary in order to find a solution applicable in all German states. Finally, a proposal from the indirect supranational channel and at the interface of secondary and higher education policy that was approved, too, is the re-structuring and harmonization of teacher training across states. It was part of the European “Bologna Reform” process and realized in gradual steps in the second half of the 2000s.

Let us briefly turn to the alternatives of hybrid decision-making. Proponents of a decentralized structure with full autonomy at the federal state level argue along the following lines.⁵ A centralization or harmonization in the sense of nationwide agreeing on and setting of binding educational norms, for instance, in the form of a minimum average student achievement in standardized tests, would necessarily lead to a substandard decree (Schwager 2005). This unavoidable result is attributed to an externality of democratic decision-making inherent to the federal system. The argument is simple and can straightforwardly be illustrated by the following scenario of a hypothetical majority vote on a subordinate target value for student performance in the *Bundesrat*. Suppose that for reasons of an unspecified x-inefficient inertia each federal state wants to stick to its realized (average) level of student performance and proposes the respective figure as the new superordinate target. The total number of seats in the council corresponds to the accumulated number of votes of states. Seats range from three to six, depending on the size of population in the respective Bundesland. In total, seats and corresponding votes in the council sum up to 69. As can be seen from Table 2, the highest educational standard capable of winning an absolute majority (≥ 35 votes) in the *Bundesrat* would correspond to the proposal made by the council members of the state of Hesse (H), Rhineland-Palatinate (RP), and Brandenburg (BB) for PISA-E tests in 2000, 2003, and 2006, respectively. In all three cases, the correspondingly proposed standard would fall below both the average student performance of all test-participating states (penultimate row in Table 2) and the German students' average performance in the international test (ultimate row in Table 2) for the respective test year.⁶

As can be seen from Table 2 and Figure 1, there has been some dynamics with regard to states changing ranks over the three considered test years from 2000 to 2006. However, there is also some persistence as regards the top flight and bottom group of *Laender* in

⁵See, for example, Schwager (2005) for the German education system and Rodden (2003) in the more general context of fiscal federalism.

⁶As can be seen from Table 1 and Table 2, the city states of Hamburg and Berlin did not (fully) participate in the PISA-E 2000 national extension of the international PISA study. The only basis of comparison for these *Laender* in 2000 is given for high school students' test achievements.

terms of PISA test achievements (upper-right and lower-left quadrant of Figure 1).

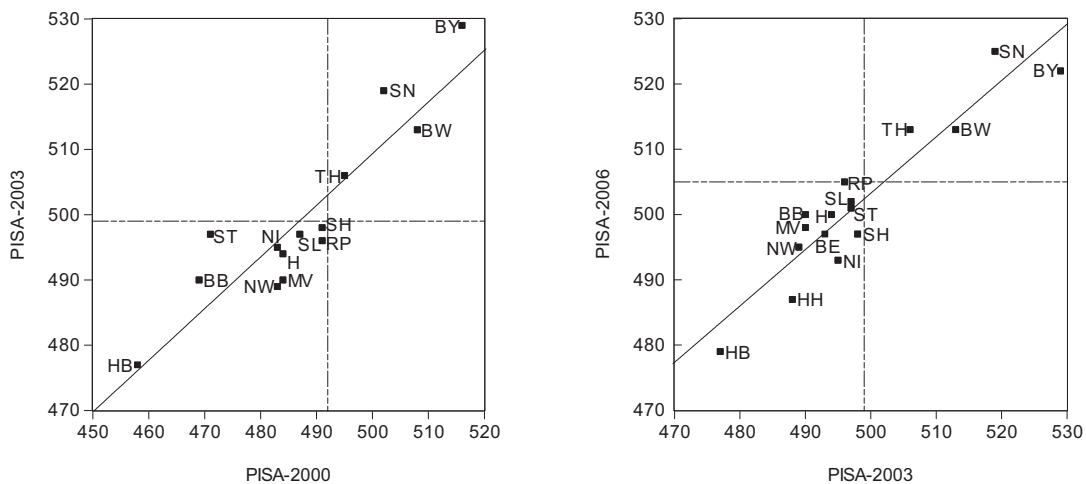
Table 2. German Laender PISA-E performances and seats in the Bundesrat.

Federal state	PISA-E 2000	PISA-E 2003	PISA-E 2006
Bavaria (BY)	516 [1 6 6]	529 [1 6 6]	522 [2 6 10]
Baden-Württemberg (BW)	508 [2 6 12]	513 [3 6 16]	513 [3 6 16]
Saxony (SN)	502 [3 4 16]	519 [2 4 10]	525 [1 4 4]
Thuringia (TH)	495 [4 4 20]	506 [4 4 20]	513 [4 4 20]
Rhineland-Palatinate (RP)	491 [5 4 24]	496 [8 4 35]	505 [5 4 24]
Schleswig-Holstein (SH)	491 [6 4 28]	498 [5 4 24]	497 [11 4 47]
Saarland (SL)	487 [7 3 31]	497 [7 3 31]	502 [6 3 27]
Hesse (H)	484 [8 5 36]	494 [10 5 46]	500 [9 5 40]
M.-West Pomerania (MV)	484 [9 3 39]	490 [13 3 57]	498 [10 3 43]
North Rh.-Westphalia (NW)	483 [10 6 45]	489 [14 6 63]	495 [13 6 57]
Lower Saxony (NI)	483 [11 6 51]	495 [9 6 41]	493 [14 6 63]
Saxony-Anhalt (ST)	471 [12 4 55]	497 [6 4 28]	501 [7 4 31]
Brandenburg (BB)	469 [13 4 59]	490 [12 4 54]	500 [8 4 35]
Bremen (HB)	458 [14 3 62]	477 [16 3 69]	479 [16 3 69]
Hamburg (HH)		488 [15 3 66]	487 [15 3 66]
Berlin (BE)		493 [11 4 50]	497 [12 4 51]
Average (PISA national)	487	498	501
Germany (PISA international)	492	499	505

Notes:

Figures in squared brackets [a, b, c] denote a) rank, b) votes which correspond to seats in the council, and c) cumulative votes, accumulated according to respective test year's ranking.

Figure 1. PISA-E test achievements across German Laender: 2000, 2003, 2006



Note positively sloped lines in Figure 1 are not angle bisectors but regression lines.

2.3 Hybrid forms of federal governance: A basic model

In the following basic model, we assume voters to compare states both at the national as well as at the supra-national level with regard to one of their major concerns: a successful education policy. As in the seminal models by Salmon (1987) and Besley and Case (1995), voting is the main incentive mechanism to discipline incumbents in order to follow a best practice education policy. To this end, we assume voters to be able to appraise incumbents' relative performance. This is a reasonable assumption as voters have access to information about the educational success of other incumbents both in a national and international comparison of student achievement rankings based on standardized tests such as PISA-E and PISA. This fact forces incumbents both at the federal state level and at the national level into a yardstick competition in which they care about what other incumbents are doing. A straightforward rationalization of this fact is first to let the reelection probability of both the upper-tier government U and lower-tier government L depend on the relative performance of students in an international (OECD-wide) and national (across federal states) comparison of student cognitive achievement, respectively. Hence, let

$$\Pr_j^U(\text{re-elect} = 1) = f(\mu_a^n - \mu_a^w), \quad (1)$$

where $f' > 0$, i.e., the reelection probability of the national (n) incumbent upper-tier government U increases with an above worldwide (w) average performance of students; $\mu_a^n \equiv \frac{1}{F} \sum_{i=1}^F a_i$ for $i = 1, \dots, F$ federal states, where a is denoting achievement, and $\mu_a^w \equiv \frac{1}{C} \sum_{j=1}^C a_j$ for $j = 1, \dots, C$ countries participating in the student assessment program. Thus, $\mu_a^n \subset a_j$. And

$$\Pr_i^L(\text{re-elect} = 1) = f(a_i - \mu_a^n), \quad (2)$$

where again $f' > 0$, i.e., the reelection probability of the incumbent lower-tier government L in state i increases with an above national (n) average performance of students.⁷

⁷Note, a_i is finite and heterogeneous. For simplicity reasons the expenditure side to reach a_i is abstracted from.

Residual or “participatory” rights of U are such that the upper-tier government is allowed to make proposals with regard to education policies that federal governments i can either accept or reject. However, as the proposal requires unanimity to pass, U has an incentive to make only a subset of Pareto efficient proposals, that is, only proposals that make every state better off, i.e., $a_{i,1} > a_{i,0}$ for all $i = 1, \dots, F$ federal states, where index $\mathbf{1}$ denotes all periods after and $\mathbf{0}$ all periods before the reform is enacted. The reform suggested by U will not be approved when policy vector $\{a_i\}_{i=1}^F$ is perceived as engineered by the proposal in a way that achievements in only a subset of states will improve. As the reelection probability of states \notin this subset necessarily falls, these states will refuse their vote. However, even the qualifying subset of Pareto efficient proposals that makes each federal state better off is not guaranteed to get approved.

There will be a strategic dilemma if for a federal state with $a_i^* > \mu_a^n$

$$E \left(\frac{\mu_{a,1}^n - \mu_{a,0}^n}{a_1^* - a_0^*} \right) > 1, \quad (3)$$

i.e., if one state of the leading group of states expects the national average of student achievements to grow faster and, hence, the bottom group to catch up faster than the top students’ states advance. Put it differently, in growth rate notation, the dilemma sets in for

$$\lim_{t \rightarrow T} E \left(\frac{\Delta \ln \mu_{a,t}^n}{\Delta \ln a_{i,t}^*} \right) > 1, \quad (4)$$

where T denotes end of incumbent period. In this case, where the national average student achievement increases by more than the state-mean of student test scores increases in, at least, one of the leading group of states, even the all-states better-off scenario fails. This is due to the fact that, at least, one of the above national average performing states improves its performance index by less than student performances in below-average performing states would be improved. As it is the relative difference that matters with regard to the reelection probability of a federal state incumbent government (eq. 2), the proposal might end up being not unanimously approved. In sum, although U might only propose strong Pareto-improving policies for the federally organized public education system, a strategic dilemma at the L -level can prevent the realization of these policies.

The reason for this rather cynical result or behavior lies in the fact that U does neither internalize VP function (2) of L in the sense of a Nash-equilibrium nor consider any distributional concerns across *Laender* in its objective function. However, the fact that Bavaria of all states did not approve the reform proposal of the dilution of the tripartite German school structure (perceived as prone to inequity) sketched in Section 2.2 may serve as some indicative evidence of such behavior. As can be seen from Table 2 above, Bavaria always ranked among the top-2 states in the PISA-E state performance ranking between 2000 and 2006. Bavarian officials' justification of their state acting as a veto player in this decision is twofold. First, it is argued that the Bavarian school system does not need to be reformed as it achieves top results in the national comparisons despite –or even because of– its strict system of separating students at relatively young age (Niemann 2009, p. 20-21). Secondly, Bavarian politicians also justify their position in this matter by pointing to the substantial cost of the reform. Following their argument, the cost would have to be beared to a relatively large extent by Bavarian taxpayers as Bavaria is used to be a net payer in the fiscal equalization scheme since the 1970s.

The linchpin mechanism of our basic model possibly implying the above sketched strategic dilemma for hybrid forms of federal governance consists of eqs. (1) and (2). The central empirical question, hence, is to analyze whether these functions are in accordance with data of a public education system which adhered to such a hybrid form of federal governance in the 2000-2006 period.

3 Evidence

In the following, we rely on polls data on stated voting intention to gauge actual voting intentions and the popularity of ruling parties in Germany. Ultimately, we use these data to proxy the reelection probability of incumbent governments. This is a frequent practice of the empirical strand of the political economy literature; see Kirchgässner (1985) for German federal elections, Carlsen (1997) for the US, and Wolfers and Leigh (2002) for federal elections in Australia. Wolfers and Leigh (2002) comparing popularity polls out-

comes with projections from economic models and betting market data find that polls do a good job in accurately assessing both the popularity and reelection probabilities of incumbents. This holds in particular over short-run, i.e. close to election, time horizons which are the relevant ones with regard to our empirical strategy. Adhering to the definition of “VP-functions” in the survey by Nannestad and Paldam (1994), our strategy consists in conditioning VP-functions of both the *Bundesregierung* (upper-tier government level) as well as the *Landesregierungen*, i.e., the federal states’ incumbent governments (lower-tier government level) on relative performances in the outlined international (PISA) and national (PISA-E) tests. Given the nature of our data, this is respectively done in the framework of an event study analysis.

3.1 Upper-tier government

As our period of investigation at the *U*-level, we choose the period from the month following the election to the *Bundestag* in fall 1998 to the month of the first advance notice of the PISA 2009 test results in June 2010. The dotted vertical lines in Figure 2 mark the months corresponding to the three elections covered by our sample, while the vertical solid lines give the months in which the PISA test scores have been published.⁸ As our proxy of reelection probabilities we consider data on stated voting intentions from the most popular popularity poll in Germany, referred to as “*Sonntagsfrage*.”⁹ The poll is run by one of the major psephological institutes in Germany. The same source of polls data (now: Infratest-dimap – then: Infratest) has been used by Kirchgässner (1985) to measure voting intentions of German voters and to estimate VP-functions of parties for the Federal Republic of Germany from 1971 to 1982. The underlying sample is representative and the poll has been conducted, at least, once a month over our period of observation. If there is more than one figure on voting intention per month, we take

⁸Notice, these dates do not correspond to the announcements of results from the national extensions of tests, i.e., PISA-E 2000, PISA-E 2003 and PISA-E 2006, that were announced later and independently.

⁹This is due to the fact that the central question in the poll reads: “Who would you vote if elections were next Sunday?”.

monthly averages of voting shares attracted by parties.

In order to assess the impact of German students' relative performance in the three national PISA test results (μ_a^n) on stated voting intention, we estimate a stylized Fair-type model (Fair 1978, 1996, Feld and Kirchgässner 2000, Lewis-Beck and Stegmaier 2000) of the incumbents' percentage of votes and include a term to capture the announcement of the relative performance in the international PISA 2000, 2003, and 2006 test, respectively.¹⁰

$$V_t = \bar{V} + \beta \mathbf{X}_t + \mathbf{b}_1 [A_{2000} (\mu_{2000}^n - \mu_{2000}^w)] + \gamma_1 A_{2003} + \gamma_2 A_{2006} + \delta GK_t + \epsilon_t, \quad (5)$$

$$V_t = \bar{V} + \beta \mathbf{X}_t + \mathbf{b}_2 \left[\sum_{j_1} A_{j_1} (\mu_{j_1}^n - \mu_{j_1}^w) \right] + \gamma A_{2006} + \delta GK_t + \epsilon_t, \quad (6)$$

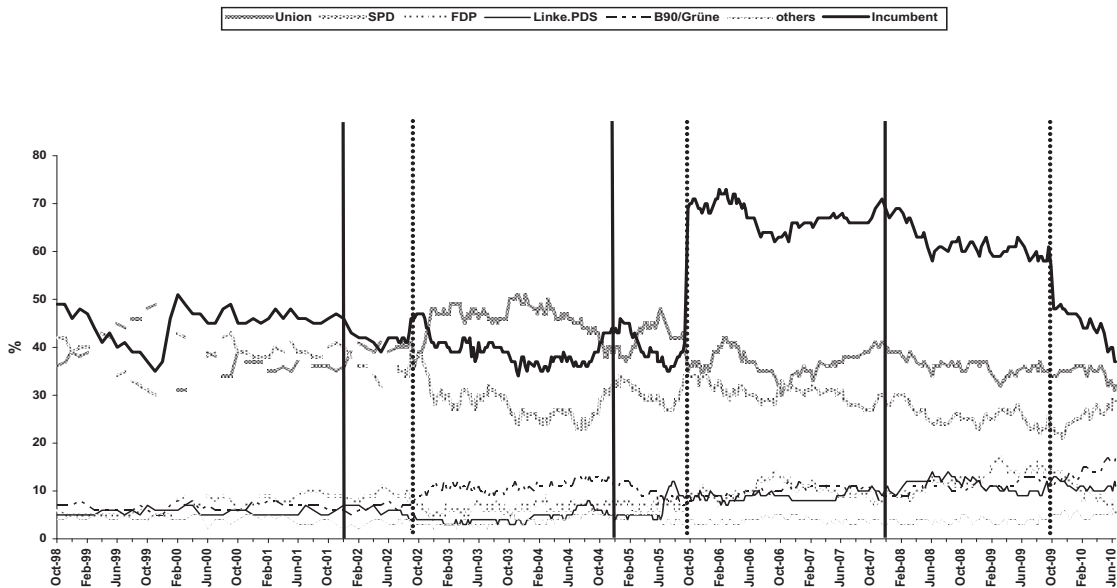
$$V_t = \bar{V} + \beta \mathbf{X}_t + \mathbf{b}_3 \left[\sum_{j_2} A_{j_2} (\mu_{j_2}^n - \mu_{j_2}^w) \right] + \delta GK_t + \epsilon_t, \quad (7)$$

where $j_1 = 2000, 2003$; $j_2 = 2000, 2003, 2006$, and \mathbf{X}_t denotes the Fair-set of conditioners made up by monthly figures of the unemployment rate, the inflation rate (computed from growth rates of the CPI), and the growth rate in real total production. Corresponding time series in monthly frequency were obtained from the German Federal Employment Agency (*Bundesagentur für Arbeit*) and the Federal Statistics Office (*Statistisches Bundesamt*). Summary statistics are given in Table A.1 in the Appendix. GK_t represents a dummy, taking on a value of one during the time of the coalition formed by the two dominating German post-war parties, CDU and SPD, i.e., during the so-called “*Große Koalition*.” As can be seen from Figure 2, it is obviously necessary to control for this coalition due to the higher incumbent government's VP-shares after October 2005. To some degree it also controls for a change in government ideology, which Potrafke (2011a, 2011b) recently found to hardly have a bearing on public spending on education. For the considered period, V_t corresponds to the share of voters intending to vote the incumbent government or coalition. For an event study analysis, the choice of the time slot for

¹⁰The following specification disregards several central determinants of popularity discussed in voting theory, including campaigns, issues, candidates, quality of challengers, and party identification (PID). However, given scarcity of aggregate data and the notoriously good performance of Fair-type models in predicting election outcomes, we are confident to rely on a fairly good second best choice.

investigation is critical. In our case, we focus on the time window from the month of the respective PISA test results announcement to the month of the next *Bundestag* election. The idea is to check for a structural break in the form of a permanent shock¹¹ beginning with the announcement of the PISA test score to the month of the next announcement or to the month of the next election: A_{2000} identifies the period from the announcement of PISA 2000 (December 2001) to the announcement of PISA 2003 (December 2004), A_{2003} identifies the period from the announcement of PISA 2003 to the following election of September 2005, which was lost by the incumbent (Red/Green) coalition. Finally, A_{2006} identifies the period from the announcement of PISA 2006 (December 2007) and the month when first information about the PISA 2009 results were published (June 2010).

Figure 2. Voting intentions and PISA-announcements: Infratest-dimap, 10:98-06:10



Note: Dotted (solid) vertical lines mark months of elections (of PISA results publication)

In specifications (5) to (7), the relative performance of German students is measured by the expression in round brackets, where the respective μ^n denotes the national and

¹¹Basic tests to check, whether the announcement effect is temporary rather than permanent in nature, speak in favor of a permanent effect. Additionally, the inclusion of a time trend into our specifications does qualitatively not alter our results.

μ^w the corresponding international mean test score. With regard to the sign of coefficients \mathbf{b} , estimates consistent with our basic model require in any case a positive sign. Discriminating specifications (5) to (7) allows us to assess whether the effect of relative performance was particularly pronounced for the early PISA tests, especially, the first one ever in 2000, compared to the later ones. The stigmatization of German education policy by the first “PISA shock” is a widely held belief (Schwager 2005, Tillmann *et al.* 2008). For all three equations, we also consider as alternative specifications, the replacement of the Fair-set of conditioners with a first order autoregressive, AR(1), part of the dependent variable V_t . Estimation results are summarized in Table 3.

Table 3. Announcement effects of relative test performance on incumbent government VP-functions: International PISA 2000, 2003, 2006

	Fair-type model		Autoregressive model		
	incl. outliers	excl. outliers		incl. outliers	excl. outliers
\mathbf{b}_1	0.42*** (3.78)	0.45*** (3.97)	AR(1)	0.52*** (2.89)	0.50*** (2.78)
adj. R^2	0.92	0.92	\mathbf{b}_1	0.20* (1.92)	0.22** (2.00)
\mathbf{b}_2	0.29*** (2.95)	0.31*** (3.13)	adj. R^2	0.95	0.95
adj. R^2	0.90	0.90	AR(1)	0.58*** (3.67)	0.57*** (3.56)
\mathbf{b}_3	0.12 (1.25)	0.13 (1.32)	\mathbf{b}_2	0.11 (1.56)	0.12 (1.64)
adj. R^2	0.88	0.88	adj. R^2	0.95	0.95
			AR(1)	0.63*** (3.84)	0.61*** (3.70)
			\mathbf{b}_3	-0.00 (-0.11)	-0.00 (-0.01)
			adj. R^2	0.94	0.94
N obs.	142	133		142	133

Notes:

t -values in parentheses (Newey and West 1987): *, **, *** significant at 10, 5, 1% level.

\mathbf{b}_1 measures the announcement effect of an incremental change in relative performance (measured in international standard deviation units) in PISA 2000 on the voting intention share (measured in percent) attracted by the incumbent government.

\mathbf{b}_2 is this effect for jointly considering announcements of PISA 2000 and 2003.

\mathbf{b}_3 is this effect for jointly considering announcements of PISA 2000, 2003, and 2006.

One may be concerned that some serious omitted variable bias plagues these estimates

as central domestic and foreign-policy events and shocks were not controlled for. In particular, there were several major influential events associated with the months September/October 2001, March/April 2002, August/September 2002, March/April 2003 and September/October 2008 that require a special treatment. The political momentousness of the 09/11 attacks and the shoulder-to-shoulder stance of Chancellor Schröder with President Bush should have contributed exceptionally to the popularity of the incumbent government. As a result of the following military actions, in March 2002 the first German soldiers died in Afghanistan, triggering a discussion about the political need of the mission. In the summer before the 2002 federal election Germany witnessed a hundred year flood, where due to the flooding of the Elbe River mainly East German regions were concerned. During August and September 2002 30,000 people got evacuated and more than 20 died. The incumbent government promised transfers and reconstruction funds amounting to 10 billion Euros. The planned tax reform for 2003 was officially delayed due to this exceptional event. The gain in popularity for the incumbents through this taking measures is common knowledge today. In March 2003 the second Persian Gulf War started. After a massive air strike coalition ground forces invaded Iraq. By mid-April, Saddam Hussein's army and government had collapsed. The German incumbents' corporate position against the invasion of Iraq also most probably affected its popularity. Finally, in September 2008 the financial crisis started to spread over the world with the bankruptcy of Lehman Brothers, which also reasonably affected the popularity of the incumbent coalition. In event study analyses, a straightforward practice to treat exceptional and influential events simply consists of dropping these observations from the sample; see, for example, Bernanke and Kuttner (2005). Leaving out our monthly data associated with 09/11, the Afghanistan conflict, the Elbe Flood, the Persian Gulf War, and the bankruptcy of Lehman Brothers decreases our sample from 142 to 133 events. As can be seen from columns three and six in Table 3, our results are nearly unaffected by excluding these outliers.

3.2 Lower-tier governments

As polls data for German *Laender* governments are available at discontinuous frequency only, the 16 different voting intention series at the federal state-level rarely consist of more than 100 observations for our period of investigation.¹² As they are constituted of in-equidistant events at the state-level, pooling the data and using within-estimators that control for fixed effects is not feasible. Thus, we have to resort to state-by-state estimations to test linchpin mechanism (2) of our basic model. An event study practice that has been successfully applied in similar empirical models, though in widely different contexts, is a one stage specification with a lower order autoregressive term and a dummy variable introducing events like announcements, accidents as the Chernobyl nuclear accident, etc. For our state-level event study analysis it appears to be the appropriate one. It is followed, for example, in Kalra *et al.* (1997), Berman *et al.* (2000), and Veraros *et al.* (2004). In analogy to the preceding section's estimates, we specify

$$V_{i,\tau} = \bar{V}_i + \alpha_{1,i}V_{i,\tau-1} + \mathbf{b}_{1,i} [(f_{i,\tau+1}^{2000} - f_{i,\tau}^{2003}) (a_{i,2000} - \mu_{2000}^n)] + \gamma_1 f_{i,\tau}^{2003} + \gamma_2 f_{i,\tau}^{2006} + \delta GK_{i,t} + \epsilon_t, \quad (8)$$

$$V_{i,\tau} = \bar{V}_i + \alpha_{2,i}V_{i,\tau-1} + \mathbf{b}_{2,i} \left[\sum_{j_1} \Delta f^{j_1} (a_{i,j_1} - \mu_{j_1}^n) \right] + \gamma f_{i,\tau}^{2006} + \delta GK_{i,t} + \epsilon_t, \quad (9)$$

$$V_{i,\tau} = \bar{V}_i + \alpha_{3,i}V_{i,\tau-1} + \mathbf{b}_{3,i} \left[\sum_{j_2} \Delta f^{j_2} (a_{i,j_2} - \mu_{j_2}^n) \right] + \delta GK_{i,t} + \epsilon_t, \quad (10)$$

where $j_1 = 2000, 2003$; $j_2 = 2000, 2003, 2006$, for all $i = 1, \dots, 16$ *Laender* over the different discontinuous points of observation τ . $V_{i,\tau}$ represents the voting intentions in terms of vote percentages for the incumbent coalition or single ruling party.¹³

In event study analyses interaction terms as, for instance, the direction (cut vs. increase) or reversals of interest rate target changes by the central bank (Bernanke and Kuttner 2005) usually are of particular interest. In our case this concerns the discrep-

¹²We draw our series from the wahlrecht.de database which comprises opinion polls data for the 16 *Laender* from different sources, i.e. from various psephological institutes. For detail see <http://wahlrecht.de/umfragen/landtage>.

¹³Note, we account for in-sample changes in the *Laender* governments by simply adjusting the figures to the respective newly elected party or newly formed coalition.

ancies in average student test scores across the *Laender*: $f_{i,\tau}$ denotes a binary variable that equals zero until the respective popularity poll observation which corresponds to the nearest neighbor month of, or in other words the closest following event to, each PISA-E announcement and equals one until the announcement of the next PISA-E result's publication or state election. Variables a_i denote the average students' test scores in each PISA-E test.¹⁴ Again, model-consistent estimates of coefficients \mathbf{b}_i require a positive sign. In analogy to the event study analysis at the national level, we use specification (8) to assess whether relative performances in PISA-E 2000 had a particularly stigmatizing effect on the incumbent governments of *Laender* at the time. In specification (9), we do so for PISA-E 2000 and 2003, while in specification (10) the stigmatizing effect of relative performance is assumed to be spread across all three considered PISA-E tests. Results are summarized on a state-by-state basis in the Appendix (Table A.2). In nearly two third of cases, i.e., in 10 out of the 16 states, we find indications of announcements effects by relying on specification (8) that are statistically significant at conventional levels. For specification (9) and (10), corresponding significant effects are found in one fourth and about one third of states, respectively. We can interpret $\mathbf{b}_{1,i}$ as a short-run multiplier, that is, multiplied with the relative performances ($X_{i,\tau} = a_{i,2000} - \mu_{2000}^n$ for PISA-E 2000) it gives the individual effect on the respective VP-function in the short run ($(\partial V_{i,\tau} / \partial X_{i,\tau}) X_{i,\tau}$), while the corresponding long-run multiplier ($(dV_{i,\tau} / dX_{i,\tau}) X_{i,\tau}$) is calculated as

$$\frac{dV_{i,\tau}}{dX_{i,\tau}} X_{i,\tau} = \frac{\mathbf{b}_{1,i}}{1 - \alpha_{1,i}} (a_{i,2000} - \mu_{2000}^n)$$

for $\mathbf{b}_{1,i}$ (Table 4).¹⁵ For $\mathbf{b}_{2,i}$ and $\mathbf{b}_{3,i}$, we calculate them at the respective mean of relative performances in the considered set of tests for states i with significantly estimated announcement effects in specification (10) and (11), respectively (Table 5 and Table 6). As $V_{i,\tau}$ is expressed in percent and we measure short-run as well as long-run effects

¹⁴In PISA-E 2000 results were published both for 15 year-olds as well as for ninth graders. We rely on the mean of the two scores in this case. Missing values for overall PISA-E 2000 scores for the city states of Hamburg and Berlin were approximated by the average score of high school (*Gymnasium*) students' test results that are available for the two states for this test year.

¹⁵Due to small sample size, we abstracted from computing a long-run multiplier for the city state of Bremen (HB).

of relative performance by $(dV_{i,\tau}/dX_{i,\tau}) X_{i,\tau}$ and $(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau}$ for each state, both measures are in percentage points. For example, $(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau} = +2.7$ represents a 2.7 percentage point increase of the VP-function of the Bavarian incumbent government implied by an incremental increase of relative performance of Bavarian students that amounted to 24.5 percent of an international standard deviation (normed to 100) in PISA-E 2000. The corresponding long-run multiplier is +5.3 percentage points.

Table 4. Significant short-run and long-run effects of relative performance I

	$a_{i,2000} - \mu_{2000}^n$	$\alpha_{1,i}$	$\mathbf{b}_{1,i}$	$(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau}$	$(dV_{i,\tau}/dX_{i,\tau}) X_{i,\tau}$
BY	24.5	0.49	0.11	+2.7	+5.3
BW	16.2	0.3	0.25	+4.1	+5.8
TH	3.4	0.08	0.96	+3.3	+3.5
RP	-0.5	0.69	4.86	-2.4	-7.8
SH	-1.2	0.41	2.21	-2.7	-4.5
NW	-8.4	0.55	0.34	-2.9	-6.3
NI	-9.0	0.34	0.89	-8.0	-12.1
ST	-21.2	0.61	0.25	-5.3	-13.6
HB	-34.0	1.15	0.06	-2.0	-
BE	-8.0	0.61	0.51	-4.1	-10.5

Note: $(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau}$; $(dV_{i,\tau}/dX_{i,\tau}) X_{i,\tau}$: %-points; underlying specification: (9)

Table 5. Significant short-run and long-run effects of relative performance II

	$\sum_{j_1} (a_{i,j_1} - \mu_{j_1}^n)$	$\alpha_{2,i}$	$\mathbf{b}_{2,i}$	$(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau}$	$(dV_{i,\tau}/dX_{i,\tau}) X_{i,\tau}$
BW	15.5	0.46	0.14	+2.2	+4.0
SH	-1.0	0.32	2.92	-2.9	-4.3
HB	-28.0	0.86	0.10	-2.8	-
BE	-4.3	0.64	0.50	-2.2	-6.0

Note: $(\partial V_{i,\tau}/\partial X_{i,\tau}) X_{i,\tau}$; $(dV_{i,\tau}/dX_{i,\tau}) X_{i,\tau}$: %-points; underlying specification: (10)

Table 6. Significant short-run and long-run effects of relative performance III

	$\sum_{j_2}(a_{i,j_2}-\mu_{j_2}^n)$	$a_{3,i}$	$\mathbf{b}_{3,i}$	$(\partial V_{i,\tau}/\partial X_{i,\tau})X_{i,\tau}$	$(dV_{i,\tau}/dX_{i,\tau})X_{i,\tau}$
BW	12.1	0.46	0.14	+1.7	+3.1
SH	-3.2	0.32	1.24	-4.0	-5.8
NI	-8.3	0.66	0.55	-4.6	-13.4
ST	-8.8	0.74	0.14	-1.2	-4.7
BE	-5.5	0.64	0.51	-2.8	-7.8

Note: $(\partial V_{i,\tau}/\partial X_{i,\tau})X_{i,\tau}$; $(dV_{i,\tau}/dX_{i,\tau})X_{i,\tau}$: %-points; underlying specification: (11)

Similar multipliers are reported in Table 5 and Table 6 for $\mathbf{b}_{2,i}$ and $\mathbf{b}_{3,i}$, respectively. For our interpretation of the size of effects, we have to keep in mind that they refer to an incumbent government and, hence, not necessarily to a single party. As expected, PISA-E 2000 had the most stigmatizing effect on German education policy makers at the state-level, inasmuch as combined relative performance and announcement effects are found in nearly two third of states, ranging between -8.0 (NI) and $+4.1$ (BW) percentage points. These statistically significant Salmon-Mechanism effects shrink to sub-groups of state incumbent governments concerned by the announcement of PISA-E 2000, when we additionally consider relative performances also for PISA-E 2003 (Table 5). The same applies to considering all PISA-E test announcements (Table 6). However, both implied short-run and long-run effects are still sizable. On average, over all considered specifications significant short-run effects of relative performances cost below-average performing state-government incumbents 3.4 percentage points of voting shares. The corresponding average long-run multiplier (< 0) amounts to a loss of 8.3 percentage points. Similarly, incumbents of above-average performing states on average gain 2.8 percentage points of voting shares in the short run and 4.3 percentage points in the long run. As expected, there are more than twice as many below-average performing and, hence, voting percentages losing state incumbents than there are above-average performing and, hence, voting percentages attracting ones.

In sum, though facing suboptimal data at the level of federal states, our event study exercises found substantial indications for the central driving mechanisms of our model.

Reelection probabilities of incumbent governments both at the national and state level, at least partially, are associated with relative performances in national and intra-national student achievement tests.¹⁶

4 Discussion and concluding remarks

In mid-2006 the first stage of the recent reform of German federalism (*Föderalismusreform*) dissolved major parts of shared decision-making in education policy of federal government and federal states. By then Germany witnessed a highly idiosyncratic hybrid form of federal governance in public education. Some fairly basic theoretical thoughts considering the two idiosyncrasies of residual rights of the federal government in the form of making proposals on the one hand and the requirement of a unanimous approval of states on the other, led to a potential strategic dilemma: If both the national and sub-national governmental VP functions depend on relative educational achievements, as we showed in the empirical parts of our study, a state belonging to the top flight might disapprove all-states better-of policies if the catch-up of low-performance states implies even just a slight loss of its ground in the pecking order. This cynical result hinges on the federal government neither internalizing the VP functions of state incumbents in the sense of a Nash-equilibrium nor considering any distributional aspects in its objective function. There are several routes to remedy this potential demerit of shared decision-making. Cutting down participatory rights of the federal government as done through the *Föderalismusreform* seems, given the historical development of constantly finding ways of bypassing the formal *Laender* autonomy in education policy, the least promising. Similarly, path dependency would not allow to turn back time and allow Germany to abstain from standardized student assessments at the national and sub-national level, as other federally organized countries do and did in the past, in order to obscure

¹⁶Notice, results are not sensitive to alternative functional forms of arguments $[\cdot]$ in equations (5) to (7) and (8) to (10). This holds, in particular, for use of ranks instead of relative performances that do not generate statistically significant results. There are also no indications that suggest a nonlinear impact of relative performances on voting intentions.

comparison and preclude yardstick competition. Also the unanimity vote requirement that proved successful in cutting down on partisan issues in the past is not disposable. Internalizing voters' preferences more directly through referendums as in the Swiss political system of direct democracy seems for similar reasons infeasible. It remains that the problem is solved simply by a repeated game structure and the learning of the players, i.e. the federal government and the federal states, to mutually internalize reaction functions. Against the backdrop of the recent experience with disapproved proposals, the paralleling of the decentralization of responsibilities with fiscal decentralization seems a promising supportive measure to avoid the sketched dilemma.

According to the fiscal federalism literature, decentralized systems, although bearing the danger of relying on bailouts (Wildasin 1997, De Mello 2000, Goodspeed 2002) and of implying impediments of coordination due to an increased number of veto-players and political actors in general (Tsebelis 1995, Wibbels 2000), also have several advantages. These include enhanced preference matching or local needs responsiveness (Oates 1999, Faguet 2004) and enhanced accountability, political participation as well as reduced rent seeking and informal activity (Seabright 1996). Additionally, in the traditional public choice literature fiscal decentralization fosters competition among sub-national entities, tames Leviathan governments, and forces local governments to implement optimal policies in terms of technical and allocative efficiency (Tiebout 1965, Brennan and Buchanan 1980, Baskaran 2010, 2012).

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Appendix

Table A.1 Summary statistics of federal government event study sample

	A_{2000}	A_{2003}	A_{2006}	GK	CPI	PI	UER	V	$\mu^n - \mu^w$
Mean	0.25	0.07	0.22	0.34	99.12	99.08	9.74	50.03	-4.10
Std. dev	0.44	0.26	0.41	0.47	5.45	9.27	1.27	11.35	9.58
Min	0	0	0	0	90.70	79.40	7.10	35.00	-13.00
Max	1	1	1	1	108.10	122.70	12.70	73.25	8.33
Range	1	1	1	1	17.40	43.30	5.60	38.25	21.33
N obs	142	142	142	142	142	142	142	142	142

Note: First four columns refer to dummy variables as defined in the text; UER – unemployment rate, PI – production index of total real production, V – share of stated voting intention attracted by incumbent government (percent), inflation rate is computed from growth rates of the consumer price index (CPI).

Sources: Bundesagentur für Arbeit, Statistisches Bundesamt, Infratest-dimap

Table A.2 VP-function estimates: PISA-E test result announcements (left: significant results)

	BY	BW	TH	RP	SH	NW	NI	ST	HB	BE ¹	SN	SL	HE	MV	BB	HH ²
$\alpha_{1,i}$	0.49*** (4.70)	0.30* (1.76)	0.08 (0.92)	0.69*** (6.53)	0.41*** (3.19)	0.55*** (7.96)	0.34** (2.08)	0.61*** (7.37)	1.15** (2.57)	0.61*** (7.10)	0.54*** (4.84)	0.56*** (3.35)	0.62*** (3.68)	0.66*** (6.37)	0.81*** (10.18)	0.37*** (2.65)
$\mathbf{b}_{1,i}$	0.11** (2.40)	0.25*** (2.28)	0.96** (2.64)	4.86** (2.42)	2.21* (1.76)	0.34** (2.51)	0.89** (2.51)	0.25*** (2.27)	0.06* (2.08)	0.51*** (2.61)	-0.06 (-0.40)	-0.33 (-0.70)	-0.20 (-1.16)	0.14 (0.64)	-0.00 (-0.04)	-0.07 (-1.64)
adj. R ²	0.52	0.49	0.67	0.75	0.91	0.71	0.69	0.70	0.92	0.86	0.43	0.70	0.79	0.51	0.62	0.57
$\alpha_{2,i}$	0.66*** (7.42)	0.46*** (4.08)	0.39*** (3.40)	0.75*** (9.26)	0.32** (2.01)	0.78*** (15.16)	0.55** (7.96)	0.76*** (7.65)	0.86** (13.83)	0.64*** (7.65)	0.54*** (4.93)	0.84*** (8.89)	0.84*** (11.80)	0.66*** (6.48)	0.81*** (9.96)	0.70*** (7.68)
$\mathbf{b}_{2,i}$	-0.05 (-1.60)	0.14** (2.60)	-0.85* (-1.87)	0.38 (1.39)	2.92* (2.01)	0.05 (0.78)	0.63 (1.63)	0.13 (1.62)	0.10** (5.95)	0.50** (2.36)	-0.06 (-0.66)	-0.01 (-0.27)	-0.04 (-0.24)	0.16 (0.78)	-0.00 (-0.05)	-0.04 (-0.99)
adj. R ²	0.46	0.44	0.54	0.74	0.91	0.67	0.61	0.68	0.93	0.86	0.44	0.67	0.77	0.52	0.63	0.50
$\alpha_{3,i}$	0.66*** (7.49)	0.46*** (4.03)	0.41*** (4.00)	0.85*** (13.78)	0.32* (1.96)	0.78*** (15.25)	0.66** (5.18)	0.74*** (7.37)	0.55** (7.66)	0.64*** (7.66)	0.55*** (4.97)	0.82*** (7.57)	0.87*** (15.12)	0.60*** (5.06)	0.81*** (10.35)	0.70*** (7.73)
$\mathbf{b}_{3,i}$	-0.05 (-1.64)	0.14** (2.65)	-0.67** (-2.03)	0.06 (0.26)	1.24*** (3.06)	0.05 (0.82)	0.55* (1.68)	0.14* (1.78)	0.08 (1.39)	0.51** (2.49)	-0.06 (-0.62)	-0.15 (-0.42)	-0.06 (-0.34)	0.18 (0.84)	-0.01 (-0.14)	-0.04 (-0.87)
adj. R ²	0.47	0.45	0.53	0.73	0.91	0.67	0.62	0.68	0.87	0.86	0.45	0.68	0.77	0.50	0.64	0.50
N obs	93	45	66	80	56	131	52	45	13	202	71	38	64	55	60	94

Note: HAC Student t -values in parantheses (Newey and West 1987), all estimates include a constant, *, **, *** denotes significance at 10, 5, 1% level of significance, respectively

¹ Dropping the announcement of PISA-E 2000 due to missing achievement data for all school-types for this state does not qualitatively change results.

² Dropping the announcement of PISA-E 2000 due to missing achievement data for all school-types for this state generates model-consistent, statistically significant estimates for PISA-E 2003 and PISA-E 2006 events.

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