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RUSSIAN POLITICS 7 (2022) 210-236

RUSSIAN POLITICS
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Signaling Games of Election Fraud: A Case of Russia

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Abstract

Over the 2000s Russian elections have become increasingly unfree and unfair, characterized by suppression of electoral competition, rising levels of administrative interference and drastic growth of electoral frauds. In this paper I propose that the pattern of fraudulent elections in Russia can be explained by combining an idea about federalism with a game-theoretic model of the relationship between the Kremlin and a single regional governor. Specifically, election fraud becomes a basic signaling mechanism of regional bosses' loyalty and of their ability to control the administrative resources to the Kremlin's benefit. If electoral signaling occurs, data manipulation is most likely to take place with 0s and 5s in the last digit of rounded percentages of turnout and electoral support, which is the easiest and most readily detected way to report basic information to superiors. Based on the Russian electoral and financial data for 2000-2018, my analysis shows strong evidence of election fraud associated with the post-electoral interbudgetary transfers.

Keywords

signaling games – Russian elections – election fraud – last digit – transfers

1 Introduction

Russia has a long history of rigged elections. In the 2000s, the growing authoritarian tendencies in Russian political system exacerbated the problem of blatant election fraud and various electoral manipulations, making it an interesting subject of research by many scholars.[1]

1 Andrei Buzin and Arkadiy Lubarev, *Crime without Punishment: administrative electoral technologies in Russian federal elections 2007-2008*. (NIKKOLO M, 2008), 248 p.; Walter R.

 | DOI:10.30965/24518921-00604018

In this paper I propose that the pattern of fraudulent elections in Russia can be explained by combining an idea about federalism with a game-theoretic model of the relationship between the Kremlin and a single regional governor. The argument is similar in spirit to Alberto Simpser's, who argues that in general electoral manipulation is not for merely winning an election but is "a powerful tool for consolidating and monopolizing political power".[2] I argue that the changing pattern of electoral frauds over the 2000s can be explained by changes in rational strategies of the governors, which are associated with the evolution of Russian federal relations. Specifically, the idea is that while in the mid-1990s and early 2000s Russian governors used strategies of bargaining, in which powerful regions provided the Center (i.e. the Kremlin) with favorable electoral outcomes in exchange for political, institutional and financial resources,[3] gradual political recentralization in the 2000s has led to revision of bargaining agreements and the imposition of what we term *electoral signaling*. This is a strategy employed by regional governors to signal their loyalty to the Center by means of fraudulently augmented electoral results and to get certain rewards in exchange, such as political survival or post-electoral transfers. According to Susan Hyde and Angela O'Mahony, higher preelection transfers may indicate either the presence or purchase of loyalty.[4]

Mebane Jr. and Kirill Kalinin, "Comparative Election Fraud Detection" (Working Paper. Prepared for presentation at the Annual Meeting of the American Political Science Association, Toronto, Canada, 2009); Mikhail Myagkov, Peter C. Ordeshook, and Dimitry Shaikin, *The Forensics of Election Fraud: With Applications to Russia and Ukraine* (New York: Cambridge University Press, 2009); Ruben Enikolopov et al., "Field Experiment Estimate of Electoral Fraud in Russian Parliamentary Elections," *Proceedings of the National Academy of Sciences of the United States of America* 110, no. 2 (2013): 448-452; Ashlea Rundlett and Milan W. Svolik, "Deliver the Vote! Micromotives and Macrobehavior in Electoral Fraud," *American Political Science Review* 110, no. 1 (2016): 180-197; Dmitry Kobak, Sergey Shpilkin, and Maxim S. Pshenichnikov, "Integer Percentages as Electoral Falsification Fingerprints," *The Annals of Applied Statistics* 10 (2016): 54-73; Robert G. Moser and Allison C. White, "Does Electoral Fraud Spread? The Expansion of Electoral Manipulation in Russia," *Post-Soviet Affairs* 33, no. 2 (2017): 85-99; Arturas Rozenas, "Detecting Election Fraud from Irregularities in Vote-Share Distributions," *Political Analysis* 25 (1 2017): 41-56.

2 Alberto Simpser, *Why Governments and Parties Manipulate Elections: Theory, Practice, and Implications* (New York: Cambridge University Press, 2013).

3 Daniel Treisman, "Russia's "Ethnic Revival": The Separatist Activism of Regional Leaders in a Postcommunist Order," *World Politics* 49, no. 2 (1997): 212-249; Daniel Treisman, "Dollars and Democratization: The Role and Power of Money in Russia's Transitional Elections," *Comparative Politics* 31, no. 1 (1997): 1-21; Grigorii V. Golosov, "The Regional Roots of Electoral Authoritarianism in Russia," *Europe-Asia Studies* 63, no. 4 (2011): 623-639; Vladimir Gel'man, *Authoritarian Russia: Analyzing Post-Soviet Regime Changes* (University of Pittsburgh Press, 2015).

4 Susan D. Hyde and Angela O'Mahony, "International Scrutiny and Pre-Electoral Fiscal Manipulation in Developing Countries," *Journal of Politics* 72, no. 3 (2010): 690-704.

While the previous research has shown that, in Russia and elsewhere, fraud can often be readily detected, it has rarely focused on the mechanisms by which election fraud can be conducted nationally. Alberto Simpser emphasizes the importance of signaling and uses a signaling game model, but he focuses on a ruling party signaling its "strength" and not, as in this paper, on officials at one level of government signaling "loyalty" to officials at a higher level in the federal system.[5] This paper argues that the pattern of fraudulent electoral results can be explained by the presence of signaling games between the regions and the Center. Fraudulent electoral results show how favorable electoral outcomes can be delivered by the regional elites to display their loyalty to the Center in exchange for administrative and financial rewards. According to my findings, even a small amount of election fraud attributed to signaling strategies affects post-election transfer payments.

To elucidate these institutions of bargaining and electoral signaling, the paper proposes a game theoretic model – a signaling model[6] – which is used to motivate a set of empirical models that are estimated using data from all federal elections in Russia for the period 2000-2018 (specifically, presidential elections in 2000, 2004, 2008 and 2018; parliamentary elections in 2003, 2007, 2011, and 2016). As a measure of electoral signaling I use the last digit test,[7] which has been used in other studies.[8] In this paper, I introduce its revised version that focuses on prevalence of anomalous data patterns in turnout and voting percentage data, specifically the frequency with which 0s or 5s appear in the last digit of rounded percentages.[9] This version of the last digit test has a direct interpretation linked with electoral signaling that makes use of percentages rather than counts. I believe that the Kremlin is capable of identifying

5 Simpser, *Why Governments and Parties Manipulate Elections: Theory, Practice, and Implications*.

6 In-Koo Cho and David M. Kreps, "Signaling Games and Stable Equilibria," *Quarterly Journal of Economics* 102, no. 2 (1987): 179-221.

7 Bernd Beber and Alexandra Scacco, "What the Numbers Say: A Digit-Based Test for Election Fraud," *Political Analysis* 20, no. 2 (2012): 211-234.

8 Evgeniya Lukinova, Mikhail Myagkov, and Peter C. Ordeshook, "Metastasised Fraud in Russia's 2008 Presidential Election," *Europe-Asia Studies* 63, no. 4 (2011): 603-621; Nils D. Weidmann and Michael Callen, "Violence and Election Fraud: Evidence from Afghanistan," *British Journal of Political Science*, 2013, 53-75; Fredrik M. Sjoberg, "Autocratic Adaptation: The Strategic Use of Transparency and the Persistence of Election Fraud," *Electoral Studies* 33 (2014): 233-245; Tomila Lankina and Rodion Skovoroda, "Regional Protest and Electoral Fraud: Evidence from Analysis of New Data on Russian Protest," *East European Politics*, 2017, 253-274.

9 Walter R. Mebane Jr. and Kirill Kalinin, "Electoral Falsification in Russia: Complex Diagnostics of Elections 2003 2004, 2007-2008" [in Russian], *Rossiiskoye Elektoral'noye Obozreniye* 2/09 (2009): 57-70.

the regions with most salient signaling strategies precisely because of the simplicity of this method: finding the frequencies of 0s or 5s in the last digit of rounded turnout/vote percentages at the regional level, and then awarding or punishing the regions that exhibit relative high or relative low frequencies should be a fairly simple task for the Center/Kremlin.

The contribution of this paper to the existing literature is threefold. First, it offers a theoretical model of electoral signaling by bringing together electoral and financial data. Second, it uses implications from formal modeling to understand the mechanisms by which the evolution of federal relations in Russia can be connected to election fraud. Finally, this paper engages an original dataset that combines electoral, financial and gubernatorial data.

The structure of this paper is as follows. The first section lays out the theory of signaling and proposes the signaling game model. The second section provides an overview of the Russian gubernatorial elections, discusses the relevance of signaling strategies in the Russian political context and formulates key research hypotheses. The third section focuses on empirical analysis, main findings and robustness tests. In the final part, I draw conclusions and discuss prospects for future research.

2 Theory

In authoritarian regimes, information uncertainty about the degree of real support for the regime among the elites prevents the autocrat from distinguishing between loyal and disloyal agents.[10] This complicates the autocrat's ability to control and punish the agents opposing the regime and to effectively allocate election fraud throughout the system. One of the solutions to the autocrat's problem would be to use the intelligence apparatus to monitor and punish disloyal agents, while using positive incentives to encourage loyalty and compliance. The exchange of loyalty and rents not only strengthens the bond between the autocrat and agents, but also strengthens loyalty, especially among agents most at risk of being excluded from the winning coalition.[11]

Elections serve an important purpose for the autocrat: they not only legitimize the regime and reduce the likelihood of a coup *d'état* by disaffected regime

10 Ronald Wintrobe, *The political economy of dictatorship* (Cambridge, UK; New York, NY: Cambridge University Press, 1998); Milan W. Svolik, *The Politics of Authoritarian Rule* (Cambridge University Press, 2012).

11 Bruce Bueno de Mesquita et al., *The Logic of Political Survival* (The MIT Press, 2004); Scott Gehlbach, *Formal Models of Domestic Politics* (Cambridge University Press, 2013).

notables,[12] but also provide a wealth of information. For instance, the autocrat is able to assess the strength of potential opposition in society, even if the signal is somewhat noisy due to manipulation or fraud.[13] Electoral information also helps to assess the loyalty status of local agents and evaluate their success in mobilizing regional political machines to insure the autocrat's victory.[14]

The principal-agent problem between the autocrat and his agents implies that the agents are willing to engage in fraud only in situations where vested risks are compensated by certain financial awards, such as rents and payments coming from the principal.[15] Election manipulation has also been shown to entangle domestic fiscal activities.[16] This observation is supported by the general theory of agency, arguing that the principal benefits from giving the agent some rent to induce him to take a desired but unobservable action and to truthfully reveal his private information. This exchange, however, is costly in terms of the policymaker's objective and decreases economic efficiency of the outcome compared to non-authoritarian states.[17]

Signaling strategies have been the subject of previous research on electoral autocracies. For instance, Alberto Simpser focuses on a ruling party signaling its "strength" by means of increasing the winner's election margin.[18] By creating a public impression of his own political dominance, the autocrat is able to

12 Barbara Geddes, Joseph Wright, and Erica Frantz, "Why Parties and Elections in Dictatorships?," chap. 6 in *How Dictatorships Work: Power, Personalization, and Collapse*, UCLA (Cambridge University Press, 2018), 129-153; Beatriz Magaloni, *Voting for Autocracy: Hegemonic Party Survival and its Demise in Mexico* (Cambridge Studies in Comparative Politics), 1st (Cambridge Studies in Comparative Politics, 2006).

13 Wintrobe, *The political economy of dictatorship*; Mesquita et al., *The Logic of Political Survival*; Jennifer Gandhi, *Political Institutions under Dictatorship* (New York: Cambridge University Press, 2008); Georgy Egorov, Sergei Guriev, and Konstantin Sonin, "Why Resource-poor Dictators Allow Freer Media: A Theory and Evidence from Panel Data," *American Political Science Review* 103, no. 4 (2009): 645-668.

14 Henry E. Hale, "Explaining Machine Politics in Russia's Regions: Economy, Ethnicity, and Legacy," *Post-Soviet Affairs* 19, no. 3 (2003): 228-263; Vladimir Gel'man, "The Dynamics of Sub-National Authoritarianism: Russia in Comparative Perspective" (Paper prepared for the Annual Meeting of the American Political Science Association, Toronto, Canada, September 3-6, 2009, 2009); Golosov, "The Regional Roots of Electoral Authoritarianism in Russia."

15 Rundlett and Svolik, "Deliver the Vote! Micromotives and Macrobehavior in Electoral Fraud."

16 Hyde and O'Mahony, "International Scrutiny and Pre-Electoral Fiscal Manipulation in Developing Countries."

17 Avinash K. Dixit, "Democracy, Autocracy and Bureaucracy," *Journal of Globalization and Development* 1, no. 1 (2010): 1-47.

18 Simpser, *Why Governments and Parties Manipulate Elections: Theory, Practice, and Implications*.

discourage the political opposition from its quest for power.[19] Ashlea Rundlett and Milan Svolik claim that to overcome the limited information problem, agents start relying on the autocrat's genuine nationwide popularity as a coordination mechanism.[20] This, however, still leads to Pareto-inferior outcome expressed in an oversupply or undersupply of fraud, resulting from a herd dynamic among agents. Kirill Kalinin argues that the "signal of loyalty" can be associated with a close match between the inflated polling estimates and incumbent's electoral returns, and vice versa, the "signal of disloyalty" is associated with a mismatch between both quantities.[21] Thus, the agents can use signaling strategies to credibly signal their loyalty to the autocrat and receive financial awards, such as rents and payments in return.

In this paper I propose the signaling game that helps to model strategic interactions between the autocrat (Kremlin/Center) and the local agent (governor).[22] The game is built around the political loyalty, defined as the local agent's ability to control the political, social and economic spheres in the dependent region so as to provide the autocrat with fraudulently augmented electoral results benefiting him. In return for favorable electoral outcomes, agents can be rewarded with financial inflows or appointments, or, in the event of a negative outcome, punished by the autocrat. Even when the political regime is stable and durable, the actual benefits from committing election frauds could far outweigh the actual costs, inducing the local agents to adopt their signaling strategies on a regular basis.[23]

In the game there are two actors: the governor ($\mathcal{G}$), who is either loyal (L) or not ($\neg L$) and the Kremlin/Center ($\mathcal{K}$), that does not know whether $\mathcal{G}$ is loyal, but can observe $\mathcal{G}$'s move to commit election fraud (F) or not ($\neg F$). After receiving the signal from the governor $\mathcal{G}$, the Center decides whether to punish or not

19 Susanne Lohmann, "The Dynamics of Informational Cascades: The Monday Demonstrations in Leipzig, East Germany, 1989-91," *World Politics* 47, no. 1 (1994): 42-101; Simpser, Why Governments and Parties Manipulate Elections: Theory, Practice, and Implications.

20 Rundlett and Svolik, "Deliver the Vote! Micromotives and Macrobehavior in Electoral Fraud."

21 Kirill Kalinin, "Linking Preference Falsification and Election Fraud in Electoral Autocracies: The Case of Russia," *Political Studies* 66, no. 1 (2014): 81-99.

22 For a more detailed discussion of the formal model please, see Kirill Kalinin and Walter R. Mebane Jr., "Understanding Electoral Frauds Through Evolution of Russian Federalism: from 'Bargaining Loyalty' to 'Signaling Loyalty'" (Paper presented at the 2011 Annual Meeting of the Midwest Political Science Association, Chicago, IL, March 31-April 2, March 1, 2012), https://ssrn.com/abstract=1668154.

23 Rundlett and Svolik, "Deliver the Vote! Micromotives and Macrobehavior in Electoral Fraud."

to punish the governor. All the payoffs for both players are functions of state of the world, action chosen and signal sent by $\mathcal{G}$. One key difference between a loyal $\mathcal{G}$ and a disloyal type is who retains any future surplus generated by a transfer from $\mathcal{K}$ the governor or the Center (See Appendix A).

According to the signaling model, several parameters are central to our understanding of why specific equilibria hold and why, in particular, the "electoral signaling" equilibrium arises. These parameters are d, the value to the Center of replacing a disloyal governor, λ, the probability that a governor is loyal, which is presumably increased by having the governor be appointed instead of elected, b, the future returns expected to be produced by a transfer, and w, the value of electoral punishment by voters for fraud committed in the election. Other parameters are less essential in our equilibrium solutions, these are p, the value of punishment imposed by the Center, v, the value of excess votes produced by fraud, t, the value of transfers from the Center to the governor. Here loyalty is regarded as a choice each governor makes and not an immutable personality trait, $\lambda \in (0,1)$: $\lambda = 0$ indicates no chance of loyal governor at all, and $\lambda = 1$, a high chance of loyalty. Even though during the 1990s and early 2000s the signaling model does not describe the relationships among election fraud and other phenomena all that well: "bargaining" is not the same as "signaling." Nonetheless we apply the analysis of the game model to this period. The most apparent feature of that period is that the value of replacing a disloyal governor d and the probability of governor being loyal λ are low.

The signaling theory implies that over all the country, regions are diverse, so a single configuration of the parameter values of the game model does not characterize the whole country. Note that we have modeled the relationship between the Center and one governor. It is assumed that the Center plays such a game independently in each region, and that regional actors learn nothing from one another's experience. Reality undoubtedly involves more interaction between regions than this, but it is intractable to extend the game to one in which the Center simultaneously interacts with all other regions. The future returns expected from a transfer, b, may be positive or negative. While negative b values are associated with corruption and political opportunism, positive b values are like a normal investment. Different regions may at any one time have different values of b. For instance, during the 1990s, the threat of regions leaving the Russian Federation was very real, so b was negative, and the relationship between election fraud and transfers is such that governors who commit fraud are likely worse off than governors who do not.[24]

24 Kirill Kalinin and Walter R. Mebane Jr., "Understanding Electoral Frauds Through Evolution of Russian Federalism: from 'Bargaining Loyalty' to 'Signaling Loyalty'."

In sum, there are ten equilibrium solutions for this game, six out of which are most feasible to the Russian political context (See Table 1). Based on the values of loyalty w and electoral punishment λ we can classify them into three periods: 1) *a period before 2005 with gubernatorial elections in place*: with varying degree of loyalty $\lambda \in [0,1]$ and non-zero electoral punishment $w > 0$ denoting the presence of gubernatorial elections; 2) *a period 2005-2012 with gubernatorial appointments in place*: varying degrees of loyalty $\lambda \in [0; 1]$ and electoral punishment $w = 0$ denoting the absence of electoral punishment for the governor; 3) *a period 2012-present with gubernatorial elections in place*: with high levels of loyalty $\lambda = 1$, describing regime evolution into a more authoritarian direction, and electoral punishment $w = 1$, denoting the possibility of electoral punishment from the regional electorate. If the periods 2000-2004 and 2005-2012 are characterized mostly by pooling equilibria, in which loyal and disloyal governors take the same actions and so making it impossible to separate the two types of governors, the period 2012-present is characterized only by separating equilibria, in which the Center is able to separate the types of governors and punish them accordingly.

Specifically, the game demonstrates that in the case of greater centralization in the 2000s, the typical value of λ has increased, the value of d also becomes high and increasing over time. The increase in d reflects cooptation of local political machines into the power vertical. As long as the loyalty of governors is not certain – $0 < \lambda < 1$ – and $b < 0$, there may be an alternation between the equilibrium in which both types of governors commit fraud (III*), and the

TABLE 1 Equilibrium strategy profiles and evolution of Russian federalism

Period	N	Profile	Loyalty	Frauds	Autocrat punishes L	Voters punish $\mathcal{G}$
2000-2005	XV*	$(\neg F_1,\neg F_2,P_1,\neg P_2)$	Uncertain λ	No fraud	Yes	Yes
	III*	$(F_1,F_2,\neg P_1,P_2)$		Both commit fraud	No	Yes
2005-2012	IX*	(F_1,F_2,P_1,P_2)	Uncertain λ	Both commit fraud	Yes	No
	I*	$(F_1,F_2,\neg P_1,\neg P_2)$	High λ	Both commit fraud	No	No
	VI*	$(F_1,\neg F_2,\neg P_1,\neg P_2)$		Loyal commits fraud	No	No
2012-Present	V*	$(F_1,\neg F_2,P_1,\neg P_2)$	High λ	Loyal commits fraud	Yes	Yes

one in which neither type of governors commits fraud – an alternation that is related to transfers and punishments and depends on loyalty (XV*). As a result, this will induce an association between transfers and punishments, on the one hand, and election fraud, on the other. Once regional elections take place or all governors are appointed, $\lambda = 1$, then several equilibria come into play with the loyal type always committing fraud and nonloyal type alternating between fraud and no fraud (III*, VI*, IX*, I*). After restoration of gubernatorial elections under the condition of certain loyalty $\lambda = 1$ and the decrease in electoral punishment vis-a-vis administrative punishment $2p \geq w$, the Center prefers to punish loyal governors for election fraud. As a result, an association between transfers, punishments and election fraud will diminish or become negative.

Hence, the theoretical model supports different predictions about the relationships among fraud, post-electoral transfers and other variables during different time periods. During the 1990s and early 2000s the model suggests that transfers will be negatively associated with measures of anomalies, when loyalty is relatively high. In the 2000s, once the Kremlin commences recentralization, particularly after 2004, when gubernatorial elections are abolished, the game model predicts that when loyalty is high the incidence of fraud will be positively associated with post-electoral transfers. Finally, after 2012 we are likely to observe the absence of association between both quantities of interest.

3 Signaling Games: A Case of Russia

The notion of signaling strategies has been especially acute during the Soviet period, when the governors would use "false accounting" (*pripiski*), designed to affect the measures of the level of regional output and help them to avoid punishment.[25] Because of this "false accounting", it comes as no surprise that with the start of new Russian recentralization in 2000s, such Soviet practices were restored in relation to Russian contemporary elections. The rise in centralization has led to integration of local agents into the superstructure of the center with economic and political resources flowing from the autocrat to subnational units. As a result, the presence of electoral anomalies has become a basic signaling mechanism of regional bosses' loyalty and of their ability to control administrative resources to the Kremlin's benefit.

25 Mark Harrison, "Forging Success: Soviet Managers and False Accounting, 1943 to 1962," University of Warwick, Department of Economics, *The Warwick Economics Research Paper Series* (*TWERPS*), January 2009.

During the 2000s Russia has gone through three main stages of evolution of federalism. All three periods can be viewed through the prism of Russia's dual evolution from a decentralized to a centralized form of federalism, and from a relatively democratic to a more authoritarian political regime.

The first period describes the situation when by the early 1990s the majority of Russian regions hosted centralized political regimes with executive authority concentrated in the office of chief executives. Popular elections helped the governors to establish political regimes without significant constraints from the Center, concentrating regional political and economic resources in their hands.[26] The bargaining included the process of distribution and acquisition of federal resources by the regions in exchange for providing electoral support to the Center during national elections.[27] This resulted in the federal asymmetry that enabled specific groups of regions to play a greater role in federal politics and implement bargaining policies with growing levels of concessions from the Center. In return for concessions from the Center, the governors mobilized their regional political machines to provide necessary electoral support to the national ruling elites.[28] Since 1996 all of the Russian regions hosted gubernatorial elections, however, so the possibility of electoral punishment by regional constituencies could constrain governors from committing electoral frauds in the region. In other words, in general electoral frauds were politically costly to the governors. This cost could vary depending on the governor's capacity to mobilize his or her political machine to provide expected fraudulent results. Another factor that could affect a governor's decision to commit fraud could be the governor's "moral" obligations to the Center, if the governor was appointed before the elections.

The second period starts after Putin's accession in 2000 when the nature of federal relations was revised by the Kremlin.[29] The nature of the

26 Daniel Treisman, *After the Deluge. Regional Crisis and Political Consolidation in Russia* (Ann Arbor, MI: University of Michigan Press, 1999); Dmitrii Gorenburg, "Regional Separatism in Russia: Ethnic Mobilization or Power Grab?," Europe-Asia Studies 51, no. 2 (1999); Mikhail Filippov, Peter C. Ordeshook, and Olga Shvetsova, *Designing Federalism: A Theory of Self-Sustainable Federal Institutions* (New York: Cambridge University Press, 2004); Andrey Starodubtsev, *Federalism and Regional Policy in Contemporary Russia* (Routledge, 2017).

27 Vladimir Gel'man, "Vozvrashenie Leviafana? Politika Recentralizatsii v Sovremennoi Rossii," POLIS 2 (2006): 90-109.

28 Gel'man, "The Dynamics of Sub-National Authoritarianism: Russia in Comparative Perspective."

29 Filippov, Ordeshook, and Shvetsova, *Designing Federalism: A Theory of Self-Sustainable Federal Institutions*, 309.

superpresidential system[30] inherited from the former Soviet authoritarian institutions helped the Center reestablish its control over the regions through administrative recentralization (return of the Center's control over regional branches of federal agencies), recentralization of economic resources (growing concentration of financial resources in the hands of the Center at the expense of the regions), finally, political recentralization (Putin demanded compliance of regional laws and constitutions with that of the federal governance).[31] Gubernatorial elections were abolished in 2005, as a result of which the governors lost their independent political base: the political survival of the governor was put under the Center's judgment. This led governors' political machines to be co-opted into the power vertical. As a result, political loyalty in addressing Kremlin's political needs was regarded by Kremlin as a crucial quality for the governors. Loyalty implied both the governor's ability to put under his or her control political, social and economic spheres in the region, and it implied that the governor would provide Kremlin with favorable electoral outcomes, especially during national elections. With the abolition of gubernatorial elections, the costs for committing frauds by the governors were reduced: if in the 1990s and early 2000s they could be electorally punished by their regional constituencies, starting 2005 electoral punishment was no longer possible. The benefits from committing frauds could far outweigh the actual costs: if Kremlin was satisfied with electoral results, the governor kept the job and the size of transfers could eventually increase. The research on the determinants of gubernatorial replacement in the second period mainly agrees that provision of favorable election results, rather than personal popularity or socio-economic performance, served as a major criteria for the Kremlin.[32]

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30 Jose Antonio Cheibub, *Presidentialism, Parliamentarism, and Democracy* (New York: Cambridge University Press, 2007), 17-18.

31 Jeffrey Kahn, *Federalism, Democratization, and the Rule of Law in Russia* (Oxford: Oxford University Press, 2002); Gel'man, "Vozvrashenie Leviafana? Politika Recentralizatsii v Sovremennoi Rossii"; Cheibub, *Presidentialism, Parliamentarism, and Democracy*; Brian D. Taylor, *State Building in Putin's Russia: Policing and Coercion After Communism* (New York: Cambridge University Press, 2011); Golosov, "The Regional Roots of Electoral Authoritarianism in Russia."

32 Gulnaz Sharafutdinova, "Subnational Governance in Russia: How Putin Changed the Contract with His Agents and the Problems It Created for Medvedev.," *Publius: The Journal of Federalism* 40, no. 4 (2010): 672-96; Ora John Reuter and Graeme B. Robertson, "Subnational Appointments in Authoritarian Regimes: Evidence from Russian Gubernatorial Appointments," *Journal of Politics* 74, no. 4 (2012): 1023-1037; William M. Reisinger and Bryon J. Moraski, "Russia's Regions and Comparative Subnational Politics," chap. 3 *Deference or Governance? A Survival Analysis of Russia's Governors under Presidential Control*, ed. William M. Reisinger (Routledge, 2013), 40-62; Vitalii Gorokhov, "I will Survive: Regional Chief Executives (Governors) and the Principal-Agent Paradigm after the

The third period is marked by the transition of presidential power from Dmitry Medvedev back to Vladimir Putin in 2012. In the fall 2011 then-President Medvedev proposed then-Prime Minister Vladimir Putin to run for a third term. This pre-arranged move of two politicians ignited a widespread public discontent and has set the tone for both upcoming Russian parliamentary and presidential elections. The parliamentary elections led to defeat of the party of power United Russia, which lost its two-thirds constitutional majority it had held prior to the election in spite of the manipulated character of elections and numerous fraud allegations. Consequently, obvious unfairness and uncleanness of election results provoked the rise of massive protests in Moscow and St. Petersburg, which forced the Kremlin to urgently launch a series of reforms aimed to provide electoral transparency of the forthcoming March presidential elections, such as installation of transparent ballot boxes (one-third of polling stations used transparent ballot boxes) and web cameras in every polling station across the country. One of the major political reforms, however, was the restoration of the gubernatorial elections through which the Kremlin hoped to transfer popular expectations to the regional level. However, the Kremlin also resorted to creation of "auxiliary institutions," which helped it to centralize power and limit contestation.[33] Specifically, the "ballot construction" strategy allowed for the addition of phony and substandard candidates, such as spoilers, and other generally hopeless candidates. The exclusion of real opposition became possible with establishment of a so-called "municipal filter," which required potential gubernatorial candidates to collect the signatures of 5-10% elected municipal executives and local deputies representing three-quarters of the sub-regional municipalities. Consequently, mobilization of friendly voters to increase the Kremlin's electoral support and demobilization of opposition supporters became increasingly effective after the cancellation of the minimum turnout threshold.[34] Further limitations introduced by President Putin granted regional legislatures the right to replace gubernatorial elections, especially in Republics and autonomous okrugs with "indirect elections" by the local legislature. While the initial list of candidates was created by the

Abolition of Gubernatorial Elections in Russia," *Journal of Contemporary Central and Eastern Europe* 25, no. 1 (2017): 103-115.

33 Regina Smyth and Rostislav Turovsky, "Legitimising Victories: Electoral Authoritarian Control in Russia's Gubernatorial Elections," *Europe-Asia Studies* 70, no. 2 (2018): 182-201.

34 Smyth and Turovsky, "Legitimising Victories: Electoral Authoritarian Control in Russia's Gubernatorial Elections"; Walter R. Mebane Jr. and Kirill Kalinin, "Electoral Fraud in Russia: Vote Counts Analysis using Second-digit Mean Tests" (Working Paper. Prepared for the 2010 Annual Meeting of the Midwest Political Science Association, Chicago, IL, April 22-25, 2010).

legislature's parties, the short list of nominees that was voted on was crafted by the Kremlin. To summarize, the literature suggests that even though the third period is characterized by the restoration of gubernatorial elections, the ability of voters to punish unpopular governors was seriously diminished. The model predicts that in the third period election fraud will be punishable by the Center. The rationale for this is laid out in the paper by Ashlea Rundlett and Milan Svolik, who argue that most governors prefer to conduct fraud when the incumbent is popular, his victory is guaranteed, and the governor's actions are unlikely to be investigated.[35] Oversupply of election fraud may be suboptimal from the incumbent's perspective, as it increases unnecessary costs associated with inflated transfers in the context of excessive loyalty levels ($\lambda = 1$), increased risks of electoral punishment of the governors by citizens ($w > 0$) and political opportunism of governors ($b < 0$). Exogenous factors, i.e. external to the signaling model, may include increased risks of nationwide anti-government protests similar to those that occurred in 2011-2012, and a decline in the regime's legitimacy due to the international reaction to electoral violations.

Hence, the presence of election fraud becomes a basic signaling mechanism of regional bosses' loyalty and of their ability to control the administrative resources to the Kremlin's benefit. Electoral signaling can be readily detected by analyzing the percentages of electoral outcomes. If electoral signaling occurs, electoral manipulations with figures are most likely to take place with rounded percentages of turnout or incumbent's vote percentages, which is the easiest and most readily detected way to report basic information to superiors.[36] In such case, favorable percentages are first sent down from Kremlin to the regional elections' commissions, which pass this information further down to the territory-level commissions and, finally, precincts. Of course, there is no direct evidence that this "passing down" is the precise procedure used to commit the fraud I allege exist, nor is reliable information available about exactly how the fraud is implemented. Ballot box stuffing and simply writing down false numbers are likely mechanisms,[37] but also likely is fraud using phony voter registrations[38] or perhaps other methods.[39]

35 Rundlett and Svolik, "Deliver the Vote! Micromotives and Macrobehavior in Electoral Fraud."

36 Here by "incumbent" I mean an actor who represents the Center/Kremlin in elections and gains certain "incumbency" advantages over political contenders.

37 Oleg Boldyrev, "Ordinary Russians Train to Observe Presidential Vote," February 25, Internet Edition, http://www.bbc.co.uk/news/world-europe-17100005, BBC News, 2012.

38 Marina Arbatskaya, How Many Voters Are there in Russia? (Political-geographical analysis of a General Number of the Russian Voters and Level of their Activity. 1990-2004 [in Russian]. (Irkutsk: Institute of Geography SB RAS, 2004).

39 Fabrice Lehoucq, "Electoral Fraud: Causes, Types, and Consequences," *Annual Review of Political Science* 6 (2003): 233-256.

One of the obvious ways to detect signaling patterns is to display kernel density estimates for precinct-level incumbent's vote percentages and turnout for the Russian federal elections. For most of the years, the subfigures in Figure 1 show the presence of non-normal distributions, exhibiting spikes at locations corresponding to the excess of vote percentages and turnout values at values of 60%, 65%, 70%, 75%, 80%, 85%, 90% and 100%.[40] The upper panel dem-

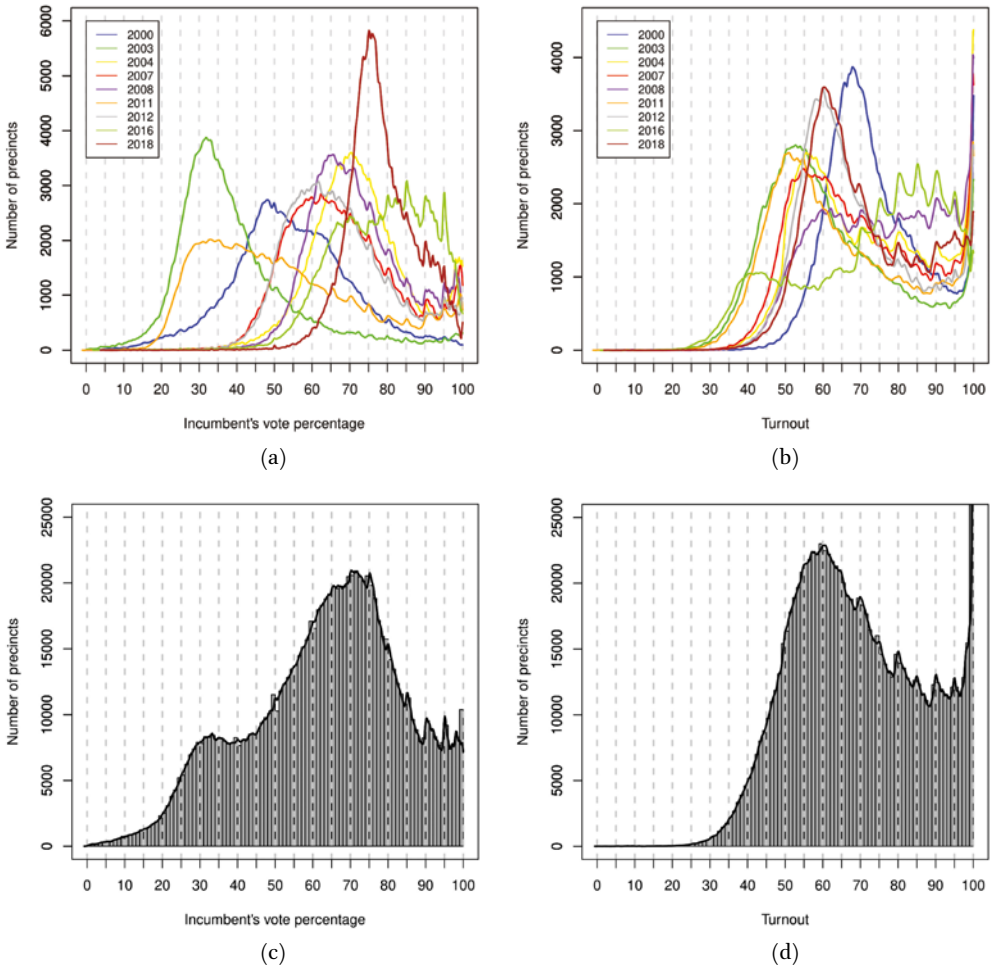

FIGURE 1 Distributions of turnout and incumbent's vote percentage, 2000-2016
Notes: (a) – distribution of incumbent's vote percentages; (b) – distribution of turnout across elections; (c) – distribution of incumbent's vote percentages in all elections combined; (d) – distribution of turnout in all elections combined.

40 Buzin and Lubarev, *Crime without Punishment: administrative electoral technologies in Russian federal elections 2007-2008.*; Mebane and Kalinin, "Electoral Falsification in

onstrates the spikeness and non-normality of distributions across the elections (See Table B1 Appendix B for additional figures and statistics), the lower panel shows the persistence of spikiness in the combined electoral dataset. Moreover, a resampled kernel density method proposed by Arturas Rozenas supports both the general signaling interpretation and the specific finding of an increase in signaling behavior since 2000.[41] For example, the figures in Table B1 in Appendix B show that the percentage of precincts with "fraudulent" election results increases from .04 percent in 2000 to 2.35 in 2016, and fall to 0.72 in 2018. Researchers argue that the only acceptable explanation for these spiked distributions is a wide-spread adjustment of those figures to specific "rounded" figures.

The 2011-2012 electoral cycle demonstrated a noticeable decline in signaling strategies. It seems that Medvedev's presidency has led to a degradation of the political machines and weakened gubernatorial signaling strategies. In contrast, Putin's return to power marked at least a temporary restoration of political machines, leading to a strengthening of signaling in 2016 and its unexpected weakening in 2018.

In Russia political machines are located in ethnic republics and autonomous districts with dense ethnicity-based social networks and rural areas with the rural population dependent on local bosses.[42] The Table B2 demonstrates the presence of cross-regional heterogeneity in signaling patterns over time: for example, ethnic Republics on average demonstrate more consistent signaling compared to oblasts. Republics with the highest number of elections with signaling in turnout are Tatarstan, Chechnya, Kabardino Balkariya, Bashkortostan, Dagestan, which partially meets our expectation from the previous findings;[43] many oblasts also exhibit stable patterns over the years, i.e. Primorskiy kray, St. Petersburg, Arkhangel'skaya, Murmanskaya, Sakhalinskaya and Tyumenskaya oblasts. Republics with highest degree of anomalies incumbent's vote percentages are Chechnya, Bashkortostan, Dagestan, Ingushetiya; and among oblasts are Sakhalinskaya and Tyumenskaya.

Russia: Complex Diagnostics Elections 2003-2004, 2007-2008"; Mebane and Kalinin, "Comparative Election Fraud Detection."

41 Rozenas, "Detecting Election Fraud from Irregularities in Vote-Share Distributions."

42 Hale, "Explaining Machine Politics in Russia's Regions: Economy, Ethnicity, and Legacy"; Kimitaka Matsuzato, "Progressive North, Conservative South? Reading the Regional Elite as a Key to Russian Electoral Puzzles," in *Regions: A Prism to View the Slavic Eurasian World* (Sapporo: Slavic Research Center, 2000); Grigorii V. Golosov, "Machine Politics: the Concept and Its Implications for Post-Soviet Studies," *Demokratizatsiya* 21, no. 4 (2013): 459-480; Kirill Kalinin, "Validation of the Finite Mixture Model Using Quasi-Experimental Data and Geography," *Electoral Politics*, no. 1 (2019): 6.

43 Nikolay Petrov and Alexey Titkov, *Reiting Demokratichnosti Regionov Moskovskogo Tesentra Karnegi: 10 Let v Stroyu*, in Russian (Carnegie Moscow Center, 2013).

Signaling patterns serve as the markers of election fraud within the data, and can be detected using various kinds of the digit-based tests. Bernd Beber and Alexandra Scacco propose the last-digit test based on the idea that clean turnout or vote counts have uniformly distributed 0-9 last digits.[44] The authors list several conditions, which need to be met for the test: a) vote counts do not cluster within a narrow range of numbers, and there is minor variation in election unit sizes, electoral support or turnout; b) vote returns must not contain many single- and double-digit counts, i.e. the method should not be applied to the minor candidates with small vote counts or small polling stations. Once these conditions are met any statistically significant divergence from the uniform distribution can be attributed to fraudulent electoral outcome. The last-digit approach can be extended to any electoral variables meeting aforementioned conditions: counts, percentages of ballots and electoral returns.[45] The last-digit test has been validated in experimental studies[46] and used in various studies as a proxy for election fraud.[47]

For the purpose of this paper, as explained earlier, I propose the revised version of the last-digit test: the last digit test for turnout and vote percentages, with particular attention to the occurrence of 0s and 5s. Hence, the signaling strategies are explicitly present when the expected value for the mean of this indicator variable is significantly higher $E(P_{05s}) = 0.2$. Computations obtained from the *EFToolkit package*,[48] show that the signaling patterns associated with turnout and vote percentages have been statistically significant over the years, with the exception of 2000, for which anomalies in vote shares are statistically insignificant (See Table B1 in Appendix B for the results from last-digit analysis).[49]

Based on the theory and specifics of the Russian political context, we can formulate the following set of hypotheses:

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44 Beber and Scacco, "What the Numbers Say: A Digit-Based Test for Election Fraud."

45 Mebane and Kalinin, "Comparative Election Fraud Detection."

46 Verena Mack and Lukas F. Stoetzer, "Election Fraud, Digit Tests and How Humans Fabricate Vote Counts – An Experimental Approach," *Electoral Studies*, 2019, 31.

47 Lukinova, Myagkov, and Ordeshook, "Metastasised Fraud in Russia's 2008 Presidential Election"; Weidmann and Callen, "Violence and Election Fraud: Evidence from Afghanistan"; Sjoberg, "Autocratic Adaptation: The Strategic Use of Transparency and the Persistence of Election Fraud"; Lankina and Skovoroda, "Regional Protest and Electoral Fraud: Evidence from Analysis of New Data on Russian Protest."

48 The *Election Forensics Toolkit* is a web application, which has been technically implemented by Walter Mebane and Kirill Kalinin (See the link: https://electionforensics.cps.isr.umich.edu/about). *EFToolkit* package is available on *GitHub* and partially uses the code from the web application.

49 Kirill Kalinin and Walter Mebane, "kkalininMI/EFToolkit: Election Forensics Toolkit," 2019, https://doi.org/10.5281/zenodo.4136408, https://github.com/kkalininMI/EFToolkit.

Hypothesis 1: Between 2000 and 2004, when electoral signaling strategies are punished by both the Center and the voters, signaling strategies expressed in association between digit-based anomalies and transfers will be absent.
Hypothesis 2: It is expected that between 2005 and 2012, after the abolition of gubernatorial elections, both types of governors (loyal and disloyal) will commit fraud. Since the fraud remains largely unpunished, fraud-signal-transfers-reward regime will be fully in place.
Hypothesis 3: From 2012 to the present, the restoration of the gubernatorial elections marks a change in the signaling strategy: these are punishable by both the Center and the voters. Therefore, we are expected to see the absence of fraud-signal-transfers-reward mechanism or its relative decline.

4 Empirical Analysis

4.1 *Model Specification*

To interpret our empirical model, transfers t are not defined by the totality of actual transfers from the Center to regional governments, but rather as a deviation from the plain relationship between successive years' transfers. That is, if the regression of total transfers T in region i in the year immediately following the election, s, on the level of transfers in the year preceding the election, $s-$, is written $T_{is} = c_0 + c_1 T_{is-} + u_{is}$, for disturbance u_{is} and coefficients c_0 and c_1, then the amount of transfers subject to manipulation may be represented by a term t_{is} in the form

$$T_{is} = b_0 + b_1 T_{is-} + t_{is} e_{is} \tag{1}$$

The coefficients c_1 and b_1 should be close to 1.0, capturing the relative stability of the social and economic needs and resources that affect the total amount of transfers going to an area. Here t_{is} can be thought as a short-run distortion that exists in the year following an election. The game model motivates a special form for t_{is} that is discussed further below. The point to make now is that for the game model's b to be interpreted in terms of the future returns associated with the component t_{is} of T_{is} and not with the entirety of T_{is}.

The empirical model is motivated by (1) testing for the associations suggested by the game model, focusing on the form of the short-run distortion term t_{is}. It does not follow in any direct way from the game model, but rather picks up on its core idea that the signaling structure induces a short-run distortion in transfer payments that depends on election fraud and loyalty.

I analyze data measuring T_{is}, transfer payments to region i for postelection year s: T_{is} measures the amount of transfers per 1,000 people allocated to the region. T_{is} is a function of preelection transfer payments T_{is-}) and other variables in model of the form

$$T_{is} = b_0 + b_1 T_{is-} + \boldsymbol{z}_i'\boldsymbol{c} + \lambda_i \boldsymbol{f}_i'\boldsymbol{d} + \lambda_i \boldsymbol{f}_i' + \boldsymbol{d} + e_i \quad (2)$$

where b_0 is a constant term and $\boldsymbol{c}$ and $\boldsymbol{d}$ are vectors of coefficients, $\boldsymbol{z_i}$ is a vector of covariates, $\boldsymbol{f_i}$ is a vector of fraud measures, λ_i is a function to be defined that represents the probability the governor is loyal and e_i is a normally distributed disturbance. $\boldsymbol{z_i}$ contains variables that plausibly affect the level of transfer payments from Center to each region. The term $\lambda_i \boldsymbol{f}_i'\boldsymbol{d}$ corresponds to the idea expressed by t_{is} in (1), for particular fraud measures $\boldsymbol{f_i}$ and particular functional forms for λ_i: postelection transfer payments are a function of readily observable fraud signals, depending on the probability of loyalty.

To measure election fraud, I use two indices, defined as follows. First compute voter turnout and incumbent's vote percentage in the election for each precinct as a percentage rounded to the nearest digit. Define two variables D_{to5} and D_{vo5} that is equal to 1 if the last digit of turnout and incumbent's variable is a zero or five and equal to 0 for other digits. The variables $P05$ and $P05$ or their indices $P05_{is}$ is and $P05_{is}$ are the means of D_{to5} and D_{vo5} for each region. Vector $\boldsymbol{z_i}$ contains other electoral variables that may relate to transfer payments: $incumbent_i$ is the percentage of incumbent's electoral support, and $Turnout_i$ is the turnout.

The term λ_i represents a notion of loyalty slightly different from that in the game model. The game has the governor moving before Center, with Nature first selecting the type of the governor. In reality the governor makes a decision whether to be loyal, in response to anticipations of what Center will do and in light of preelection conditions. Among those conditions are preelection actions by the Center. A simple way to connect preelection actions to the game model is to imagine that they influence the value of λ: preelection actions affect the likelihood that the governor is loyal. Here the λ_i is defined as a logistic function of preelection transfers (T_{is-}) and $days_i$, a variable measuring number of days the governor served before the elections, assuming that the amount of time in the office is positively correlated with loyalty.

$$\lambda_i = \frac{1}{1 + \exp(-a_0 - \boldsymbol{x}_i'\boldsymbol{a})} \quad (3)$$

where a_0 is a constant, x_i is a vector containing $Transfers_{is}$ and $Days_i$.

The rationale behind selection of the nonlinear functional form is explained by estimation of loyalty. Since we are dealing with probabilities of loyalty, we need to have a function that naturally varies between 0 and 1. Moreover, logistic function has a good theoretical underpinning. Both lower and higher levels of loyalty are associated with the weaker effect of loyalty on dependent variable (election fraud or transfers), which can be especially the case if the Center is indifferent between too small or too large levels of loyalty. Moreover, the results of nonparametric regression analysis show the presence of nonlinear relationships between proposed measures of election fraud and differences between real transfers per capita before and after the elections (See Table B1 in Appendix B)

This model (2) represents a very simple implementation of a mixture model. Fraud measures and transfers are related when the governor is loyal and not otherwise. The probability that the governor is loyal is measured by λ_i. All parameters are assumed to be identical for the various types of governors, so the interaction term involving λ_i is sufficient to represent the mixture. Conceptually, the fraud variables play a role only when the governor is loyal. Regression relationships based on linear predictors are not specifically implied by suggested theoretical model, but they represent the easiest way to get at possible relationships, taking into account the likelihood that multiple, correlated and conceptually distinct variables are associated with the occurrence of fraud.

4.2 *Data Analysis*

I draw upon the data taken from multiple sources. The data on financial transfers 2000-2018 is downloaded from the website of the Russian treasury https://roskazna.gov.ru/. The electoral data for 2000-2018 is obtained from the website of the Russian Central Elections Commission http://www.izbirkom.ru/. The data on gubernatorial appointments is taken from https://rulers.org/. The rest of the data is collected from the databases of Federal State Statistics Service.

The results from the nonlinear least squares regression (NLS)[50] are presented in Figure 2 (a table with regression results is provided in the Appendix C1). Since the sample size used in this analysis is small and there is no substantive justification for which outliers should be excluded, I keep all of the observations in the regression. To estimate the model (3) I apply to nonlinear least squares using transfer payments, T_i, measured in postelection years 2001,

50 $\text{Transfers}_{is} = b_0 + c_1 \text{Vote percentage}_i + c_2 \text{Turnout}_i + c_3 \log \text{Transfers}_{is-} + c_4 \text{VRP}_{is-} + f_0 \text{Turnout P05}_i + f_1 \text{Vote percentage P05}_i + \lambda_i + \lambda_i (f_1 \text{Turnout P05}_i + f_2 \text{Vote percentage P05}_i) + e_i$,
$\lambda_i = \frac{1}{1 + \exp\{-(a_0 + a_1 \log \text{Transfers}_{is-} + a_2 \log \text{Days served}_i)\}}$.

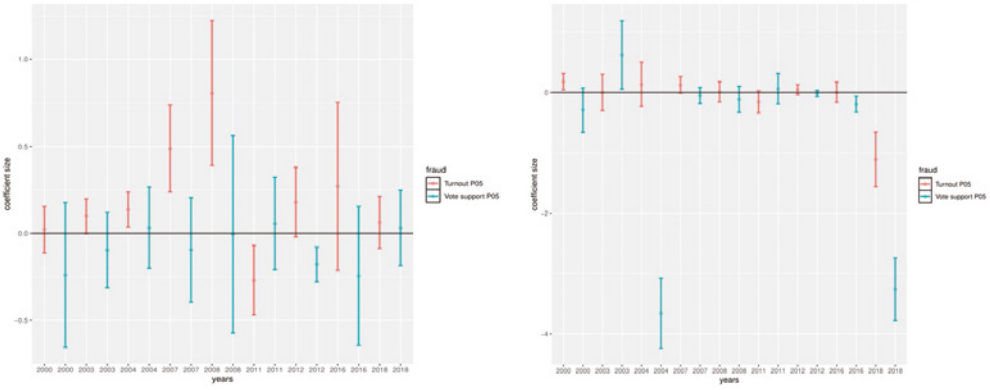

FIGURE 2 Nonlinear least squares results
Notes: (a) – logged real transfers per capita (b) – logged shares of transfers in the regional revenues

2005, 2009, 2013, 2019 for presidential elections and 2004, 2008, 2012, 2017 for parliamentary elections.[51] Each model is estimated for each year separately. Moreover, two different indicators of transfers are included as dependent variables: real transfers per capita and proportion of transfers in the regional revenues. It can be argued that the existence of multiple NLS solutions is theoretically grounded in the existence of multiple equilibria in the signaling game, therefore I focus on a subset of solutions with reasonable starting values for the parameters as described by the model.

My initial expectation that none of the coefficient estimates $\hat{f}_1$ for turnout and $\hat{f}_2$ for vote percentage yield statistically significant results in the early 2000s is supported by the findings. The strength of the signaling pattern of $\hat{f}_1$ tends to gradually increase, gaining marginal statistical significance in 2003 parliamentary elections. With the elimination of gubernatorial elections in 2004, the effect of signaling associated with turnout becomes stronger, peaking in 2008. At the end of Medvedev's presidency in 2012, the signaling effect associated with turnout $\hat{f}_1$ loses its statistical significance. After Putin's return to presidential office, the signaling effects associated with turnout gradually rebound though fail to exhibit any statistical significance. Notably, both 2016 and 2018 show no statistically significant signaling effects, which meets our theoretical expectations about disappearance of association between transfers

51 For estimation I use the nls2: Non-linear regression with brute force package in **R**; R Development Core Team, R: A Language and Environment for Statistical Computing, ISBN 3-900051-07-0 (Vienna, Austria: R Foundation for Statistical Computing, 2011), http://www.R-project.org.

and election fraud due to signaling. While the decline in signaling effects can be attributed to degradation of the political machines during Medvedev's presidency, Putin's return failed to demonstrate convincing evidence in favor of strengthening of signaling effects in 2016 and 2018. There is one important caveat here: since this study focuses primarily on signaling strategies associated with 0s or 5s in the last digit of rounded percentages, I intentionally avoid analyzing anomalous patterns associated with "global" bimodality in the distribution of turnout/vote percentages discussed in the other works of election forensics scholars, which would lead to a substantial increase in election fraud for the 2011-2012 electoral cycle.[52]

Finally, the shares of transfers in the regional revenues shown in Figure 2(b) do not yield statistically significant findings with exception of signaling in vote percentages for 2003, 2004, 2016 and 2018, and signaling in turnout for 2000, 2007 and 2016. These results are inconsistent with my findings on transfers per capita, indicating the presence of punishment in 2004, 2016 and 2018 federal elections. One explanation for these weak findings is the lack of cross-year variation in the shares of transfers.

Overall, the demonstrated models yield broad variation of signaling strategies throughout the studied period: relatively weak signaling patterns associated with turnout in the early 2000s; relatively strong signaling is associated with turnout in 2007-2008 elections; relatively weak signaling in 2011-2012 and 2016-2018. Presumably, the co-occurrence of signaling patterns is linked with Putin's presidency especially for a period from 2000 to 2008.

How robust are my findings from nonlinear least squares regression analysis?

First, it might be the case that the model produces biased findings since P05 digit-means can be affected by random noise. Based on the *EFToolkit*'s region-level computations, I constructed a dummy variable that takes a value of "1" when the signaling patterns are statistically different from zero and "0" otherwise.[53] While the model shows some differences between the results, the overall signaling trend is relatively consistent with the original model: the effects of signaling gradually intensify in the early 2000s peaking in 2007 and gradually decline until 2011 (See Figure C2 in Appendix C).

52 Dmitry Kobak, Sergey Shpilkin, and Maxim S. Pshenichnikov, "Statistical anomalies in 2011-2012 Russian elections revealed by 2D correlation analysis," arXiv:1205.0741 [physics.soc-ph], 2012, eprint: 1205.0741 (physics.soc-ph); Diogo Ferrari, Kevin McAlister, and Walter R. Mebane, "Developments in Positive Empirical Models of Election Frauds: Dimensions and Decisions," Working paper. Presented at the 2018 Summer Meeting of the Political Methodology Society, Provo, UT, 2018, Walter R. Jr. Mebane et al., "Measuring Election Frauds," Working Paper, March 6, 2022.

53 Kalinin and Mebane, "kkalininMI/EFToolkit: Election Forensics Toolkit."

Second, as an additional robustness test I relax model assumptions by including a set of control variables with an interaction term between loyalty and election fraud.[54] Not surprisingly, observed trends are robust across non-linear regression model specifications. Figure C3 in the Appendix C shows that the patterns of signaling are largely consistent with our previous findings from the constrained model.

Third, I use panel data analysis to address the problem of region-specific heterogeneity associated with socio-economic and cultural factors as well as various time shocks that can potentially bias my estimates of interest. I use a two-way fixed effects regression given by

$$T_{is} = \nu_i + \delta_s + \lambda_{is} f_i + \gamma T_{is-} + X'_{is}\beta + \epsilon_{is} \tag{4}$$

where T_{is} is transfer payment to region i for postelection year s, ν_i is a region fixed effect that rules out omitted variable bias from unobserved time invariant characteristics (e.g., region's geographic features, its political culture and history), δ_s is a year fixed effect to control for common time shocks to all regions over observed period, γ is an effect of pre-electoral transfer on post-electoral transfer, i.e. deviation from the plain relationship between successive years' transfers, λ_{is} are the quantities of interest, which identify the effect of fraud on transfers, X_{is} is a vector of time-varying covariates, including a constant, and ϵ_{is} is an idiosyncratic error term.[55]

Table 2 presents the results from the two-way fixed effects specification. The coefficient on the signaling strategies associated with turnout (*Turnout P05*) in Model 1 is statistically significant at $\alpha = 0.05$: a one-unit increase in *Turnout P05* increases transfers by 39% ($e^{0.33}$) percent on average. In Model 2 we compare the signaling phenomena between Putin's and Medvedev's presidencies: on average the signaling strategies related to incumbent's vote percentages (*Vote percentage P05*) yield 50% ($e^{0.4}$) greater effect during Putin's years in the office compared to Medvedev's. Finally, Model 3 demonstrates several key findings regarding our hypotheses: compared to the first period, the second shows that on average an increase in signaling associated with turnout by 84% ($e^{0.61}$), in the third period the signaling power more than doubles ($e^{0.80}$). In contrast, signaling patterns based on vote percentages show the opposite trend: if in the first period the increase in signaling is by 84%, in the second – decreases

54 $\text{Transfers}_{is} = b_0 + \text{Vote percentage} + c_2\text{Turnout}_i + c_3 \log \text{Transfers}_{is-} + c_4\text{VRP}_{is-} + \lambda_i \cdot (f_1\text{Turnout P05}_i + f_2\text{Vote percentage P05}_i) + e_i$, $\lambda_i = \frac{1}{1+\exp\{-(a_0 + a_1 \log \text{Transfers}_{is-} + a_2 \log \text{Days served}_i)\}}$.

55 For estimation I use the *plm: Linear Models for Panel Data* package in **R**.

by 42% ($e^{-0.88}$) and in the third period by about 50% ($e^{-0.71}$) while controlling for potential confounders. Models 4-6 displaying the results of regression with shares of transfers included, fail to show particularly interesting results. Only M6 model confirms our earlier observation from model M3 that signaling associated with vote percentages tend to decrease over time.

TABLE 2 Panel data analysis

	M1	M2	M3	M4	M5	M6
log $Transfers_{s-1}$	0.011	0.011	0.01			
	(0.008)	(0.008)	(0.008)			
log Share $Transfers_{s-1}$				0.469***	0.471***	0.466***
				(0.042)	(0.042)	(0.043)
VRP_{s-1}	3.2e-07	7.9e-07	-3e-08	-2.8e-07	-2e-07	4e-08
	(3.2e-07)	(9.8e-07)	(2.4e-07)	(1.3e-07)	(6e-08)	(1.4e-07)
Appointed	-0.015	-0.016	-0.021	0.004	0.005	0.004
	(0.017)	(0.017)	(0.017)	(0.012)	(0.011)	(0.011)
Log days served	-0.003	-0.01	-0.0013	-0.0014	-5e-04	4e-04
	(0.004)	(0.007)	(0.003)	(0.003)	(0.002)	(0.002)
Vote percentage	0.042	0.045	0.073	0.031	0.037	0.038
	(0.076)	(0.076)	(0.064)	(0.035)	(0.036)	(0.035)
Turnout	-0.039	-0.046	-0.051	-0.046	-0.51x	-0.037
	(0.051)	(0.055)	(0.053)	(0.028)	(0.029)	(0.029)
Vote percentage P05	-0.098	-0.244***	0.612x	0.025	0.07x	0.376*
	(0.088)	(0.073)	(0.331)	(0.046)	(0.042)	(0.172)
Turnout P05	0.33*	0.406*	-0.123	-0.014	-0.131	0.079
	(0.141)	(0.184)	(0.125)	(0.058)	(0.092)	(0.089)
Putin X Vote percentage P05		0.402*			-0.058	
		(0.159)			(0.087)	
Putin X Turnout P05		-0.118			0.155	
		(0.151)			(0.097)	
Period2 X Vote percentage P05			-0.876*			-0.346*
			(0.36)			(0.188)
Period2 X Turnout P05			0.609*			-0.163
			(0.2)			(0.126)
Period3 X Vote percentage P05			-0.708x			-0.587*
			(0.394)			(0.24)
Period3 X Turnout P05			0.799*			-0.105
			(0.365)			(0.144)

TABLE 2 Panel data analysis (*cont.*)

	M1	M2	M3	M4	M5	M6
Region fixed effects	✓	✓	✓	✓	✓	✓
Time fixed effects	✓	✓	✓	✓	✓	✓
R^2	0.031	0.042	0.073	0.286	0.289	0.302
N	619	619	619	619	619	619

Notes: Region-level data built on precinct-level data. Dependent variable for M1-M3 – logged real transfers per capita; for M4-M6 – logged shares of transfers in the regional revenues. Clustered standard errors in parentheses. Significance levels: $^{x}p \leq 0.1$, $^{*}p \leq 0.05$, $^{**}p \leq 0.01$, $^{***}p \leq 0.001$.

The region fixed effects extracted from the models M1 and M4 demonstrate the essence of Russian fiscal federalism, in which the levels of transfers differ significantly across the regions. The Figures in the Appendix C1 show that the largest transfers flow to recipient regions such as the republics of Ingushetiya, Tyva, Dagestan, Altay, Karachaevo-Cherkessiya, Crimea, Severnaya Osetiya and Kamchatskiy kray, etc.; and the smallest transfers tend to reach donor regions such as the cities of Moscow and St. Petersburg, Tyumenskaya, Sverdlovskaya, Samarskaya, Permskaya, Leningradskaya, Moskovskaya oblasts.

My findings from two-way fixed effects regression suggest that the results from nonlinear least squares can be relatively biased due to omitted variable bias associated with time invariant unobserved heterogeneity. Notably, the interaction effects between the time period and my signaling variables hold across different model specifications, i.e. with controlled region specific effects or year fixed effects (See C6 in Appendix C).

Hence, while my first hypothesis is confirmed by my findings, the second and third hypotheses are only partially confirmed. Throughout the 2000s, the Russian federal elections have shown an increase in effects between the signaling strategies associated with turnout and post-election transfers. For elections from 2000 on, and very clearly for the elections held in the period between 2005 and 2012, the evidence indicates that there was widespread fraud motivated by governors' desire to signal their individual loyalties to the Center. Nevertheless, my findings for 2012 and onwards are inconsistent between the results from nonlinear least squares and panel data regression: the later provides us with stronger statistical evidence in support of signaling in the third time period. This is especially true for turnout exhibiting growing effects of anomalies on

transfers. My findings with respect to vote percentages yield the evidence of signaling evolving in the opposite direction: across both periods these signaling strategies are actually punishable by the Center (supported by both models with post-electoral transfers per capita and post-electoral shares of transfers in the regional revenues included as dependent variables). This observation says something about election fraud activities and signaling strategies different for these two quantities of interest. Unfortunately, the mechanisms driving this discrepancy goes beyond the scope of my game model, requiring further research in the future. It is likely that the variability, hierarchies and interactions between different signals make signaling a rather complex phenomenon that is difficult to study given a small dataset.

5 Conclusion

My hypotheses derived from the signaling game are partially supported by empirical analysis. In particular, the study shows strong evidence of election fraud associated with the interbudgetary transfers: the signaling patterns in turnout and incumbent's vote percentage are apparently closely connected with postelection rewards. The results sometimes display a more complex picture than expected by the theory: for elections from 2000 and on, governors' desire to signal their individual loyalties to Kremlin has been steadily increasing for turnout, but decreasing for vote percentages. This observation is supported by our auxiliary analysis as well. More in-depth research is needed to explain why the signaling patterns for turnout and vote percentages change in the opposite directions over time. One potential explanation for this is that it is actually easier to mobilize someone to vote (e.g., by pressuring to show up at the precinct, facilitating transportation, putting on festivities at the polling station, etc.) than to force them to vote for the right candidate, because of the vote secrecy and the difficulty of tracking actual vote. For this reason, unlike voting outcomes, signaling manipulation with turnout is easier to detect statistically.

In a broader perspective my analysis suggests that institutional change over time associated with Putin's recentralization policies in the 2000s also impacted the structure of election frauds in Russia. In terms of the game model, the value of the parameter d, the value to the Center of replacing a disloyal governor, greatly increased. As recentralization gained hold, the threat associated with transfers to regions often decreased – the threat of regional secession disappeared – so that the long-run returns associated with transfers likely often increased. These changes altered the strategy that governors and the Kremlin saw as optimal, leading to situations in the past two periods where

election fraud is easy to detect because governors use them to send signals to the Kremlin. As has been shown, in Russia, the occurrence of 0s or 5s as the last digit in turnout and vote percentages is connected to an extensive signaling structure.

The prevalent "signaling" mechanism raises a fundamental problem for the political regime: regional elites after being coopted by the Center are inclined to exploit the existing asymmetry in distribution of information between the Center and themselves for their own benefit, by systematically distorting information in their best interests, including electoral information. Is it "folly" to rest "the stability of a federation on the shoulders of some electoral scheme"?[56] Brian Taylor suggests perhaps yes.[57] The scope of this analysis is too narrow to support an evaluation of whether what Jenna Bednar calls the "safeguards" of federalism have been improved or worsened by the highlighted changes.[58] But in Russia, the signals of political loyalty, in exchange for reduced interference by the Center highlighted here occur in the context of great informational asymmetry between the regions and the Center. The true level of support for the incumbent or the ruling party is difficult to discern. Both periods 2000-2004 and 2005-2012 contain pooling equilibria in which loyal and disloyal governors take the same actions. This makes the Center unable to separate the types of the heads of the regions – who is really supportive of the regime and who is not but is successfully faking their support. For the 2012-present period the model predicts separating equilibria with the Center being able to separate the types of the heads of the regions and even punish them as is shown in the vote percentages analysis.

In addition to the new theory of signaling strategies, this paper also introduced a new election forensics measure, which has been validated on the Russian financial and electoral data. Even though this paper is largely focused on the effects of this new measure on a short-run distortion in transfer payments, we can also track its cumulative effects over time. This paper's methodological results can be generalizable to cross-national setting. The implications from the game-theoretic model are helpful in our understanding of the general mechanisms by which specific "signaling" markers such as 0s and 5s occur in turnout and vote percentages across different political regimes. Specifically, the presence of rigged elections and associated numerical anomalies either

56 Filippov, Ordeshook, and Shvetsova, *Designing Federalism: A Theory of Self-Sustainable Federal Institutions*, 175.

57 Taylor, *State Building in Putin's Russia: Policing and Coercion After Communism*.

58 Jenna Bednar, *The Robust Federation: Principles of Design* (New York: Cambridge University Press, 2009).

in democracies or autocracies can be explained by a combination of various institutional factors such as regime type (authoritarian or democratic), system of government (federal or unitary), form of government (presidential vs. parliamentary). In sum, all these factors preset a specific level of loyalty of local agents via-a-vis the Center, leading to the described strategic behavior expressed in signaling strategies.

Acknowledgements

Earlier versions of this project were presented at the Annual Meeting of the American Political Science Association, Annual Conference of the Midwest Political Science Association, and International workshop organized by the Electoral Integrity Project. I am grateful to Walter Mebane for his tremendous help and support at all stages of this project. I thank William Zimmerman, Vladimir Gel'man, an anonymous reviewer and the editors of Russian Politics for their insightful comments and suggestions.

Appendices

The appendices A-C of this article have been made available online at: https://doi.org/10.6084/m9.figshare.19944776.