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CSH POLICY BRIEF

No signs of electoral fraud in Brazil's 2022 presidential election

SUMMARY.

The presidential election in Brazil on October 30, 2022 has evoked a heated debate and speculation on electoral fraud. Given the tiny margin of less than 1% of votes, by which LI Lula has won the election, it is important to estimate if and to what extent election fraud might have taken place. And if there was electoral fraud, whether it was significant in determining the election or not.

Here we present an election forensic analysis of the second round of the recent Brazilian presidential elections. It clarifies to what extent voting irregularities are detectable in the outcomes of the election data on the level of voting stations and whether these irregularities were relevant for the election outcome. The employed test quantifies the extent to which the observed election results are compatible with the specific types of electoral malpractices. In particular, we test for statistical fingerprints of "ballot stuffing" (multiple ballots per person during the voting process) and "voter rigging" (intimidation and coercion of voters). These tests identify statistical anomalies in the election results. **We find no statistical signs for election fraud for both types of electoral malpractices. In the following we present the analysis in detail.**

THE 2022 PRESIDENTIAL ELECTION. A LOOK BACK.

On October 30, 2022, Brazil's closest presidential election to date was held [1]. As no candidate was able to achieve more than 50% in the 1st round, Brazilians went to the ballot boxes again for the 2nd round (neither postal voting nor early voting is provided in Brazil so far). In that runoff 118,552,353 people casted a valid vote [2], deciding the race for the presidency between two rivals on opposite sides of the political spectrum: Luiz Inácio Lula da Silva (Partido dos Trabalhadores - PT) on the left and the current incumbent Jair Bolsonaro (Partido Liberal - PL), who was seeking a second term, on the far-right. In the end, Lula won with 60,345,999 valid votes (50.90%), while Bolsonaro achieved 58,206,354 valid votes (49.10%) [2]. He owes his victory primarily to the northeast of the country, while Bolsonaro was able to win over the south [3].

Although the runoff was much closer, the election results mirrored those from the first round of voting on October 2, 2022 - in which Lula received 57,259,504 votes, giving him 48.43%, while Bolsonaro came in second with 51,072,345 votes and 43.20%. The other nine candidates received a combined total of only 9,897,870 votes (8.37%). The overall voter turnout was 79.05% [4].

Given the close outcome of the runoff and the fact, that Bolsonaro did not instantly admit his defeat publicly [5], concern quickly arose that he will reject the election results [6] and voices were also raised accusing Lula of electoral fraud [7]. Supporters of former far-right president Jair Bolsonaro even called

on the military to intervene after his defeat, to prevent President-elect Luiz Inácio Lula da Silva from taking office next January. While the Navy, Army, and Air Force subsequently recognized the right to demonstrate, they also emphasized their commitment to democracy in a joint statement [8]. The examination of the electronic ballot boxes and the electoral process by various institutions and specialists, as well as the military itself, could not find any evidence of irregularities or manipulation of the election [9]. Nevertheless, the Ministry of Defense does not completely reject the possibility of manipulation [10], which could further encourage radical Bolsonaro supporters. **For this very reason, it is of particular importance to ensure the integrity of this election. With modern statistical election forensics, we were able to do this and find no evidence of election fraud.**

DATA.

The following analyses are based on data of 471,983 electoral units (also referred to as "districts") for which we consider electorate size (number of vote eligible population), number of valid votes and the number of votes for LI Lula and Bolsonaro, respectively. All electoral units with an electorate of less than hundred voters are discarded from the analysis to rule out artefacts from small numbers. The number of valid votes divided by electorate size are referred to as the *voter turnout*, the number of votes divided by valid votes are called *vote shares*. The data is available from the Brazilian government site [11].

Statistical testing for election malpractices

The basis of the election forensic statistics is the turnout-vote distribution (the so-called election-fingerprint) that is straight forwardly extracted from the data as a two-dimensional histogram. Certain deviations of this distribution from basic assumptions of normality can indicate the presence of correlations between turnout and votes for the winning party (voter-turnout inflation), which in turn can be signals for election fraud in the form of, e.g., "Ballot-stuffing". This practice refers to the practice of stuffing multiple ballots into a box on top of the ``normal'' election results. Under the assumption that such malpractices occurred, one can formulate a statistical model that assesses how many districts have to be affected by ballot stuffing in order to reproduce the observed statistics [12]. Similar malpractices is include the exchange of election boxes with boxes that are contain large shares of pre-filled ballots. Previous work on election-fraud detection forensics showed that geographic factors play a role in how susceptible various regions, in particular rural areas, are for other types of electoral malpractices like voter coercion [13,14]. In a nutshell, the smaller and the more remote a district is, the less likely it is visited by election observers (e.g. from OSCE) and the easier it is to deny specific (groups of) people their right to cast their votes in a fair way. The practice of intimidation and coercion of voters has been termed "voter rigging". To quantify the extent of voter rigging the so-called *voter-rigging test* was developed [13,14]. This test compares vote shares and turnout of a given electoral unit with those of its neighbouring units (making it likely that the voting station is visited by people with similar distributions of political preferences) and then evaluates whether small voting stations are more likely to show inflated vote and turnout than comparable large ones. In the following we test for both, voter-turnout inflation and voter rigging.

RESULTS.

No indications for voter-turnout inflation. In Figure 1, we show a so-called "election fingerprint" for the second round of the Brazilian presidential election 2022 [12,13,15]. This is a two-dimensional histogram showing the voter turnout and the percentage of votes for Lula (left) and Bolsonaro (right). Every voting district has a turnout and a result (% for Lula or Bolsonaro) and adds to the histogram (yellow indicates many events, blue means no events). The bulk of districts (yellow blob in the middle) has a turnout between 60 and 80% and vote shares ranging from 25 to 80%, for both candidates. The ``blob'' is found to be symmetric with respect to the y-axis and does not indicate any correlation between turnout and votes. Such a correlation, that would be visible through a smearing out of the "blob" from its centre to the upper right, is clearly absent. A smearing of this kind would be an indication of strong election fraud, such as ballot stuffing. An example for such a smearing, we include the result of the recent election of the Russian Duma in 2021, in Figure 4.
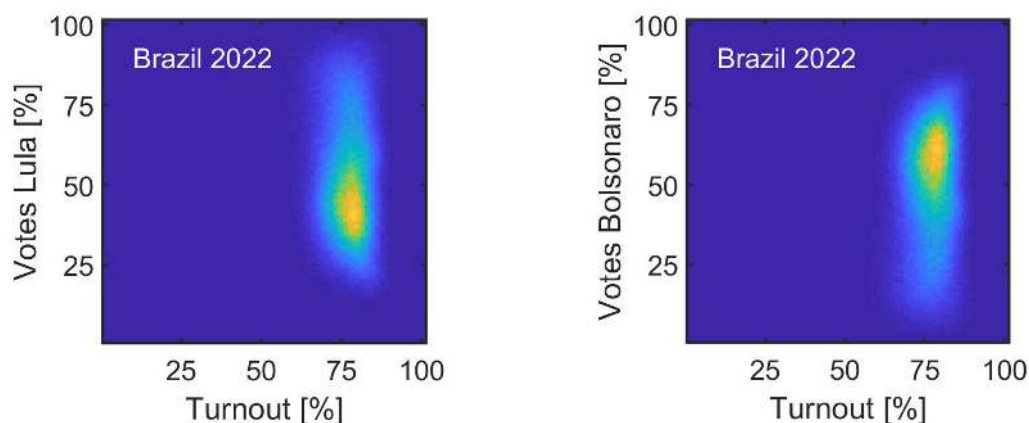
Figure 1: *Election fingerprint, a two-dimensional histogram of turnout and vote shares. The colour scale denotes the number of districts with a given turnout and percentage of votes, increasing from blue to yellow. We observe the bulk of districts with vote shares between approximately 25 and 80%, and turnouts between 60 and 80%. Both fingerprints do not show a tendency of a correlation of high turnouts and high votes for any candidate, which would be a signature for malpractices like ballot stuffing. For an example of severe election fraud, see Figure 4 from the* CSH policy brief *[18].*
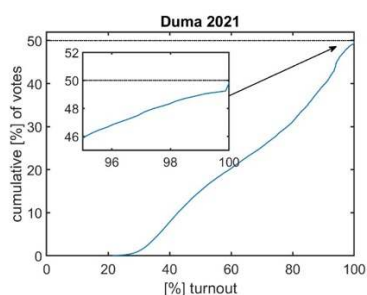
(A)   (B)   (C)

Figure shows the voter-turnout distribution for both candidates. On the y-axis the figure shows the percentage of Lula (left) and Bolsonaro (right) as a function of the voter turnout on the x-axis. The

graph considers all electoral units with less than a given percentage of turnout and gives the vote shares for Lula/Bolsonaro when including only those units. By including more and more districts, with increasing cumulative turnout, the vote share for both candidates converge to the final result, seen in the plateau to the right of the figure. The dashed line indicates the threshold for reaching the majority (more than 50% of valid votes). There is no sign that that votes become inflated, which would be seen if the curves would keep increasing with turnouts approaching 100%. In this case the plateaus would not form. This provides further evidence that no election fraud in form of a voter-turnout inflation occurred in this presidential election. Again, for an example of severe voter turn-out inflation see, Figure 4.
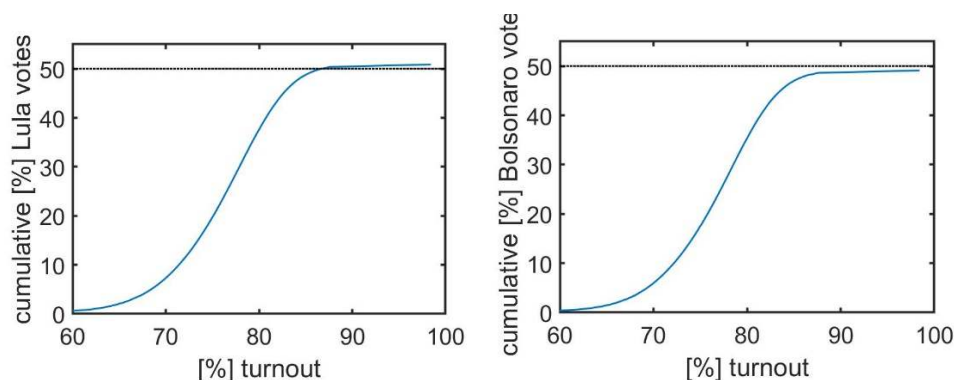

Figure 2: *Share of all votes that Lula (left) and Bolsonaro (right) received when looking at all electoral units that show less than a given turnout. The plots show that the votes of Lula converge towards the final outcome of 50.90%. Bolsonaro converges slightly below 50%. A statistical signature for election fraud would be present, if the curves would keep increasing and no plateau would form. For an example of severe electoral fraud, see Figure 4.*

Testing for ballot-stuffing. The vote–turnout distribution of the Brazilian presidential election does not show signs of atypical structures that could be explained with malpractices in the voting process. One possible explanation for atypical vote–turnout distributions is ballot stuffing. It can be made quantitative through a statistical approach to election fraud [12,13,14,15,16,17]. In the election under investigation there are no statistical indications of ballot stuffing. More concrete, the statistical test for vote-turnout inflation confirms that the vote-turnout distribution can best be explained by assuming the absence of ballot-stuffing mechanisms in all districts (i.e., the most likely value for the incremental and extreme fraud parameters introduced in [12] is zero).

No indications for voter-rigging. Results of the voter-rigging test are shown in Figure 3, where small stations are defined as those with an electorate size being in the lowest ten percentiles. To adjust for geographic heterogeneities (panel Figure 3 A), for each electoral district we subtract the average vote shares/turnout of all geographically neighbouring stations and divide by the corresponding standard deviation to obtain the so-called *standardized* votes and turnouts (see panel Figure 3 B). The standardized fingerprint of small stations (red circles) and large stations (blue circles) practically coincide, signalling that there was no voter rigging present on a quantifiable level. This means that there was no statistically significant difference in the way that smaller versus larger stations contributed to the standardized vote-turnout distribution.
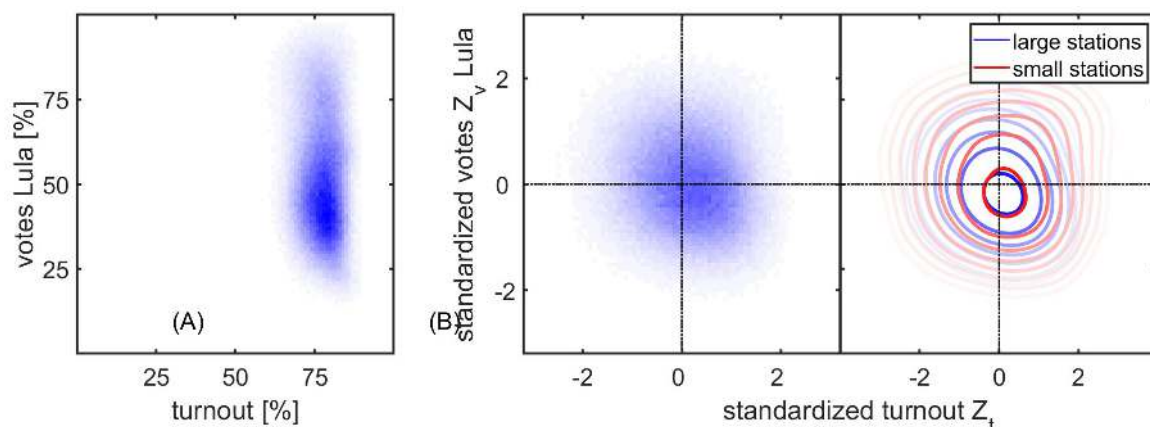
Figure 3: *Results for the voter rigging test. From the election-fingerprint (A) the standardized distribution is obtained (left part of panel B). The right hand side of panel B shows small (red) and large (blue) voting stations in terms of their standardized vote and turnout distributions. The vote-turnout distributions for small and large stations are shown as "equi-density" contour lines red for small and blue for large stations. The more intense the colour, the larger the number of districts with the given vote-turnout shares. The lines practically coincide. The fact that no displacement between small and large stations is observed, indicates the absence of voter-rigging.*

Reference example for severe election fraud. As a reference, we include an example of an election with heavy election fraud in the 2021 Duma election in Russia. The party *United Russia* won the election by a tiny margin that was only obtainable with fraud in place, see CSH policy brief [18]. In Figure 4 A we clearly see indications of a voter-turnout inflation (smearing of the central blob towards the upper right corner). The cumulative percentage of votes as a function of the turnout is seen in panel B. Clearly the curve keeps increasing and no plateau is forming. The inset shows that the extent of fraud was necessary to reach the 50% mark (severe increase at the close to 100% turnout). Panel C shows the voter-rigging test, where the small and large regions are not coinciding but small stations are "shifted" towards the upper right, a clear sign of voter intimidation.
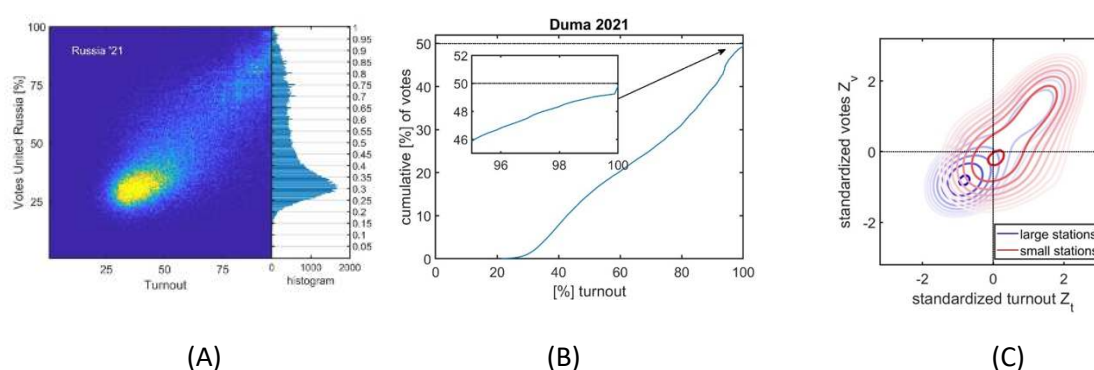

Figure 4: *We count the share of all votes that United Russia received when looking at all electoral units that have not more than a given level of turnout. The plot shows that UR typically less vote shares in low-turnout districts.* **Figure 1B:** *Election fingerprint, a two-dimensional histogram of turnout and vote shares. The colour scale denotes the number of districts with a given turnout and percentage of votes, increasing from blue to yellow. We observe the bulk of districts with vote shares and turnout between 25 and 50%. However, a substantial number of districts has an inflated turnout and this inflation almost always coincides with an increased vote share for UR. Next to the y-axis we show the histogram of all vote shares for districts with more than hundred voters. The effect of round numbers is clearly visible, with a disproportionate number of districts with UR receiving, e.g., 70%, 75%, … 95% of all votes.*

CONCLUSION.

An election forensic analysis of the recent Brazilian presidential elections shows no detectable statistical signs for systematic electoral fraud of different type. The data on the voting district level is made available by the Brazilian government and was used to extract election fingerprints. Based on these statistical tests for deviations from normality (voter-inflation test) and a test to quantify the level of voter rigging were carried out. Neither statistical test showed indications for malpractices.

ABOUT THE CSH

The Complexity Science Hub Vienna was founded with the aim of using Big Data for the benefit of society. Among other things, the CSH systematically and strategically prepares large data sets in such a way that the effects of decisions in complex situations can be tested in advance and systematically evaluated. In doing so, the CSH provides the foundations for evidence-based policy.

CSH Policy Briefs present socially relevant statements that can be derived from CSH research findings.

CSH researchers Stefan Thurner and Peter Klimek co-wrote this policy brief.

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