Understanding Electoral Frauds through Evolution of Russian Federalism: the Emergence of "Signaling Loyalty" *

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March 1, 2012

*Previous versions of this paper were presented at the Annual Meeting of the American Political Science Association, Washington, DC, September 2–5, 2010, and at the Annual Meeting of the Midwest Political Science Association, Chicago, IL, March 31–April 2, 2011. The first author acknowledges support from a University of Michigan Political Science Department Summer Collaboration Fellowship.

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Abstract

We argue that the pattern of fraudulent elections in Russia can be explained by combining ideas about federalism with a formal signaling game model. We argue that the changing pattern of electoral frauds from the mid-1990s to the 2000s can be explained by changes in rational strategies of regional governors tied to the evolution of Russian federal relations. While in the mid-1990s Russian governors provided the center with favorable electoral outcomes in exchange for political, institutional and financial resources, in the 2000s political recentralization led governors to send signals about their loyalty to the Center by means of fraudulently augmented turnout, receiving certain rewards in exchange, such as postelectoral fiscal transfers. The argument is supported by statistical analysis of empirical data.

1 Introduction

In authoritarian and formerly authoritarian regimes in recent decades there have been many elections, some truly competitive and some not (Levitsky and Way 2010; Wolchik and Bunce 2010; Bunce and Wolchik 2011; Hyde 2011; Hyde and Marinov forthcoming). Election fraud and its detection have been a concern (Lehoucq 2003; Bjornlund 2004; Schedler 2006; Alvarez, Hall, and Hyde 2008; Myagkov, Ordeshook, and Shaikin 2009; Cantu and Saiegh 2011; Fukumoto and Horiuchi 2011; Simpser forthcoming). Over the most recent election cycles 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 (Freedom House 2010). Previous research has shown that in Russia, and elsewhere, fraudulent voter turnout can often be readily detected (Myagkov and Ordeshook 2008; Myagkov, Ordeshook, and Shaikin 2008; Myagkov et al. 2009; Mebane and Kalinin 2009b,a). Election manipulation has also been shown to entangle domestic fiscal activities (e.g. Hyde and O'Mahony 2010). We explore factors that are conducive to the emergence of fraudulent turnout in Russia, which also show one way election manipulations may be related to fiscal distortions.

We 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 Kremlin and a single regional governor. Our argument is similar in spirit to 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" (Simpser forthcoming). We argue that the changing pattern of electoral frauds from the mid-1990s to the 2000s can be explained by changes in rational strategies of the governors, changes tied to the evolution of Russian federal relations. The changes are a case of what Filippov, Ordeshook, and Shvetsova describe as "an institutional solution to the problem of dysfunctional bargaining" (Filippov et al. 2004, 174). United Russia becomes "an integrated party that facilitates cooperation across levels of government" (Filippov et al.

2004, 195) at the price of some "perversion of democracy" (Filippov et al. 2004, 174). Deficits in the Russian party system (Golosov 2004) are not improved, rather elections either disappear or become artificial. Specifically, our idea is that while in the mid-1990s Russian governors used strategies of bargaining, in which powerful regions provided the center with favorable electoral outcomes in exchange for political, institutional and financial resources (Treisman 1997b,a), 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 postelectoral transfers.

To elucidate these institutions of bargaining and electoral signaling, we develop a game theoretic model—a signaling model (Cho and Kreps 1987)—which we use to motivate a set of empirical models that we estimate using data from four recent Presidential elections in Russia: 1996, 2000, 2004 and 2008. As a measure of electoral fraud we use the last digit of the turnout percentage (Beber and Scacco 2008), which proved to be a good measure of fraud in Mebane and Kalinin (2009b,a). Unlike other approaches, it has a direct interpretation linked with electoral signaling, and it matches our theoretical assumptions stressing the importance of turnout percentages rather than vote counts.

Simpser (forthcoming) also emphasizes the importance of signaling and uses a signaling game model, but Simpser focuses on a ruling party signaling its "strength" and not, as we do, on officials at one level of government signaling "loyalty" to officials at a higher level in the federal system. In fact, Gandhi argues that elections can provide lots of information in spite of the fraudulent factor, allowing assessment of the strength of the potential opposition in society, even if the signal is somewhat noisy due to attempts at manipulation and fraud (Gandhi 2008, 167). We take no position on whether the election frauds we discuss have been necessary to produce the election victories United Russia has enjoyed.

1.1 Bargaining strategies in the 1990s

By the early 1990s the majority of Russian regions hosted centralized political regimes with executive authority concentrated in the office of chief executives. The governors were able to establish political regimes without significant constraints from the Center, concentrating regional political and economic resources in their hands (Filippov et al. 2004, 301–315). The power asymmetry between the Center and the regions resulted in "opportunistic" bargaining during the 1990s. 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. The resources provided to the regions by the federal center included various institutional resources, which could be used by the regions to systematically violate federal laws. They included economic resources, which assumed distribution of state property and tax revenues in favor of some regions. Finally they included political relations, the change in economic and political status of some of the regions made manifest by the Center signing bilateral treaties with half of the regions (Gel'man 2006). The resulting federal asymmetry enabled specific groups of regions to play a greater role in federal politics and continue their bargaining policies with growing levels of concessions from the center. In a long-term perspective, such bargaining enabled the regions to institutionalize their opportunistic behavior. By 1998, 42 bilateral treaties were signed between the Center and the regions, delegating specific political and economic rights to these regions versus the remaining regions, which were excluded from such bargaining.

Unlike Russian oblasts, ethnic Russia regions (republics) were more successful in using bargaining strategies, by providing electoral support to the Center in exchange for political and economic resources (Treisman 1999). In fact, Republican elites considered promotion and management of ethnic revival on their territories as a way of getting a better bargaining position with the federal center (Gorenburg 1999). Moreover, the greater electoral legitimacy of Republican leaders compared to the appointed heads of the Russian regions until the mid-1990s also added to their bargaining leverage (Treisman 1999).

In return for concessions from the Center, the governors mobilized their regional "political machines" to provide necessary electoral support to the national ruling elites (Gel'man 2009). 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. During the preelectoral period financial resources provided by the Center were directed to increased public spending in the region and contributed to increase in electoral support of both office-seekers, i.e. the elected governors, and the President, which could make any electoral frauds simply unnecessary. Treisman offers empirical evidence to support his claim that the governors who opposed Yeltsin would use central transfers in a way that would boost local support for the Center and themselves, though this reduced their leverage in the future bargaining with the Center (Treisman 1999, 111–115).

1.2 Signaling strategies in the 2000s

After Putin's accession in 2000 the nature of federal relations was reviewed by Kremlin (Filippov et al. 2004, 309). The nature of the superpresidential system (Cheibub 2007, 17–18) inherited from the former Soviet authoritarian institutions helped Center reestablish its control over the regions through administrative recentralization (return of 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) (Kahn 2002; Gel'man

2006; Cheibub 2007; Taylor 2011). The policy of recentralization was launched to restore the Center's control over the regions by revision and cancellation of the majority of the bargaining agreements of the 1990s. Specifically, recentralization was expected to undermine the growing bargaining leverage of the Republics, which hindered sustainability of the Russian state.

Recentralization led to considerable reduction of bargaining resources of the regions and dramatic increase of coercive economic and political resources of the Center. As a result, the regions became politically integrated into the superstructure of the Center with economic resources flowing from the Center to the regions. Gubernatorial elections were abolished in 2004, 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 they could be electorally punished by their regional constituency, in 2008 electoral punishment was no longer possible. Moreover, if in 2008 a governor failed to provide a certain level of political outcome to Kremlin, he or she could be considered as non-loyal and lose the seat. 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.

Additional political control over the governors was insured with the creation of the party of power, i.e. Unity/United Russia, that was designed to provide strong incentives for elite coordination and generating mechanisms for sanctioning defectors (Smyth 2007:123). The governors were expected to demonstrate their loyalty to United Russia and mobilize both administrative and financial resources of their regional apparatus to help United Russia to win the elections prior to presidential elections (Buzin and Lubarev 2008). After gubernatorial elections were abolished in December 2004, by the spring of 2007, 70 of 85 governors announced their participation in the party of power (Gel'man 2007). The practice was to head the party lists of United Russia, when a governor would head the party list as a poster candidate, helping the party to win more seats, but retreat as soon as elections end (Tkacheva 2009). This not only helped to gain greater electoral support for United Russia in the regions, but also signaled about governor's loyalty and capability to provide electoral results for more crucial presidential elections, which usually followed parliamentary elections.

1.3 Signaling methods

In Soviet times to meet the figures in the plan and not be punished the regional bosses often applied "false accounting" (*pripiski*), affecting the measures of the level of regional output (Harrison 2009). No wonder that with the start of new Russian recentralization in 2000s, such Soviet practices were restored in relation to Russian contemporary elections. As a result, the federal and regional elections were transformed into "electoral type events," characterized by demonstration of loyalty with electoral *pripiski* rather than real elections with electoral accountability of rulers to the citizens. As a result, the presence of electoral frauds became a basic signaling mechanism of regional bosses' loyalty and of their ability to control the administrative resources to Kremlin's benefit. According to Gel'man "the compromise between the federal and local leaders, achieved on the basis of the scheme 'monopoly control on power in exchange for the "correct" results in the elections' was the most important part of Russia's subnational authoritarianism" (Gel'man 2009). The growth of electoral manipulations and crude falsifications, their widespread systematic pattern can be referred to as "mass administrational electoral technology" (Buzin and Lubarev 2008; Lubarev, Buzin, and Kynev 2007).

Electoral signaling can be readily detected by analyzing the percentages of electoral outcomes. If electoral signaling occurs, electoral *pripiski* are most likely to take place with rounded percentages of turnout, which is the easiest and most readily detected way to report basic information to superiors. 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 we have no direct evidence that this "passing down" is the precise procedure used to commit the frauds we allege exist, nor are we sure exactly how the fakery is implemented. Ballot box stuffing and simply writing down false numbers are likely mechanisms (e.g. Boldyrev 2012), but also likely are frauds using phony voter registrations (Arbatskaya 2004) or perhaps other methods (Lehoucq 2003). Since the territory-level commissions serve as an intermediate body between regional and precinct level commissions, we suppose that these have the highest leverage to produce faked numbers in the system and report them to the upper level in percentages. Thus we expect numeric anomalies with percentages to be detected at both tiers of the system, i.e. at both precinct and territory levels.

Both the level of turnout and level of electoral support have been important indicators of the regime's sustainability and consistency. In Mebane and Kalinin (2009b,a) as well as in Buzin and Lubarev (2008, Appendix, Illustration 38) there is strong empirical evidence about the presence of anomalies in the distribution of turnout in the most recent electoral cycle (2007-2008) compared to (2003-2004). As is shown in Figure 1, in 2008 there are spikes in the kernel density estimate of the distribution of precinct turnout in oblasts for turnout values of values of 60%, 70%, 80%, 90% and 100% (Mebane and Kalinin 2009b,a), a pattern also noticed by Shpilkin and Shulgin (Buzin and Lubarev 2008, 201).[1] In republics the turnout distribution peaks at 100% but there is also a peak at 75%. Similar patterns, although slightly less pronounced, are visible in the turnout distribution for 2004.

[1] A "precinct" is a UIK, *uchastkovaya izbiratelnaya komissiya*. In terms of the variables in the database at `http://www.cikrf.ru`, Turnout = 100(C3 + C4 + C5)/C1. The density is computed using the `density()` function of **R** (R Development Core Team 2011).

The only plausible explanation for the spiked distributions is a wide-spread adjustment of turnout to specific "rounded" figures. Moreover, analysis of the last digits of turnout counts (Beber and Scacco 2008) shows there are always too many zeros, with one exception too few nines, and usually too many fives (Mebane and Kalinin 2009b,a). As one moves from 2003 to 2008 the fakery with turnout seems to be much worse at the end of the time period than at the beginning (Mebane and Kalinin 2009b,a).

*** Figure 1 about here ***

The vote counts for the various parties also show signs of distortions that coincide with the "rounded" turnout figures, although the coincidence is not perfect. In particular, in precincts that have "rounded" turnout there are often too many votes for the party of power compared to precincts that have turnout one percent greater or one percent less. One way to show this is to consider the results from a randomization test. Let V_{pi} denote the vote count for party p in precinct i, and let U_i denote the precinct's turnout percentage rounded to the nearest integer.[2] Write U_i^* if U_i is evenly divisible by five, and use V_{pi}^* to denote the corresponding vote count. Consider the set of all precincts that have a particular value U_i^*. The mean of the vote counts V_{pi}^* in those precincts is compared to the mean of the vote counts in all precincts that have turnout either one percent lower $(U_i^* - 1)$ or one percent higher $(U_i^* + 1)$. For example, the mean vote count for United Russia's candidate in all precincts that have turnout 70% is compared to the mean of all precincts that have turnout either 69% or 71%. There's no obvious reason why the vote count in the "rounded" precincts should be systematically higher than in the numerically nearby precincts, except of course if there is manipulation.

To assess whether the actual differences are exceptionally large, we compare them to the differences observed after the vote counts have been randomly permuted among precincts. The vote counts in all precincts within two percentage points of U_i^* are shuffled and then the differences are recomputed. For example, if $U_i^* = 70$, then the bin of precincts

[2]Referring to note 1, $U_i = \texttt{round}(\text{Turnout})$.

whose vote counts are shuffled contains all precincts with turnout values of 68, 69, 70, 71 or 72. The shuffling and mean-differences calculations are repeated 1,000 times, then we check where the actual difference falls in the distribution of all the differences computed using the random shuffles. If Q is the quantile of the actual difference, then $P = 1 - Q$ is the probability that a difference as large as the actual one would have occurred by chance.

We conduct the foregoing randomization test using the precinct data we have for 2004 and 2008. Using test level $\alpha = .05$ and filtering the results for United Russia candidates for false discovery (Benjamini and Hochberg 1995), we find the vote counts are significantly too large for $U_i^* = 85,\ 90,\ 95$ in 2004 and for $U_i^* = 65,\ 80,\ 85,\ 90,\ 95$ in 2008.[3] That United Russia's vote counts are sometimes but not always too large when turnout is apparently manipulated is not surprising given the basic point Simpser (forthcoming) makes, which is that election manipulation is not solely or even always about increasing the winner's election margin.

We argue 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 results can be delivered by the regional elites to display their loyalty to the Center in exchange for administrative and financial rewards.

2 A Formal Model

Consider the signaling game (Cho and Kreps 1987) represented by the diagram in Figure 2. $\mathcal{N}$ denotes a random move by Nature to produce a first player (the governor, $\mathcal{G}$) who is either loyal (L) or not ($\neg L$). Then Prob(L) $= \lambda$ and Prob($\neg L$) $= 1 - \lambda$. In the election the governor then either commits fraud (F) or not ($\neg F$). Player 2 (the Center, $\mathcal{K}$) does not know whether $\mathcal{G}$ is loyal, but $\mathcal{K}$ does observe $\mathcal{G}$'s move. $\mathcal{K}$ then either punishes (P) or not ($\neg P$). The payoffs are given at the bottom of Figure 2. The interpretation of the symbols

[3] Vote counts in "rounded" precincts also appear significantly too large sometimes for other candidates, including for the "against all" (*Protiv vseh*) option in 2004.

used in the payoff definitions is as follows.

- $w \geq 0$ is the value of electoral punishment by voters for fraud committed in the election; $w > 0$ in years before elections are abolished, and $w = 0$ after 2004
- $p > 0$ is the value of punishment imposed by $\mathcal{K}$
- $v > 0$ is the value of excess votes produced by fraud
- $t > 0$ is the value of transfers from $\mathcal{K}$ to $\mathcal{G}$
- b is a coefficient that when multiplied by t gives the present discounted value of the future expected to be produced by a transfer; this may be positive or negative
- $d > 0$ is the value to $\mathcal{K}$ of replacing a disloyal $\mathcal{G}$

*** Figure 2 about here ***

Here are some comments to further explain the payoffs. Given equivalent actions by $\mathcal{K}$, fraud is always worse for $\mathcal{G}$ due to the sanction from voters. That is, if $\mathcal{G}$ is loyal and $\mathcal{K}$ always punishes, then playing F gives $\mathcal{G}$ a payoff of $-w - p$ while playing $\neg F$ gives $-p$. If there is no sanction from voters, $w = 0$, then F and $\neg F$ give $\mathcal{G}$ the same payoff given an identical response from $\mathcal{K}$. The payoffs to $\mathcal{G}$ from F are always w subtracted from the corresponding payoff from $\neg F$.

If fraud happens, $\mathcal{K}$ always gains excess votes v. If $\mathcal{K}$ doesn't punish, then $\mathcal{G}$ always gains a transfer from $\mathcal{K}$, t, which costs $-t$ to $\mathcal{K}$. If $\mathcal{K}$ punishes, then $\mathcal{G}$ always loses $-p$ which also costs $-p$ to $\mathcal{K}$. But if a disloyal $\mathcal{G}$ is punished (e.g., fired), then $\mathcal{K}$ gains d.

One key difference between a loyal $\mathcal{G}$ and a disloyal one is who retains any future surplus generated by a transfer from $\mathcal{K}$. Compare the payoffs when a loyal $\mathcal{G}$ commits fraud and is not punished to the payoffs when a disloyal $\mathcal{G}$ commits fraud and is not punished: the difference is that the term bt is added to $\mathcal{K}$'s payoff in the former case but is added to

$\mathcal{G}$'s payoff in the latter case. A similar situation holds when $\mathcal{G}$ does not commit fraud and is not punished: the disloyal $\mathcal{G}$ retains the surplus while with a loyal $\mathcal{G}$ $\mathcal{K}$ retains the surplus.

We represent the game in multiagent normal form (Myerson 1991). To facilitate doing that, we relabel the moves as shown in Figure 3. The strategies of the loyal $\mathcal{G}$ are now denoted F_1 and $\neg F_1$ while the disloyal $\mathcal{G}$'s strategies are F_2 and $\neg F_2$. $\mathcal{K}$'s strategies are now P_1 and $\neg P_1$ if acting after fraud and are P_2 and $\neg P_2$ if acting after no fraud. The multiagent strategic normal form of the game appears in Table 1.

*** Figure 3 and Table 1 about here ***

We test necessary conditions to be a perfect Nash equilibrium for the set of possible pure strategy equilibria. The strategy profiles along with the payoffs that go to $\mathcal{G}$ and $\mathcal{K}$ are listed in Table 2. The strategy profiles, the results of testing whether the profile can be a Nash equilibrium and a brief description of the reqirements for the profile to be an equilibrium appear in Table 3. The tests are done by comparing payoffs produced with each profile to the payoffs produced with the profiles produced by changing each agent's strategy while holding the other strategies constant. For instance, comparing the payoffs produced by $(F_1, F_2, \neg P_1, \neg P_2)$ (profile I*) to the payoffs produced respectively by $(\neg F_1, F_2, \neg P_1, \neg P_2)$, $(F_1, \neg F_2, \neg P_1, \neg P_2)$, $(F_1, F_2, P_1, \neg P_2)$ and $(F_1, F_2, \neg P_1, P_2)$ shows that $(F_1, F_2, \neg P_1, \neg P_2)$ gives a weakly greater payoff than the adjacent payoffs only if $\lambda = 1$ and $w = 0$. This result is the equilibrium condition for profile I* in Table 3. Sometimes a profile cannot produce payoffs that are weakly greater than those produced by the adjacent profiles, given the domains defined for the parameters. In such cases the equilibrium conditions appear in Table 3 as "never." The equilibrium conditions for $(F_1, F_2, \neg P_1, P_2)$ (profile III*) are too complicated to describe in Table 3. Those appear in Table 4.

*** Tables 2, 3 and Table 4 about here ***

Several profiles that can be equilibria have conditions that require either $\lambda = 0$ or $\lambda = 1$. These are the profiles labeled I*, II*, V*, VI*, XI* and XVI*.[4] While some of these equilibria have potentially interesting features, we think the condition $\lambda = 0$—no chance of loyalty at all—is too extreme to describe the reality in Russia. Loyalty in reality is a choice each governor makes and not an immutable personality trait. Once elections are abolished and all governors are appointed, the circumstance of $\mathcal{K}$ being certain of $\mathcal{G}$'s loyalty ($\lambda = 1$) becomes at least thinkable, but first we will consider equilibria that admit uncertainty: $\lambda \in (0, 1)$.

The profiles that can be equilibria and admit uncertainty about $\mathcal{G}$'s loyalty are the ones labeled III*, IX*, XII* and XV*.[5] Of these profiles we think IX* is possible only after 2004 when gubernatorial elections are abolished, because it requires $w = 0$, but then it also requires that loyalty be uncertain ($\lambda < 1$) and that the expected long-term returns from transfers to the regions be very negative ($b \leq -(p+t)/(1-\lambda)t < 0$). A situation where $\mathcal{G}$ is appointed by $\mathcal{K}$ ($w = 0$) but is not certainly loyal is possible, but the fiscal return condition seems unrealistically extreme: for example, if $p = t$, then $b \leq -2/(1-\lambda) \leq -2$. Profile XII* we rule out because it requires that the electoral punishment of $\mathcal{G}$ by voters for committing fraud is greater than the sum of punishment imposed by $\mathcal{K}$ and the value of transfers from $\mathcal{K}$ ($w \geq p + t$). While w may be comparable to p if p corresponds to being removed from office, we know of no case where a governor was voted out of office for having committed election fraud, so we think in fact $p > w$. These considerations leave only profiles III* and XV* as, in our judgment, practically viable equilibria.

The two equilibria, III* and XV*, can sometimes exist simultaneously. For XV* to be an equilibrium it is required that $(t+p)/(w+t+p) \leq \lambda < 1$ and $p > t + v$, and a condition for III* to be an equilibrium with $0 < \lambda < 1$ is $p \geq t - (v + d)$; but $p \geq t - (v + d)$ is always true if $p > t + v$ is true. Another condition for XV* to be an equilibrium is

[4]Explicitly, these profiles are I*, $(F_1, F_2, \neg P_1, \neg P_2)$; II*, $(F_1, \neg F_2, \neg P_1, P_2)$; V*, $(F_1, \neg F_2, P_1, \neg P_2)$; VI*, $(F_1, \neg F_2, \neg P_1, \neg P_2)$; XI*, $(\neg F_1, F_2, \neg P_1, P_2)$ and XVI*, $(\neg F_1, F_2, \neg P_1, \neg P_2)$.

[5]Explicitly, these profiles are III*, $(F_1, F_2, \neg P_1, P_2)$; IX*, (F_1, F_2, P_1, P_2); XII*, $(\neg F_1, \neg F_2, \neg P_1, P_2)$ and XV*, $(\neg F_1, \neg F_2, P_1, \neg P_2)$.

$p \geq (1-\lambda)d + (1-\lambda b)t$. If XV* is an equilibrium, then $\lambda < 1$ and $b < 0$, so $(1-\lambda)d + (1-\lambda b)t > 0$. The most important aspect of this result is the presence of d on the lefthand side of $p + v + d \geq t$ but on the righthand side of $p \geq (1-\lambda)d + (1-\lambda b)t$: as the value d that $\mathcal{K}$ places on having a loyal $\mathcal{G}$ rises, for fixed values of p and t, the conditions for III* to be an equilibrium become satisfied while the conditions for XV* to be an equilibrium may cease to be satisfied.

Expectations about the long-term returns from transfers from $\mathcal{K}$ to the region also affect whether the two equilibria exist simultaneously. In order for XV* to be an equilibrium, these expectations must satisfy

$$\frac{-(p+t)}{(1-\lambda)t} \geq b \geq \frac{v+t-p}{t}, \tag{1}$$

which implies $b < 0$. The equilibrium conditions for III* impose no upper bound on b, but specify lower bounds that depend on λ:

$$b \geq \begin{cases} (w-p-t)/t, & \lambda = 0 \\ [(1-\lambda)d + t - p]/(\lambda t), & 0 < \lambda < 1 \\ (t-p)/t, & \lambda = 1\,. \end{cases} \tag{2}$$

All these lower bounds are negative, so under III* as an equilibrium b may be either positive or negative. XV* and III* can both be equilibria simultaneously if the intervals defined by (1) and (2) overlap and b is contained in this overlapping region.

If III* and XV* exist as equilibria simultaneously, which one will $\mathcal{G}$ and $\mathcal{K}$ act to instantiate? To answer this question we first evaluate the players' payoffs under the respective equilibria, and in particular we ask whether one equilibrium benefits the players more than the other one. If so, we expect the players will enact the equilibrium that pays them the most.

Consider the situation where the intervals defined by (1) and (2) overlap, and define

$$b_\delta = \delta \frac{-(p+t)}{(1-\lambda)t} + (1-\delta)\frac{v-p+t}{t}, \quad \delta \in [0,1].$$

Now, with $b = b_\delta$, compare the payoffs under III* to those under XV*. The payoffs are weakly better under III* when

$$\mathcal{G}: \quad -w + t[1 + b_\delta(1-\lambda)] \geq -p \Rightarrow (1-\delta)[t + \lambda p + (v+t)(1-\lambda)] \geq w \tag{3}$$

$$\mathcal{K}: \quad v + t(\lambda b_\delta - 1) \geq \lambda(b_\delta - 1)t - (1-\lambda)t \Rightarrow v \geq 0 \tag{4}$$

The difference between $\mathcal{K}$'s payoffs under III* versus XV* does not vary with b: whenever both equilibria exist simultaneously, (4) shows that $\mathcal{K}$ always gains v by being in equilibrium III* instead of equilibrium XV*. For $\mathcal{G}$ the difference in payoffs depends on the relative sizes of p, t, v and w. If (3) is true, then $\mathcal{G}$ is weakly better off with III*, otherwise $\mathcal{G}$ is better off with XV*. Even if $p > w$, as we believe, (3) is false for δ sufficiently large or λ sufficiently small, as long as $w > 0$. So if the voters do exact some electoral punishment on $\mathcal{G}$ for committing fraud, and the likelihood that $\mathcal{G}$ is disloyal is sufficiently high or the expected returns from transfers are sufficiently negative, $\mathcal{G}$ benefits more from being in equilibrium XV* rather than equilibrium III*. Eliminating gubernatorial elections and hence setting $w = 0$ guarantees that $\mathcal{G}$ is better off under equilibrium III* than under equilibrium XV*.

If III* and XV* are simultaneously equilibria and (3) is false, then even though $\mathcal{K}$ is better off if III* is enacted than if XV* is enacted, $\mathcal{K}$ should predict that $\mathcal{G}$ will play $\neg F$ instead of F, and so $\mathcal{K}$ should play $\neg P_2$ instead of P_2. Playing (P_1, P_2) when $\mathcal{G}$ plays (F_1, F_2) is not rational for $\mathcal{K}$ in any case, since we are considering the case when XV* is an equilibrium.

Another way to look at the same constraints on λ is to observe that, for $b < 0$, t and p affect the range of λ values that are compatible with equilibrium. If $0 < \lambda < 1$ and $b < 0$ in

III*, bounds on λ are given by $1 + (t + p)/(bt) \leq \lambda \leq 1 - [t(b-1) + p]/(bt + d)$. The lower bound is negative and so not binding on λ as long as $1 + p/t > -b$, but the upper bound is greater than zero only if $p < t + d$. If XV* is an equilibrium—in which case we must have $(t + p)/(w + t + p) \leq \lambda$—then $\mathcal{G}$ may do $\neg F$ instead of F.

The foregoing discussion suggests that whether III* or XV* is enacted should depend on the levels of d, p, t, v and w. As d, p, t and v increase, or as w decreases, the prospects of III* happening rather than XV* should be higher. As the value $\mathcal{K}$ places on $\mathcal{G}$ loyalty, the value of punishment imposed by $\mathcal{K}$, the value of transfers from $\mathcal{K}$ and the value of excess votes produced by fraud increase, or as the value of electoral punishment for $\mathcal{G}$'s committing fraud decreases, we should expect fraud to become more prevalent. We use these insights to motivate our empirical investigation, below.

Our argument so far does not show how fraud can be associated with transfers, punishments and the like when expectations for the returns from transfers are positive ($b > 0$). Such conditions rule out XV* as an equilibrium. Likewise after 2004, when elections for governor are abolished and so $w = 0$, (3) suggests XV* will never happen. But our empirical analysis below shows that transfers and punishments are in fact associated with election fraud after 2004. It may be this implies that, simply, $b < 0$.

Arguments to associate transfers and punishments with election fraud when $b > 0$ all have shortcomings. For instance, consider one connection that might work by alternating between III* and XII*. If $0 < \lambda < 1$ and $b > 0$, then by III* bounds on λ are given by

$$1 + \frac{t + p}{bt} \geq \lambda \geq 1 - \frac{t(b-1) + p}{bt + d} \,. \tag{5}$$

Now the upper bound is never binding, but the lower bound may be. The lower bound may or may not be increasing in t,[6] but in any case as $t \to \infty$ for finite p and d, the bound approaches $1/b > 0$. If b is positive, then III* can be an equilibrium only if the chances of

[6] If $z \equiv 1 - [t(b-1) + p]/(bt + d)$, then $\partial z/\partial t = [bp + (1-b)d]/(bt + d)^2$, so the bound increases in t if $bp + d > bd$.

$\mathcal{G}$ being loyal are not too low. If $b > 0$ and III* is not an equilibrium because λ is too low but not zero, then the game's only equilibrium is XII*, which predicts $\mathcal{G}$ plays $\neg F$ rather than the F of III*. But XII* requires high values of w, and in fact $w = 0$ after gubernatorial elections were abolished in 2004.

Another way to account for the association between transfers, punishments and fraud with $b > 0$ is to reconsider our stance against profiles whose equilibrium status depends on extreme loyalty beliefs. In particular we may allow that once Kremlin eliminates elections for governors and begins appointing governors, the idea that $\mathcal{K}$ has no doubt that $\mathcal{G}$ is loyal ($\lambda = 1$) becomes plausible. Allowing this brings profiles II*, V* and VI* back in as feasible equilibria.[7]

If $\lambda = 1$, then II* can be an equilibrium for a range of both positive and negative values of b. The relevant equilibrium condition is $(t+p)/t \geq b \geq (t-p-v)/t$. If $\lambda = 1$, however, II* implies $\mathcal{G}$ always commits fraud. Taking II* into account can explain why transfers and punishments are associated with fraud, but only if the values of λ and b are associated with one another. If $-(p+t)/t > b$ and $\lambda = 0$, then under II* there is no fraud and the payoff to $\mathcal{G}$ is $-p$. With $\lambda = 1$ and $b \geq (t-p-v)/t$ there is fraud and a payoff to $\mathcal{G}$ of $t - w$. In 2008, $w = 0$ so the payoff to $\mathcal{G}$ from committing fraud is t. So if an association between λ and b is allowed, II* alone could be sufficient to explain an association between the occurrence of fraud and higher transfers when $b < 0$.

If $\lambda = 1$, then VI* can be an equilibrium for $b \geq 0$ but only if $t \geq p$. Profile VI* is $(F_1, \neg F_2, \neg P_1, \neg P_2)$, so again an increase in t or a decrease in p may be associated with a greater frequency of observed fraud in the period during and after 2004, although here it is unclear what situation we should think of the situation with VI* as being compared to.

If $\lambda = 1$, then V* can be an equilibrium only if $b \leq 0$, because a condition for V* to be an equilibrium with $\lambda = 1$ is $(1-b)t \geq p \geq t$. Comparing the equilibrium payoffs with $\lambda = 1$, the conditions for III* to give higher payoffs than V* are for $\mathcal{G}$, $t \geq p$, and for $\mathcal{K}$,

[7] We ignore I*, which also is an equilibrium only if $\lambda = 1$, because actions under I* are identical to those under III* for behavior on the equilibrium path.

$p \geq -t(b-1)$. Given $\lambda = 1$, $t \geq p$ may be true and $p \geq -t(b-1)$ is necessarily true if III* is an equilibrium. A condition for V* to be an equilibrium is $p \geq t$. So a decrease in t may give one or both players higher payoffs under V* than under III*, and an increase in p may give $\mathcal{G}$ a higher payoff under V* than under III*. But profile III* is $(F_1, F_2, \neg P_1, P_2)$ while profile V* is $(F_1, \neg F_2, P_1, \neg P_2)$. Fraud occurence is the same, since $\lambda = 1$, but the incidence of punishment is different.

3 Empirical assesssment

According to our model, three parameters are central to our understanding of why specific equilibria hold and why in particular the "electoral signaling" equilibrium of the 2000s arose. 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, and b, the future returns expected to be produced by a transfer.

We imagine that over all of Russia, regions are diverse, so a single configuration of the parameter values of the game model does not characterize the whole country.[8] The future returns expected from a transfer, b, may be positive or negative. Negative b values we associate with corruption and political opportunism: as far as the Center is concerned, economic resources transfered to a corrupt region are expected to produce no significant value in the future, and if the resources facilitate regions' gaining further autonomy and even independence, the return on transfers to a region may even be evaluated as strictly negative. Or b may be positive. Indeed, if b is like a normal investment, we should have $b \geq 1$: the transfer is at least expected to pay for itself. Different regions may at any one time have different values of b. During the 1990s, the threat of regions leaving the Russian

[8]Note that we have modeled the relationship between the Center and one governor. We assume 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 89 regions.

federation was very real, so we think that often b was negative.

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 coeffficients c_0 and c_1, then the amount of transfers subject to manipulation may be represented by a term t_{is} in the form

$$T_{is} = b_0 + b_1 T_{is-} + t_{is} + e_{is} \,. \tag{6}$$

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. We think of t_{is} as a short-run distortion. In particular we consider t_{is} to exist in the year following a presidential election. The game model motivates a special form for t_{is} that we discuss further below. The point we want to make now is that we mean 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}.

During the 1990s we think 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 the 1990s is that the values of d and of λ are low. If as well $b < 0$, then we think the relationship between Center and governor is best described by thinking of the possible equilibrium profiles as III*, or $(F_1, F_2, \neg P_1, P_2)$, and XV*, or $(\neg F_1, \neg F_2, P_1, \neg P_2)$. But during the 1990s the value of d was very low, $w > 0$ in cases where the governor was elected, and λ tended to be low due to governors' high degree of autonomy. Because III* requires $p + v + d \geq t$ but XV* requires $p \geq (1 - \lambda)d + (1 - \lambda b)t$, low d suggests XV*, and recalling (3), a higher value of w also suggests XV*. The value of λ may be so low that b is less than the lower bound identified by (2) as necessary for III* to be an equilibrium. So variation in λ should largely determine whether III* or XV* holds. The payoff to the governor under III* is $-w + t[1 + b(1 - \lambda)]$ while under XV* the payoff is $-p$. If b is sufficiently negative, a governor who commits fraud, as in III*, may receive a payoff more negative than that of the governor with lower λ who does not commit fraud, as in XV*.

If $b > 0$ during the 1990s, then we think III* and XII* are the best candidates to describe the relationship between Center and governor. Recall that XII* is the profile $(\neg F_1, \neg F_2, \neg P_1, P_2)$. The key question becomes whether the value of λ is so low that (5) rules III* out as an equilibrium. Since governors managed to bargain successfully, it is reasonable to suppose t is large so that the lower bound on λ under III*, given in (5), is not far from the limiting value of $1/b$. How big is b? Even if transfers, thought of as investments, were expected eventually to produce a return that doubled the original transfer, we would have $1/b = 0.5$, and it is reasonable to think that λ in the 1990s was usually smaller than that. This leaves for an equlibrium only the profile described by XII* in which there is no fraud, although XII* cannot be an equilibrium if $t > w$. In any case, because the low value of λ likely rules out III*, we have no reason to expect the occurrence of fraud to be associated with transfers.

To summarize, for the 1990s we think the game model does not explain the relationship that may exist between election fraud and postelection transfers all that well, but when we apply the model anyway the game model suggests that, when $b < 0$, the relationship between election fraud and transfers is such that governors who commit fraud are likely worse off than governors who do not.

In the 2000s the clearest change is that the value of d becomes high and increasing over time. Recentralization signals such a change, and the abolition of gubernatorial elections in 2004 decisively indicates it. The increase in d reflects how local "political machines" were coopted 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 III*, in which both types of governors commit fraud, and XV*, in which neither type of governors commits fraud—an alternation that is related to transfers and punishments and depends on loyalty. As in 1996, this will induce an association between transfers and punishments, on the one hand, and election fraud, on the other.

Recentralization greatly reduced separatist concerns, so that perhaps $b > 0$. A positive value of b would rule out XV* as an equilibrium. Recentralization likely raised the typical value of λ, so that b may more often exceed the lower bound in (5). In the period before gubernatorial elections were abolished—in particular 2004—this may imply an alternation between III* and XII*. Now a payoff of $-w + t[1 + b(1 - \lambda)]$ to the governor who commits fraud, under III*, is likely positive, while the payoff to a governor who does not commit fraud, under XII*, is $-p < 0$.

Once all governors are appointed, in 2008, $w = 0$ rules out XII*. If $b > 0$ and having governors be appointed means that often $\lambda = 1$, then VI*, or $(F_1, \neg F_2, \neg P_1, \neg P_2)$, comes into play as a possible equilibrium alternative to III*, with the alternation between the two depending on the balance between transfers and punishments. If transfers are high enough, VI* may come into play so that only truly loyal governors commit fraud. The occurrence of both III* and VI* would complicate assessing the relationship between transfers, punishments and fraud, because in III* governors commit fraud and are not punished while in VI* governors commit fraud and are punished. Nonetheless, III* and VI* give identical payoffs if $\lambda = 1$.

If often $b < 0$ notwithstanding recentralization, then II* can explain why high λ goes with fraud and higher transfers and low λ goes with no fraud and lower transfers, if the value of b is associated with λ.

3.1 Specification

We use an empirical model motivated by (6) to test for the associations suggested by the game model, focusing on the form of the short-run distortion term t_{is}. The empirical model 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. We analyze data measuring T_{is}, transfer payments to region i for postelection year s: T_{is} measures the amount of transfers per 10000 people allocated to the region (divided by one million).[9] T_{is} is a function of preelection transfer payments (T_{is-}) and other variables in models of the form

$$T_{is} = b_0 + b_1 T_{is-} + \mathbf{z}_i'\mathbf{c} + \lambda_i \mathbf{f}_i'\mathbf{d} + e_i \,, \tag{7}$$

where b_0 and b_1 are coefficients and $\mathbf{c}$ and $\mathbf{d}$ are vectors of coefficients, $\mathbf{z}_i$ is a vector of covariates, $\mathbf{f}_i$ 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. $\mathbf{z}_i$ contains variables that plausibly affect the level of transfer payments from Center to each region. The term $\lambda_i \mathbf{f}_i'\mathbf{d}$ corresponds to the idea expressed by t_{is} in (6), for particular fraud measures $\mathbf{f}_i$ and particular functional forms for λ_i: postelection transfer payments are a function of readily observable fraud signals, depending on the probability of loyalty. For some years (1996, 2000) we have territory-level election data. For other years (2004, 2008) we have both territory- and precinct-level (UIK-level) election data.

To measure election fraud, we use Frauds Indices, defined as follows. First compute voter turnout in the presidential election for each precinct or territory as a percentage rounded to the nearest digit. Define a variable `last0` that is equal to 1 if the last digit of this turnout variable is a zero and equal to 0 for other digits, and define another variable `last5` that is equal to 1 if the last digit is a five and equal to 0 for other digits. The

[9] Data source information is in the Appendix.

variable `fraud0s` is the mean of `last0` in each region, and `fraud5s` is the mean of `last5`. The Frauds Indices are $\texttt{fraud0s}_i$ and $\texttt{fraud5s}_i$. These two variables comprise $\mathbf{f}_i$.

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 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. We define λ_i to be a logistic function of preelection transfers (T_{is-} or $\texttt{pretrans}_i$) and possibly several other preelection variables: $\texttt{appointed}_i$, a dummy variable measuring whether the governor was appointed a year before the elections; $\texttt{bilateral}_i$, a dummy variable measuring whether the regions signed a bilateral treaty by the year of elections; and $\texttt{GUR}_i$, a dummy variable measuring whether a governor openly supported Unity/United Russia after 1999 parliamentary elections. The formulation is

$$\lambda_i = \frac{1}{1 + \exp(-a_0 - \mathbf{x}_i'\mathbf{a})} \tag{8}$$

where a_0 is a constant, $\mathbf{x}_i$ is a vector containing $\texttt{pretrans}_i$ and possibly some of the other preelection covariates, and $\mathbf{a}$ is a vector of coefficients. Variables $\texttt{appointed}_i$ and $\texttt{GUR}_i$ measure actions affecting or taken by the governor that would suggest the governor is loyal, and $\texttt{bilateral}_i$ indicates disloyalty. Higher preelection transfers may indicate either the presence or purchase of loyalty (Hyde and O'Mahony 2010).

Vector $\mathbf{z}_i$ contains other variables that may relate to transfer payments: $\texttt{Republics}_i$ is a dummy variable measuring whether a region belongs to a Republic; $\texttt{Incumbent}_i$ is the percent of the incumbent party's electoral support in the region (in 1996 the incumbent is Yeltsin, in 2000 and 2004 it is Putin, and in 2008 it is Medvedev); and $\texttt{turnout}_i$ is the turnout percentage defined above.

This model represents a very simple implementation of a mixture model. Fraud measures and transfers are related when the governor is loyal and not otherwise, and 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 our 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.

The theoretical model supports different predictions about the relationships among fraud, transfers and other variables in different time periods. The game model suggests that transfers will be negatively associated with measures of fraud, where loyalty is relatively high, during the 1990s. During the 2000s, once Kremlin commences recentralization and Putin comes to power, and 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 transfers.

Two principles guide our choice of what to include in $\mathbf{x}_i$, the vector of variables that relate directly to the probability that the governor is loyal: substantive judgments about what factors matter; and statistical model selection criteria.

The first principle draws on our judgments that different institutional arrangements existed at different times, so that actions to incentivize or reflect loyalty are different at different times. We always assume that $\mathbf{x}_i$ includes $\texttt{pretrans}_i$, preelection transfers. The $\texttt{appointed}_i$ variable comes in in 1996, 2000 and 2004, because when these three elections occurred, some governors were appointed while others were elected, but it does not figure in 2008 because by then all governors were appointed.[10] Variable $\texttt{GUR}_i$, used in years 2000,

[10]The 2004 presidential election held on March 14, 2004, before gubernatorial elections were abolished at the end of 2004.

2004 and 2008 to indicate whether the governor was nominated on the United Russia ballot in the previous parliamentary elections (1999, 2003 and 2007), measures how closely affiliated a governor is to Unity/United Russia and the governor's predisposition to use necessary economic and administrative resources of the region to support the Kremlin's candidate at the presidential elections. Variable $\texttt{bilateral}_i$, used in years 1996, 2000 and 2004 to indicate whether the region has signed a bilateral treaty with the Center, measures the political autonomy of the governor from the Center. Because most bilateral treaties were abolished after 2004, $\texttt{bilateral}_i$ is excluded in 2008.

We use statistical model selection criteria to winnow the set of variables included in $\mathbf{x}_i$ because we do not have a precise idea how the foregoing variables may all together best measure the loyalty idea represented by λ_i. Because nonlinear least squares is used to estimate (7), we use F-tests to choose among a sequence of nested specifications.[11] We start with a specification that has $\mathbf{x}_i = T_{is-}$ then test whether including the other variables in $\mathbf{x}_i$ significantly improves the model's fit to the data. Another reason to reject the more inclusive specification is if the more inclusive model fails to converge while the less inclusive specification does converge.

3.2 Empirical Results

We use nonlinear least squares to estimate model (7) using transfer payments, T_{is}, measured in postelection years 1997, 2001, 2005 and 2009.[12] The model is estimated separately in each year. For 1996 the model is estimated separately for the first and the second round elections using fraud measures derived respectively from each election.

Table 5 reports results for 1996. For both election rounds, F-tests show there is no significant improvement from including $\texttt{appointed}_i$ or $\texttt{bilateral}_i$ in $\mathbf{x}_i$. Hence λ_i is a function only of $\texttt{pretrans}_i$, which has significant positive coefficient estimates $\hat{a}_1$ in both

[11] If, for sample size n, specification A nests specification B, with parameter counts respectively k_A and k_B, $k_A > k_B$, and residual sums of squares respectively S_A and S_B, then $F = (S_B - S_A)/(k_B - k_A)/(S_A/(n - k_A))$ with degrees of freedom $(k_A - k_B, n - k_A)$.

[12] For estimation we use the `nls()` function of **R** (R Development Core Team 2011).

models: an increase in $\texttt{pretrans}_i$ goes with an increase in λ_i. The coefficient estimates $\hat{f}_0$ and $\hat{f}_5$ of the Frauds Index measures are both significantly negative in the model for the first election round but neither coefficient is significantly different from zero in the second-round model. The first-round results therefore match what the game model suggests for the case when game model parameter b is very negative: when the probability of a governor being loyal (λ_i) is relatively high, the governor is worse off if there is election fraud (equilibrium III*) than if there is not (equilibrium XV*). In the second round fraud as measured by the Frauds Index measures seems to play no role, and postelection transfers instead increase directly with the incumbent party's vote share: $\hat{c}_2$, the coefficient estimated for $\texttt{Incumbent}_i$, is significantly positive only in the model for the second round.

*** Table 5 about here ***

Table 6 reports results for 2000. F-tests show the model is improved by including $\texttt{appointed}_i$ in $\mathbf{x}_i$ but not $\texttt{bilateral}_i$ or $\texttt{GUR}_i$. The coefficient estimates $\hat{a}_1$ and $\hat{a}_2$ of $\texttt{pretrans}_i$ and $\texttt{appointed}_i$ in λ_i are both significantly positive. The coefficient estimate $\hat{f}_0$ for Frauds Index measure $\texttt{fraud0s}_i$ is significantly negative while the estimate $\hat{f}_5$ of the coefficient for $\texttt{fraud5s}_i$ is significantly positive, and $\hat{f}_0$ is more than twenty times larger in magnitude than $\hat{f}_5$. Perhaps this indicates that fraud dynamics of the kind apparent in the model estimates for the first round in 1996 continue, in part, while also dynamics of the kind that developed through the 2000s—where governors who commit fraud are rewarded—are incipient.

*** Table 6 about here ***

Table 7 reports results for 2004, with separate estimates using Frauds Index measures derived from both territory-level and precinct-level election returns. F-tests show the model for territory returns should include all of $\texttt{appointed}_i$, $\texttt{bilateral}_i$ and $\texttt{GUR}_i$ in $\mathbf{x}_i$ in addition to $\texttt{pretrans}_i$, but for precinct returns λ_i is best respresented as a function solely of $\texttt{pretrans}_i$. In the territory-based analysis, the coefficient estimates $\hat{a}_1$, $\hat{a}_2$ and $\hat{a}_4$ are all significantly positive and the estimate for the coefficient of $\texttt{bilateral}_i$ is significantly negative, as intuition suggests they should be—receiving previous transfers, being appointed and being affiliated with United Russia should be associated with a higher likelihood of being loyal while having a bilateral treaty should be associated with a lower likelihood. The fact that λ_i is a function of different covariates when territory-level versus precinct-level returns are considered may reflect the reality that different kinds of officials are involved in frauds committed in the respective election commissions. Perhaps, in reality, election frauds in Russia in 2004 involved multiple levels of signaling, not merely signaling between each governor and the Center.

*** Table 7 about here ***

The Frauds Index measures for both levels of election aggregation in 2004 have significantly positive coefficient estimates $\hat{f}_0$ and $\hat{f}_5$: when the probability of loyalty is high, committing readily observable fraud is associated with higher levels of postelection transfers to each region. This is the kind of result the game model suggests should happen when either game model parameter b is positive and there is alternation between the equilibria respectively described by III* and XII*, or b is negative and there is alternation between fraud and no fraud as allowed by II* when there is suitable association between b and λ. Notably, the vote share for the incumbent ($\hat{c}_2$) is not significantly associated with transfers, and the turnout proportion itself ($\hat{c}_3$) is significantly associated with lower transfers when the territory-level returns are considered.

Table 8 reports results for 2008, again with separate estimates using Frauds Index measures derived from both territory-level and precinct-level election returns. F-tests show the models for both territory and precinct returns should include only $\texttt{pretrans}_i$ in $\mathbf{x}_i$. For both levels of election aggregation, the coefficient estimates $\hat{a}_1$ are positive but not significantly different from zero. Perhaps this means that having appointed all governors assured that all governors had a high probability of being loyal. In any case, our model for

λ_i does not let us sharply distinguish among governors' loyalty probabilities. The Frauds Index measures both have insignificant coefficient estimates $\hat{f}_0$ and $\hat{f}_5$ in the territory-based model, and the precinct-based model converges only if only $\texttt{fraud0s}_i$ and not $\texttt{fraud5s}_i$ is included.[13] The coefficient estimate $\hat{f}_0$ in the precinct-based model is significantly positive and substantively comparable in magnitude to the value estimated for 2004. When the probability of loyalty is high, readily observable fraud committed at the precinct level is associated with higher levels of postelection transfers to each region.

*** Table 8 about here ***

4 Conclusion

The results from estimating model (7) using data from the various elections very strongly confirm the theoretical argument that refers to the game model and also validates using the fraud measures that focus on particular digits occurring in turnout figures. All the Russian presidential elections we examined show evidence of fraud that is described more or less well by the game model. For elections from 2000 on, and very clearly for the elections of 2004 and 2008, we are confident saying that there is widespread fraud motivated by governors' desire to signal their individual loyalties to the Center. The fact that the signaling in 2004 is apparent in both territory-level and precinct-level turnout data suggests, of course, that many officials besides merely the governors are involved in the frauds. That signaling in 2008 is apparently connected to postelection turnout rewards only when the precinct-level fraud measure is used may say something about how election fraud activities by 2008 have become even more completely federalized in ways that go beyond the scope of our game model. Likely hierarchies of signals are involved.

[13] For the model that includes both $\texttt{fraud0s}_i$ and $\texttt{fraud5s}_i$, the `nls()` function stops with the message, "Reason stopped: step factor 0.000488281 reduced below 'minFactor' of 0.000976562," giving $\hat{\sigma} = 0.003633$. Attempts to supply different starting values or different optimization algorithm parameters produce the same error message albeit with different values for "step factor" and "minFactor." Standard errors produced for these estimates suggest the likelihood is singular when both $\texttt{fraud0s}_i$ and $\texttt{fraud5s}_i$ are included.

The specific institutional change we think is most important to explain the change over time in the structure of election frauds in Russia is the recentralization that began as Putin came to power in 2000. In terms of our game model, the value of the parameter d greatly increased. As recentralizaton 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: b was less often negative or at least often less negative. These changes changed the strategies governors and the Kremlin found optimal, leading to the situtations seen in 2004 and 2008, where election frauds are easy to detect because governors are using them to send signals to the Kremlin. Of course, the methods used by Myagkov et al. (2009) that focus on turnout also diagnose fraud in all of these Russian elections, but their methods do not focus specifically on turnout figures' last digits. We have shown that, in Russia, the occurrence of zeros or fives as the last digit in turnout percentages is connected to an extensive signaling structure wherein election frauds are connected to postelection rewards and punishments.

Overall, our theoretical propositions are supported by our data. The results sometimes display a complex picture. The presidential election of 1996 seems to contain elements of bargaining that our signaling model is not optimally designed to represent. In the first round of the 1996 election we see empirical results that match what the game model suggests should happen—governors who commit election fraud are worse off—but in the second round we see evidence of a simpler arrangement in which rewards simply go to regions that deliver higher election return for the incumbent party. The presidential election of 2000 reflects political uncertainty and institutions under transition: governors who signal by committing fraud seem to be rewarded in an incipient way. By 2004 and continuing into 2008, the fraud-signal-transfers-reward regime seems to be fully in place. If anything the rewards in terms of postelection transfers from committing fraud in order to signal seem to be smaller in 2008 than in 2004. The frauds that are rewarded in 2008 do not include the territory-level frauds that attract postelection transfers in 2004. In 2008, only precinct-level frauds seem to merit postelecton transfer rewards.

The prevalent "signaling" mechanism raises a fundamental problem for the political regime: regional elites after being coopted by the Center were 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" (Filippov et al. 2004, 175)? The scope of our analysis is too narrow to support an evaluation of whether what Bednar (2009) calls the "safeguards" of federalism have been improved or worsened by the changes we highlight, but popular control and accountability seem obviously compromised (Bednar 2009, 107–119), and Taylor (2011) suggests judicial safeguards are compromised as well. In Russia, the signals of political loyalty we have highlighted occur in the context of great informational asymmetry between the regions and the Center. The true level of support for the ruling party is difficult to discern. Both III* and XII*, among the equilibria we believe best describe what happens in 2004 and 2008, are pooling equilibria: both 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.

Appendix: Data Sources

The data used in this research were taken from multiple sources. The data on financial transfers for different periods were kindly provided by Daniel Treisman and Andrei Starodubtsev. The data on governor's affiliation with United Russia in 2003 and 2008 were kindly given by Olesya Tkacheva, the governors affiliation with Unity was taken from Republics (2000). The electoral data for 1996 and 2000 presidential elections were sent to us by Alexei Sidorenko. The data for 1996 and 2000 include only territory-level election reports. The electoral data for 2004 and 2008 were obtained from the website of Russian Central Elections Commission (`http://www.cikrf.ru`). The data for 2004 and 2008 include both precinct-level (UIK-level) and territory-level election reports. Other data were collected by the authors from the databases of Federal State Statistics Service and the websites of regional administrations.

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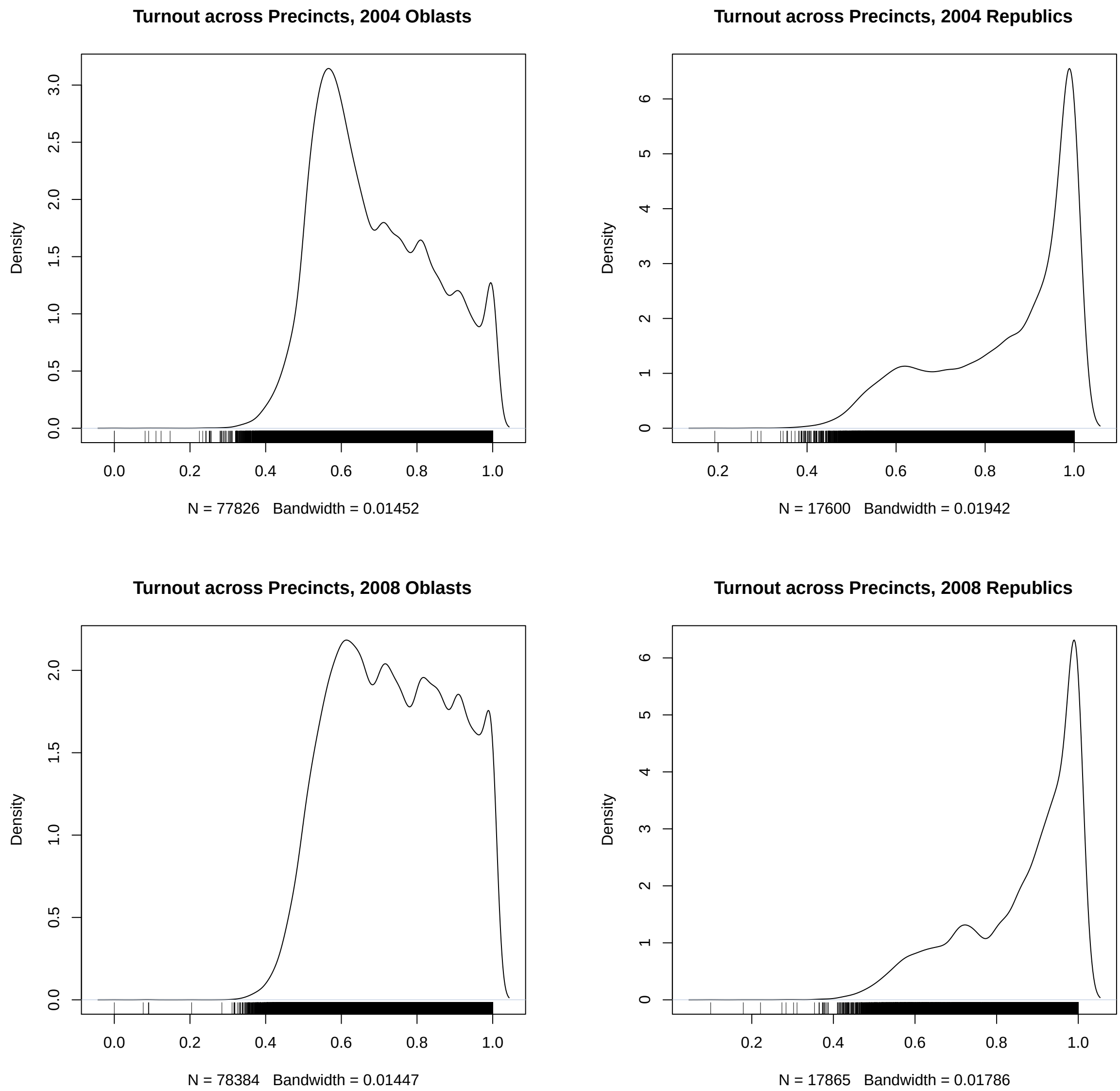
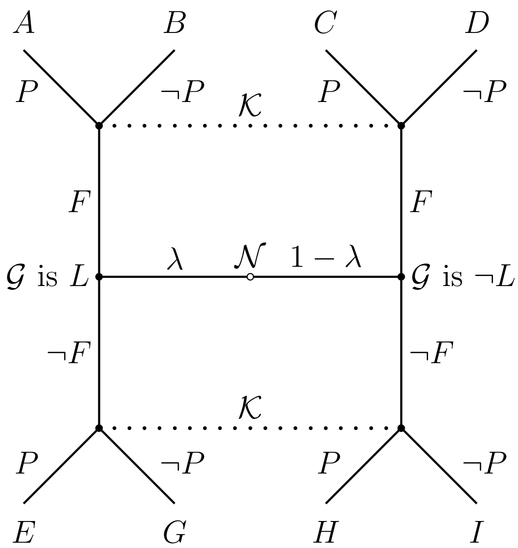
Figure 1: Turnout distribution across precincts for 2004 and 2008 in Republics and oblasts





Payoffs

symbol	$\mathcal{G}$	$\mathcal{C}$
A	$-w-p$	$v-p$
B	$-w+t$	$(b-1)t+v$
C	$-w-p$	$v-p+d$
D	$-w+(b+1)t$	$v-t$
E	$-p$	$-p$
G	t	$(b-1)t$
H	$-p$	$-p+d$
I	$(b+1)t$	$-t$

Figure 2: Game Diagram

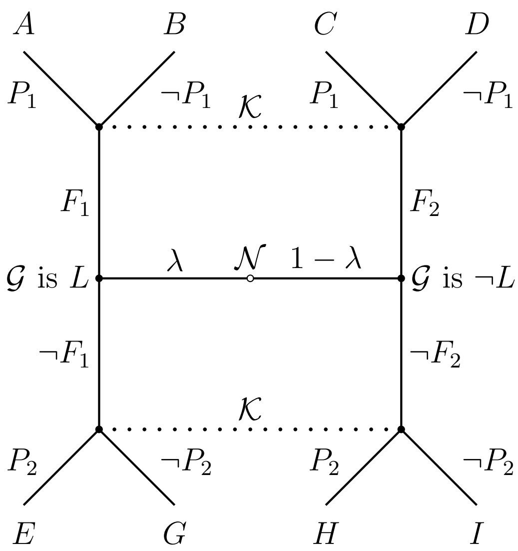


Figure 3: Game Diagram with Multiagent Annotated Moves

Table 1: Game in Multiagent Strategic Normal Form

P_2

		P_1	$\neg P_1$
F_1	F_2	$-w-p,$ $v-p+(1-\lambda)d$	$-w+t[1+b(1-\lambda)],$ $v+t(\lambda b-1)$
F_1	$\neg F_2$	$-\lambda w-p,$ $\lambda w-p+(1-\lambda)d$	$-p(1-\lambda)-\lambda(w-t),$ $\lambda[(b-1)t+v]+(1-\lambda)(d-p)$
$\neg F_1$	F_2	$-(1-\lambda)w-p,$ $-p+(1-\lambda)(v+d)$	$-\lambda p+(1-\lambda)[(b+1)t-w],$ $-\lambda p+(1-\lambda)(v-t)$
$\neg F_1$	$\neg F_2$	$-p,\ -p+(1-\lambda)d$	$-p,\ -p+(1-\lambda)d$

$\neg P_2$

		P_1	$\neg P_1$
F_1	F_2	$-w-p,$ $v-p+(1-\lambda)d$	$-w+t[1+b(1-\lambda)],$ $v-t(\lambda b-1)$
F_1	$\neg F_2$	$-\lambda(w+p)+(1-\lambda)(b+1)t,$ $\lambda(v-p)-(1-\lambda)t$	$-\lambda w+t[1+(1-\lambda)b],$ $\lambda v+(\lambda b-1)t$
$\neg F_1$	F_2	$-\lambda(w+p)+(1-\lambda)t,$ $\lambda(b-1)t+(1-\lambda)(v-p+d)$	$t[1+(1-\lambda)b]-(1-\lambda)w,$ $(1-\lambda)v+(\lambda b-1)t$
$\neg F_1$	$\neg F_2$	$-p,\ \lambda(b-1)t-(1-\lambda)t$	$t[1+(1-\lambda)b],\ (\lambda b-1)t$

Table 2: Payoffs for Strategy Profiles

label	profile	governor's payoff	Center's payoff
I*	$(F_1, F_2, \neg P_1, \neg P_2)$	$-w + t[1 + (1-\lambda)b]$	$v + (\lambda b - 1)t$
II*	$(F_1, \neg F_2, \neg P_1, P_2)$	$-p(1-\lambda) - \lambda(w - t)$	$\lambda[(b-1)t + v] + (1-\lambda)(d-p)$
III*	$(F_1, F_2, \neg P_1, P_2)$	$-w + t[1 + b(1-\lambda)]$	$v + t(\lambda b - 1)$
IV*	$(F_1, \neg F_2, P_1, P_2)$	$-\lambda w - p$	$\lambda v - p + (1-\lambda)d$
V*	$(F_1, \neg F_2, P_1, \neg P_2)$	$-\lambda(w-p) + (1-\lambda)(b+1)t$	$\lambda(v-p) + (1-\lambda)(-t)$
VI*	$(F_1, \neg F_2, \neg P_1, \neg P_2)$	$-\lambda w + t[1 + (1-\lambda)b]$	$\lambda v + (\lambda b - 1)t$
VII*	$(\neg F_1, \neg F_2, \neg P_1, \neg P_2)$	$t[1 + (1-\lambda)b]$	$(\lambda b - 1)t$
VIII*	$(\neg F_1, \neg F_2, P_1, P_2)$	$-p$	$-p + (1-\lambda)d$
IX*	(F_1, F_2, P_1, P_2)	$-w - p$	$v - p + (1-\lambda)d$
X*	$(\neg F_1, F_2, P_1, P_2)$	$-(1-\lambda)w - p$	$-p + (1-\lambda)(v+d)$
XI*	$(\neg F_1, F_2, \neg P_1, P_2)$	$-\lambda p + (1-\lambda)[(b+1)t - w]$	$-\lambda p + (1-\lambda)(v-t)$
XII*	$(\neg F_1, \neg F_2, \neg P_1, P_2)$	$-p$	$-p + (1-\lambda)d$
XIII*	$(F_1, F_2, P_1, \neg P_2)$	$-w - p$	$v - p + (1-\lambda)d$
XIV*	$(\neg F_1, F_2, P_1, \neg P_2)$	$-\lambda(w+p) + (1-\lambda)t$	$\lambda(b-1)t + (1-\lambda)(v-p+d)$
XV*	$(\neg F_1, \neg F_2, P_1, \neg P_2)$	$-p$	$\lambda(b-1)t + (1-\lambda)(-t)$
XVI*	$(\neg F_1, F_2, \neg P_1, \neg P_2)$	$t[1 + (1-\lambda)b] - (1-\lambda)w$	$(1-\lambda)v + (\lambda b - 1)t$

Table 3: Some Equilibrium Tests

label	profile	equilibrium conditions
I*	$(F_1, F_2, \neg P_1, \neg P_2)$:	$\lambda = 1 \cap w = 0$
II*	$(F_1, \neg F_2, \neg P_1, P_2)$:	$\lambda = 0 \cap \frac{-p-t}{t} \geq b,\ \lambda = 1 \cap \frac{t+p}{t} \geq b \geq \frac{t-p-v}{t}$
III*	$(F_1, F_2, \neg P_1, P_2)$:	complicated (see Table 4)
IV*	$(F_1, \neg F_2, P_1, P_2)$:	never
V*	$(F_1, \neg F_2, P_1, \neg P_2)$:	$\lambda = 0 \cap p \geq -(1+b)t$, $\lambda = 1 \cap b \leq 0 \cap (1-b)t \geq p \geq t \cap 2p \geq w$
VI*	$(F_1, \neg F_2, \neg P_1, \neg P_2)$:	$\lambda = 1 \cap w = 0 \cap t \geq p \cap b \geq 0$
VII*	$(\neg F_1, \neg F_2, \neg P_1, \neg P_2)$:	never
VIII*	$(\neg F_1, \neg F_2, P_1, P_2)$:	never
IX*	(F_1, F_2, P_1, P_2) :	$\lambda < 1 \cap w = 0 \cap \frac{-(p+t)}{(1-\lambda)t} \geq b$
X*	$(\neg F_1, F_2, P_1, P_2)$:	never
XI*	$(\neg F_1, F_2, \neg P_1, P_2)$:	$\lambda = 0 \cap w = 0 \cap b \geq \frac{w-p-t}{t}$
XII*	$(\neg F_1, \neg F_2, \neg P_1, P_2)$:	$w \geq p + t \cap t + d \geq p + v$
XIII*	$(F_1, F_2, P_1, \neg P_2)$:	never
XIV*	$(\neg F_1, F_2, P_1, \neg P_2)$:	never
XV*	$(\neg F_1, \neg F_2, P_1, \neg P_2)$:	$\frac{t+p}{w+t+p} \leq \lambda < 1 \cap \frac{-(p+t)}{(1-\lambda)t} \geq b \geq \frac{v+t-p}{t}$
XVI*	$(\neg F_1, F_2, \neg P_1, \neg P_2)$:	$\lambda = 0 \cap w = 0 \cap b \geq 0 \cap p \geq d + t$

Table 4: Equilibrium Tests for Profile III*

	profile	governor's payoff	Center's payoff
III*	$(F_1, F_2, \neg P_1, P_2)$	$-w + t[1 + b(1-\lambda)]$	$v + t(\lambda b - 1)$

conditions:

$$\lambda = 0 \Rrightarrow t(b+1) \geq w - p \cap v + d \geq t - p \cap p - t \geq d$$

$$\lambda = 1 \Rrightarrow t \geq w - p \cap t(b-1) \geq -p$$

$$0 < \lambda < 1 \Rrightarrow t + p \geq w \cap t(b+1) + p \geq w \cap v + t(b-1) + p \geq 0 \cap v + d + p \geq t$$

$$\cap\, t(b+1) + p \geq \lambda bt \geq (1-\lambda)d + t - p$$

$$\Rightarrow \begin{cases} 1 + \dfrac{t+p}{bt} \leq \lambda \leq 1 - \dfrac{t(b-1)+p}{bt+d}, & \text{if } b < 0 \\ \lambda \geq 1 + (t-p)/d, & \text{if } b = 0, \text{ requires } p \geq t \\ 1 + \dfrac{t+p}{bt} \geq \lambda \geq 1 - \dfrac{t(b-1)+p}{bt+d}, & \text{if } b > 0 \end{cases}$$

$$b < 0: \quad 1 + \frac{t+p}{bt} = 0 \text{ if } b = -\frac{t+p}{t}, \quad 1 - \frac{t(b-1)+p}{bt+d} = 1 \text{ if } b = \frac{t-p}{t}$$

$$b > 0: \quad \lim_{t\to\infty}\left(1 + \frac{t+p}{bt}\right) = 1 + \frac{1}{b}, \quad \lim_{t\to\infty}\left(1 - \frac{t(b-1)+p}{bt+d}\right) = \frac{1}{b}$$

Table 5: Presidential Elections 1996: Postelectoral Model (Territory)

	Round 1[a]		Round 2[a]	
	Transfers 1997		Transfers 1997	
	Coef.	S.E.	Coef.	S.E.
a_0	−9.050	2.38	−5.739	2.48
a_1	7.119	2.04	2.410	3.78
f_0	−4.959	.729	13.113	40.02
f_5	−13.30	1.26	−11.525	39.72
b_0	−.149	.092	.055	.18
b_1	1.562	.0504	1.087	.07
c_1	.0033	.060	.005	.09
c_2	−.0447	.231	.127	.32
c_3	.0010	.002	−.004	.0028
$\hat{\sigma}$	.2181		.3429	
N	87		87	

Note: Nonlinear least squares estimates.
[a] Model: $\texttt{trans}_i = b_0 + b_1\texttt{pretrans}_i + c_1\texttt{Republics}_i + c_2\texttt{Incumbent}_i + c_3\texttt{turnout}_i + \lambda_i(f_0\texttt{fraud0s}_i + f_5\texttt{fraud5s}_i) + e_i$, $\lambda_i = \dfrac{1}{1+\exp\{-(a_0 + a_1\texttt{pretrans}_i)\}}$.

Table 6: Presidential Elections 2000: Postelectoral Model (Territory)

	Transfers 2001[a]	
	Coef.	S.E.
a_0	-7.30	1.43
a_1	97.90	36.78
a_2	2.52	.80
f_0	-2.60	.23
f_5	.122	.09
b_0	.0025	.0052
b_1	1.576	.087
c_1	.0058	.0021
c_2	$-.0028$	.0086
c_3	$9.37e{-}05$	$6.87e{-}05$
$\hat{\sigma}$	.007013	
N	78	

Note: Nonlinear least squares estimates.

[a] Model: $\texttt{trans}_i = b_0 + b_1\texttt{pretrans}_i + c_1\texttt{Republics}_i + c_2\texttt{Incumbent}_i + c_3\texttt{turnout}_i + \lambda_i(f_0\texttt{fraud0s}_i + f_5\texttt{fraud5s}_i) + e_i$, $\lambda_i = \dfrac{1}{1+\exp\{-(a_0 + a_1\texttt{pretrans}_i + a_2\texttt{appointed}_i)\}}$.

Table 7: Presidential Elections 2004: Postelectoral Model

	Territory[a]		Precinct[b]	
	Transfers 2005		Transfers 2005	
	Coef.	S.E.	Coef.	S.E.
a_0	−4.927	1.11	−3.763	1.42
a_1	48.86	12.87	38.740	17.90
a_2	.985	.62	—	—
a_3	−1.160	.49	—	—
a_4	1.046	.76	—	—
f_0	.260	.039	.171	.089
f_5	.426	.083	.679	.29
b_0	.00958	.010	.00490	.014
b_1	.694	.030	.580	.12
c_1	.00388	.0030	.00372	.0043
c_2	.00988	.016	.00974	.019
c_3	$-2.10e{-}04$	$9.13e{-}05$	−.323	7.16
$\hat{\sigma}$	.008694		.01143	
N	78		78	

Note: Nonlinear least squares estimates.

Model: $\texttt{trans}_i = b_0 + b_1\texttt{pretrans}_i + c_1\texttt{Republics}_i + c_2\texttt{Incumbent}_i + c_3\texttt{turnout}_i + \lambda_i(f_0\texttt{fraud0s}_i + f_5\texttt{fraud5s}_i) + e_i$.

[a] $\lambda_i = \dfrac{1}{1 + \exp\{-(a_0 + a_1\texttt{pretrans}_i + a_2\texttt{appointed}_i + a_3\texttt{bilateral}_i + a_4\texttt{GUR}_i)\}}$.

[b] $\lambda_i = \dfrac{1}{1 + \exp\{-(a_0 + a_1\texttt{pretrans}_i)\}}$.

Table 8: Presidential Elections 2008: Postelectoral Model

	Territory[a]		Precinct[b]	
	Transfers 2009		Transfers 2009	
	Coef.	S.E.	Coef.	S.E.
a_0	-1.07	4.87	-16.8	11.43
a_1	246.	768.	324.	231.0
f_0	$-.00776$	.00689	.111	.0403
f_5	$-.0125$	.0111	—	—
b_0	$-.992$	.00467	.00387	.00145
b_1	1.19	.0247	1.00	.0624
c_1	1.00	.00138	.00202	.00109
c_2	$-.0104$	.00687	$-.00305$	.00148
c_3	$3.35e{-}05$	$4.11e{-}05$	$1.159e{-}06$	$1.205e{-}06$
$\hat{\sigma}$	.003899		.003598	
N	82		82	

Note: Nonlinear least squares estimates.

Model: ^{a} $\texttt{trans}_i = b_0 + b_1\texttt{pretrans}_i + c_1\texttt{Republics}_i + c_2\texttt{Incumbent}_i + c_3\texttt{turnout}_i + \lambda_i(f_0\texttt{fraud0s}_i + f_5\texttt{fraud5s}_i) + e_i$,

$$\lambda_i = \frac{1}{1+\exp\{-(a_0 + a_1\texttt{pretrans}_i)\}};$$

^{b} $\texttt{trans}_i = b_0 + b_1\texttt{pretrans}_i + c_1\texttt{Republics}_i + c_2\texttt{Incumbent}_i + c_3\texttt{turnout}_i + \lambda_i f_0\texttt{fraud0s}_i + e_i$,

$$\lambda_i = \frac{1}{1+\exp\{-(a_0 + a_1\texttt{pretrans}_i)\}}.$$