Kamikazes in Public Procurement

April 2023

Abstract

Using granular auction data on 15 million item purchases in Brazilian public procurements between 2005-2021, we document a widespread pattern that the lowest bidder ("kamikaze") does not satisfy required formalities after the auction is concluded, which allows the second-lowest bid to win the auction. Such a pattern can be observed in up to 15-20% of procurement auctions and results in 15-17% higher procurement prices as compared to similar auctions procuring the same product or service items, organized by the same government institutions, and even having the same winning firm. Kamikaze firms are smaller, younger, and tend to be co-owned by the same ultimate owner as the winning firm. Using observed kamikaze behaviour as a marker, we aim to measure how higher procured prices contribute to real outcomes by public service providers by reducing the budget available for sourcing other items. Taking the case of hospital mortality data, we see an increased number of deaths in the four quarters after an increased fraction of procurement auctions involving kamikazes.

Keywords: procurement auctions, bid-rigging, shared ownership, non-market collusion outcomes

JEL Classification: G34, G38, L22, L41

Governments spend significant resources purchasing goods and services from private companies.[1] Due to concerns of inefficiency and corruption, regulators usually encourage the use of competitive auctions in public purchases to minimize the likelihood that public officials can affect the procurement outcome and direct award public contracts to their favorite firms (Transparency International, 2015). While auctions are thought to be efficient since they award the contract to the lowest bidder, private agents can rig the procurement process. For example, participants can collude to drive up their revenue from supplying goods or services to the public sector, a process known as bid-rigging (OECD, 2009) Among many inefficiencies resulting from bid rigging, financially constrained governments that overspend on rigged procurements might have to save remaining resources and could end up providing lower quality of overall public services.

Quantifying such negative externalities of bid rigging on the quality of public services is challenging as, apart from the judicially prosecuted cases, outsiders do not observe most of the bid rigging cases. Using granular auction data on about 15 million distinct item purchases in public procurements in Brazil between 2005 and 2021,[2] this paper documents one unique widespread pattern that we attribute to bid-rigging motives and we later use as a "bid-rigging marker" to study how financial constraints endogenous to collusion affect real outcomes, such as health quality in Brazilian public hospitals, and road quality in Brazilian highways.

In Brazil's electronic first-price open auctions, the country's predominant procurement auction method, we observe that the lowest bidder ("kamikaze") often drops out from the auction after the auction is concluded (e.g., by not satisfying certain formalities), which allows the second-lowest bid to win the auction. Such a pattern can be observed in up to

[1] Public procurements constitute 12% of the global GDP (Bosio et al., 2022).

[2] Auction data comes from ComprasNET, the electronic portal where procurements are conducted, and allows us to observe detailed information on the auction: items, bidders, their bids, and bid timing. The data covers 4.8 thousand government institutions purchasing 139 thousand distinct items and services. We observe 7 bidders per auction and 4.7 bids per average bidder. We match participant data to firm data from the Registry such as the firm's location, industry, and owners.

15-20% of procurement auctions in Brazil over our sample period.[3] On average, kamikazes' bids are 30% lower than the winners' bids in the same auctions.

We first ask whether such pattern results in worse procurement outcomes such as higher product prices that the government pays for acquiring the goods and services. If such behavior is non-strategic (e.g., happens by accident or smaller firms mis-estimate their costs and/or capacities to deliver the products), firms' bidding strategy should not depend on the bid of others, and the second-lowest bidder price should not be different from the price for the same item in similar procurements.

We observe that procurement prices are 15-17% higher when we observe the kamikaze pattern, i.e., when we observe that the lowest bidder drops out from the auction and the second-lowest bidder wins. Our result is identified after comparing kamikaze procurements to other auctions that involve exactly the same products and services being purchased (i.e., controlling for item x year fixed effects), the same number of bidders (i.e., controlling for the number of participants x year fixed effects or even item x number of participants x year fixed effects), and the same public buyers (i.e., government institution x year fixed effects).

Yet procurements with and without kamikaze firms can still have different prices because the winners of these procurements are firms with different types. For example, such over-pricing could be explained if winners of kamikaze procurements are, by chance, less efficient than those in non-kamikaze procurements. However, when we condition on auctions having the same eventually-winning firm, we still find significant overpricing when such win comes after the other firm drops out from the auction as compared to when the winning firm is the lowest bidder itself.

In such auctions with kamikazes, we observe fewer bids by other participants than in the comparable auctions and the bids by other bidders exhibit lower dispersion in the dol-

[3]Such practice has also been cited in other jurisdictions. For example, Antitrust Primer by Department of Justice (2021) mentions that "in some schemes, a low bidder will agree to withdraw its bid in favor of the next low bidder in exchange for a lucrative subcontract that divides the illegally obtained higher price between them."

lar values of bids, suggesting less aggressive competitive strategies. In addition, the more aggressive the kamikaze is itself, i.e., the lower is its eventually forfeited bid, the higher is the overpricing when we compare the winning bid to similar auctions. We also see similar patterns if there are multiple kamikazes involved in the auction. These findings suggest that the kamikaze strategy could act as an intimidation signal to other competitors about the commitment of the bid-rigging cartel to winning the said auction.

We further look at the characteristics of the kamikaze firms. Comparing firms participating in the same procurements and bidding for the same individual product item, we find kamikaze firms to be smaller and younger than the winning firms, and we also find that both kamikaze and winner tend to be based in the same geographic area. We also observe that kamikaze firms and the eventual bid winners within the procurement are more likely to share the same ultimate owners than they do with other procurement participants. This shared ownership allows these firms to coordinate more effectively in pursuing coordinated strategies and driving up product prices, thus providing more direct evidence that linked winner and kamikaze firms likely engage in the bid rigging behavior.

Further, we observe little bid rotation as firms tend to adopt constant roles in coordinated strategies. We find that previous kamikaze firms are less likely to win and more likely to continue adopting the kamikaze strategy in the future, while the previous winners in kamikaze procurements are more likely to continue winning, especially when there is another kamikaze firm. This complements our previous evidence that shows that these firms are more likely to be connected via common owners or geographical proximity, suggesting that they have other ways to reward kamikaze firms for their anti-competitive behavior.

Our findings also indicate that kamikaze procurement practices can place financial strain on government institutions. Institutions that experience kamikaze behavior are less likely to make purchases of the same product or service in the following quarters. Overspending due to kamikaze can negatively impact future public budgeting and potentially hinder the ability of these agencies to provide essential services to the public.

We further use observed kamikaze behaviour as a marker/filter to measure how much higher procured prices contribute to real outcomes in two of the main types of public services, namely public healthcare and highway infrastructure. We argue that such financial constraints arising endogenously from collusion could likely have negative externalities on the quality of public services provision.

First, we investigate the impact of kamikaze pcorurements on hospital mortality rates by examining the purchase of essential medicines. We take information from 61 federal hospitals in Brazil and compare the death rates in hospitals that acquire medicines for the same disease and in the same quarter, but with different incidences of kamikaze firms. We see an 10% increase in the hospital mortality rate after the purchase of essential medicines in hospitals whose procurement of essential medicines involved the kamikaze strategic behaviour.

As a second piece of evidence suggesting the real effects of bid-rigging, we investigate the incidence of traffic accidents after road maintenance/repair contracts are awarded in procurements with and without kamikaze behaviour. Roads awarded to firms in kamikaze procurements experience 13.5% increase in road accidents and 11.5% in victims after the contract is awarded. This effect is robust to comparing road repairs with similar complexity.

These results suggest that overpricing in government auctions could reduce the budget available for sourcing other items and result in serious negative non-market effects.

Our findings suggest that for financially constrained government institutions bid-rigging could reduce budgets available for other procurement auctions and thus reduce the quality of public services provision. These results also bring to the attention one particular coordination strategy that firms frequently use and that is associated with significant overpricing. They also provide support for Kumar et al. (2015), who suggest that one reason why firms exist is to give the impression of competition in public procurements.

Our paper primarily relates to the literature on cartel detection (e.g. Porter and Zona, 1993, 1999; Bajari and Ye, 2003; Chassang et al., 2022) by studying one particular observable mechanism of how firms engage in bid rigging behavior. We refrain from rationalizing the

market equilibrium whether such behavior when the lowest bidders consistently remove themselves from the auction is sustainable in a dynamic game with other bidding participants, or which policy interventions would attenuate the prevalence of these strategies. Instead, we use this observed kamikaze behavior as the marker to study the non-market outcomes, such as hospitalization, as a way to quantify the broader real outcomes resulting from firm collusion and participation in the procurement auctions at large. With this we also relate to the studies on broader macroeconomic implications and other externalities resulting from public procurement auctions such as firm growth (Ferraz et al., 2022), productivity (di Giovanni et al., 2022), and healthcare assess (Barkley, 2023).

Previous public procurement literature has looked at abnormally low tenders and the defaulting winners (e.g. Spulber, 1990; Zheng, 2011; Decarolis, 2014). For example, the European Commission (2002) mentions that *"contractors who intentionally submit abnormal tenders might be those who seek an ex post renegotiation of the terms of the contract. They could also be firms in bad financial conditions that, however, are either reluctant to lay off their employees or are in search of a contract in order to obtain a cash advance from their client or bank"*. In our case, we study how such non-winning lowest bids in the public procurements are exploited strategically, possibly as part of the bid rigging process rather than occur due to misestimation of the cost components or a failed strategy of the expected contract renegotiation.

Finally, as we observe that the coordination is particularly prevalent in the cases where the winning firm and the kamikaze share ultimate owners, we relate to the finding in Charoenwong and Asai (2020) that shared ownership networks are positively associated with higher contract prices in public procurement auctions.[4] We study one particular mechanism—kamikazes—how the coordination via shared ownership can be implemented in the public procurements.[5] In addition, related to the broader corporate ownership implications, we

[4]Also, see Schmalz (2021) for a recent review of the literature of common ownership and industrial organization.

[5]Note that since 2014 the auctioneers using Brazil's ComprasNET electronic system can observe the

provide new evidence of how firm ownership can affect patient health outcomes (e.g. Eliason et al., 2019; Gupta et al., 2021; Ashtari Tafti and Hoe, 2022; Liu, 2022; Schmalz and Xie, 2022).

1 Data

The main dataset comes from the ComprasNET portal. It is an electronic platform for government institutions to conduct procurements. As such, it contains information on the universe of federal public procurements in Brazil since 1996. This information includes procurement outcomes, descriptions of the items purchased, and the bidding history of each auction. In the end, the data includes 4.8 thousand government institutions purchasing 139 thousand distinct items and services in 15 million auctions from September 2005 to August 2021. Average auction in the data had, on average, seven participants, and these participants made 4.7 bids each. All in all, the dataset contains about 450 million distinct bids.

We classify items as the interaction of their official government registry – i.e., *Cadastro dos Materiais* (CADMAT) for products and *Cadastro dos Serviços* (CADSER) for services – with the unit of measurement in which they are purchased. Table A1 in the Internet Appendix provides an example list with selected products and services in the sample.

Table A2 presents a selected list of government institutions present in the database. Figure 1 plots the number of government institutions per municipality in Brazil. Out of the 5,500 municipalities, government institutions in the dataset are present in about 1,049 distinct municipalities. The municipalities with the most government agencies are Brasília (381), followed by the Rio de Janeiro (373), Belém (172), and São Paulo (167). Figure 2 plots the number of distinct participants per municipality. The municipalities with the most number of participants are São Paulo (10,108), Brasília (8,503), Rio de Janeiro (8,371), and Belo Horizonte (4,684).

ultimate ownership structures of the auction participants. Such information is not observable to other auction participants.

We also use a couple of secondary datasets for our analysis. First, we gather firms' registry data from the *Receita Federal*. This dataset contains information on firms' location, industry, and legal structure, among other data, for the universe of Brazilian firms. The firm registry is used to identify the characteristics of non-winning lowest bid firms and firms that are awarded public contracts in procurements where they were not the lowest bid. Second, we take data on hospital deaths in Brazil from DataSUS, a publicly available dataset on the healthcare performance of hospitals that serve patients through the Brazilian Unified Health System (*Sistema Unificado de Saúde - SUS*). This information on hospital deaths in Section 3.4 is used when we discuss the real effects of the kamikaze behavior in public procurements.

Table 1 presents the summary statistics of the main outcome variables used in the paper.

2 Institutional Background

Procurements for common goods and services in Brazil are mainly held by two main procedures. The first one is the bid waiver (i.e., *Dispensa de Licitação*), where purchases are made without the need for competitive bidding. Because of the fear that bid waivers may give too much discretion to public officials, this procedure is only allowed on special occasions such as for small-value purposes, emergency situations, or lack of competitors. It accounts for about 45% of the total value purchased as of 2019.[6] For all the other purposes, competitive bidding is used (i.e., *Pregão Eletrônico*). In this procedure, the lowest bidder wins and is awarded the public contract to sell goods and services to the government. Auctions account for about 50% of the total value purchased as of 2019.

A government institution must go through several stages to purchase items via auctions. Initially, it must get regulatory approval for the purchase in question. After the clearance is obtained, they write down a detailed notice, explaining the item(s) demanded, as well as clarifying the other proceedings of the auction. The government institution then makes this

[6]See Portal da Transparência (https://portaldatransparencia.gov.br/licitacoes?ano=2019).

notice public and collects proposals from potential bidders until the date when the bidding is going to take place, as specified by the notice. These proposals are then evaluated to see if they are in line with what has been asked by the government institution. Bidders from the approved proposals are then authorized to participate in the bidding stage. The bidding is made electronically on the ComprasNET portal. While bidders cannot observe the identities of others, they can observe the other bids being made. The first bid is defined as per initial proposal. Once the bidding stage starts, the bidders can decide whether to propose another bid, which must be lower than the bidder's previous bid, but that can be larger than the lowest overall bid at that moment. After some time, the bidding stage ends, and the auctioneer declares the winner as the participant that offered the lowest bid.

The winner is then asked to submit approval documents (e.g., documents that prove that the firm is in order). If the required documents are accepted, the winner is approved by the auctioneer, the public contract is signed, and the procurement ends. If, however, the winner fails to deliver the documents, or they are not in order, then the winner is disqualified, and the second-lowest bidder is declared the winner. This process is repeated until the winner is approved by the auctioneer. When this happens, then the public contract is signed, and the procurement ends.

In this paper, we study these situations in which the original winner(s) do not win because they fail to be approved after the bidding ends. While such failure to deliver these documents may be an honest mistake or be a result of cost mis-estimation, Brazilian regulators and monitors suspect that participants exploit this as part of a bid-rigging process. This suspicion is amplified by the fact that these non-winning lowest bidders often have bids that are much lower than the second-lowest bid. According to the Brazilian federal audit institution *Tribunal de Contas da União* (TCU), the main goal of such a behavior is to "scare" off potential competitive bidders away.[7] Because of these characteristics, policy makers and

[7]TCU's sentence no. 1793/2011 paragraph 69 argues that *"it is possible that there are companies reducing prices in order to discourage the participation of other bidders in the bidding stage, later withdrawing from the bidding to benefit another company that is participating in the collusion, which, in turn, ends up being*

industry professionals in Brazil call these bidders "kamikaze" firms.

Using data from ComprasNET, we find that such a pattern is relatively common. In Figure 3, we plot the dollar value of the fraction of auctions with kamikaze in Brazil semiannually between 2005-2021. We see that up to 15-20% of procurement auctions in Brazil can be considered as having a kamikaze firm. In addition, we find that kamikaze firms' bids are, on average, 30% lower than the winners' bids in the same auctions (Figure 4), confirming the aggressive bid behavior of these to-be-forfeit bids.

If such behavior is frowned upon, why does it still persist? In fact, Federal Law No. 10,250/2022 in its Article 7 says that *"Whoever ... fails to deliver or present false documentation required for the bidding process ..."* may be banned from participating in public procurements for a maximum of five years. While such a threat could curb some firms from engaging in foul play, in practice such punishments are rarely given. Based on the official data of the 83 thousand firms that do not win even with the lowest bid, only 13 thousand, or 15%, are eventually punished for this behavior. Conditional on being penalized for this behavior, these firms are banned from participating in federal public procurement by a median of 180 days, significantly less than the maximum of five years allowed by law.

According to the TCU, the lack of enforceability of the law is partially explained by government institutions not having enough manpower to go ahead with administrative processes against every firm that does not follow the auctions rules by the book.[8] Another possible reason for the lack of severe punishment is that the law in Brazil follows a "proportionality principle" in which misdemeanors should be punished less than more severe offenses. Thus, corporate lawyers tend to argue that in the absence of proof of willful misconduct, firms should not be severely punished for not fulfilling all the stages of the auction as it could have been a good-faith mistake. Severe punishments would not only be unfair to the firm in question but could also potentially reduce the number of potential competitors in future

hired without having presented the best proposal, thus causing damage to the Administration."

[8]See TCU's sentence no. 1793/2011, paragraph 90.

auctions, leading to overpricing.

3 Empirical Analysis

This section discuss the empirical methodology and their results. We first present the results on whether auctions with kamikaze firms are associated with higher product prices than the similar auctions. We then explore the heterogeneity of the effect based on the observed kamikaze behavior. We next study the characteristics of the kamikaze firms and the dynamics of kamikaze behavior. We conclude with a discussion of how kamikaze behavior is related to real non-market outcomes, such as health outcomes in public hospitals, or the number of accidents on federal highways.

3.1 Overpricing

We first study whether auctions that present "kamikaze" behavior have different outcomes than other similar auctions. Kamikaze behavior happens when the lowest bid firms do not win the procurement, because they either fail to deliver documents, or are disqualified due to inconsistencies. While this behavior raises suspicions of foul play, it may also be non-strategic (e.g., it happens by accident or smaller firms mis-estimate their costs and/or capacities to deliver the products). In the latter scenario, firms' bidding strategy should not depend on the bid of others, and the second-lowest bidder price should not be different from the price for the same item in similar procurements. Thus, we should not expect differences in procurement outcomes.

We implement the following specification:

$$y_{ipt} = \alpha_{pt} + \alpha_{X_i t} + \beta \cdot HasKamikaze_{ipt} + e_{ipt} \tag{1}$$

Has Kamikaze$_{ipt}$ equals to 1 if a firm has the lowest bid, but does not win procurement i

for product p in year t, and 0 otherwise. y_{ipt} is the log of the price of item p procured in procurement i at time t. α_{pt} is a item-year fixed effects; $\alpha_{X_i t}$ are interactions of procurement i characteristics (X_i) and year fixed effects such as # of participants x year fixed effects and government institution x year fixed effects.

Table 2 presents the results when the outcome variable is the log of prices. Column I shows that purchases in auctions with kamikaze firms have 16.9% higher prices for the same item purchased and for procurements with the same number of participants. Column II compares auctions by the same government institution. In this case, the coefficients drops slightly to 15%. Finally, column III further saturates the specification by comparing procurements with for the same item-number of participants-year and procurements with the same government institution-year. The coefficient is virtually unchanged, i.e., 15%. Additionally, Figure 5 shows that the overpricing of kamikaze is consistently above 12% across all years in the sample. Overall, it seems that the kamikaze behavior leads to significant overpricing compared to similar procurements.

While prices are higher for procurements with kamikaze firms, one may ask why such an outcome arises. Table 3 shows how the bidding behavior changes in procurements with versus without kamikaze firms. Columns I to III show that there are, on average, 2 to 2.2 fewer bids per bidder in the presence of kamikaze firms. Columns IV to VI shows that the standard deviation across all the bids within an auction are 18-21 percentage points (relative to its mean) lower in kamikaze procurements. All in all, these results suggest that kamikaze firms are successful in curbing competition by decreasing the number of bids as well as the aggressiveness of non-kamikaze bidders.

One potential alternative explanation for the differences in outcomes might be differences in characteristics of the winners in kamikaze versus non-kamikaze procurements. If winners are more inefficient in the former than in the latter, than this might explain why prices are higher. We address this concern by comparing procurements with the same winner in Table 4. Once we add winner fixed effects, we still find evidence of overpricing, but the

magnitude of the coefficient drops by half to about 8% (columns I and II). Number of bids by bidder decreases by about 1.7 (columns III and IV) and the volatility of the bids decreases by 17 percentage points (relative to its mean) in columns V and VI. Overall, while kamikaze firms seem to lead to more inefficient winners, we find that the overpricing still persists significantly when we compare procurements with the same eventual winner.

3.2 Heterogeneous Effects

We now study the heterogeneity of the effect based on the observed kamikaze behavior. If the kamikaze behavior successfully affects procurement outcomes, one would expect that these consequences are higher when this behavior is more aggressive (*intensive margin*), or there are more firms using this strategy in the same auction (*extensive margin*).

Table 5 presents the results interacting the *Has Kamikaze* dummy with dummies based on how much lower the kamikaze bid was relative to the winning bid. Results in column I show that the lower the bid, the higher the resulting overpricing of the procurement. This result is consistent with the intimidation by kamikaze firms. The lower the bid, the less likely potential competitors will continue bidding. As a result, the second lowest bid is going to be much higher than what it should be in the absence of kamikaze firms.[9]

Table 6 presents the results interacting the *Has Kamikaze* dummy with dummies reflecting the buckets of the number of kamikaze firms in the particular auction. Indeed, the same auction can have multiple kamikaze firms that do not submit the required documents after the auction. These kamikaze firms could be part of the same coordinated group or come from competing groups. Results paint a similar picture to the intensive margin results. We see that the higher the number of kamikaze firms, the more overpriced the outcomes of the auction, the lower the number of bids per bidder, and the less volatile the bid values within

[9]Note that this effect is not mechanical as we are not comparing kamikaze bid with the winning bid but we are comparing the winning bid in an auction with kamikazes with a winning bid in similar auctions—after controlling for the same item-year, number of participants-year, and same government institution-year fixed effects—without kamikazes.

the auction. All in all, these results suggest that multiple kamikaze firms signal a more committed strategy (and are likely coordinating between themselves) that leads to an even larger overpricing.

3.3 Characteristics and Dynamic Roles of Kamikaze Firms

One question that arises from these findings is: who are these kamikaze firms? What are their characteristics? And are they connected to the winning firm in any way? We next study the characteristics of the kamikaze firms and the dynamic roles of kamikaze behavior.

3.3.1 Firm Characteristics

To test this, we take information on firm characteristics from a Brazilian firm registry *Receita Federal*. This information includes the firm's age, size, location, and owners. The specification we are going to estimate is as follows:

$$y_{ipj} = \alpha_{ip} + \beta X_{ipj} + e_{ipj} \tag{2}$$

where y_{ipj} is either the p(kamikaze$_{ipj}$)—a dummy equal to 1 if bidder j at procurement i for item p is a kamikaze firm and zero otherwise—or (win$_{ipj}$)—a dummy equal to 1 if bidder j at procurement i for item p is the winner and zero otherwise. The main explanatory variables, X_{ipj} are firm characteristics at the procurement i, item p, and firm j level. This specification adds procurement-item fixed effects, which effectively compares the characteristics of firms participating in the same auction.

Table 7 presents the results. Columns I and II shows that, relative to other participants, opaque firms are more likely to be kamikaze. Also, firms that were created less than three years ago are 3.24% more likely to engage in the kamikaze strategy than other firm participants. Finally, cmall firms are 3.89% more likely to be kamikaze firms.

Columns III to VII provide characteristics of winners in kamikaze procurements. We

see that young and small firms are 1.68% and 5.32% less likely (columns III and IV) to be winners compared to other participants. In columns V to VII, we only focus on the non-kamikaze participants in auctions with kamikazes. Our explanatory variables are then the dummies that firm j is from the same municipality (column V), is from the same zip code (column VI), and has the same owner (column VII) as the kamikaze firm in procurement i and item p.

We find that winning firms are more likely to be connected to kamikaze firms relative to other participants in the procurement. Those participants that are from the same municipality or the same zip code as the kamikaze firm are 3.17% and 8.51% more likely to win the procurements in the auctions with kamikaze firms.

More importantly, we observe shared ownership structures between kamikazes and winning firms. Those participants that have at least one owner in common with the kamikaze firm are 6.91% more likely to win the procurements. This finding provides the most direct evidence on the possible ex ante coordination between winners and kamikaze firms.[10]

3.3.2 Kamikazes and Shared Ownership

Since kamikaze firms are more likely to share owners with the potential winners, we study a follow-up question of the interactive effect of an auction having both kamikaze firms and firms with common owners. Table 8 presents the results. From columns I to III, one can see that procurements with common owners and kamikazes are 3.5-6.3% more overpriced than procurements with kamikaze firms but without common owner firms. This effect represents 23%-42% of the unconditional effect of having a kamikaze firm in an auction. These results that overpricing is larger in those cases when kamikaze and winning firms are linked via shared ownership give the most direct evidence of the potential coordination in actions between these sets of firms.

[10] One alternative explanation could have been that kamikaze firms do not coordinate their behavior with the winning firms ex ante but "blackmail" them ex post. The overpricing then could reflect anticipated side payment to the kamikaze firm.

3.3.3 Dynamic Roles

How do kamikaze firms coordinate with the winners? Are they more likely to switch positions in different auctions or do they adopt constant roles in these strategies? To study the dynamics of the roles that kamikaze and winning firms take, we investigate whether firms that engaged in kamikaze strategies in some auctions are more or less likely to continue engaging in this strategy in other auctions.

We initially consider whether firms switch across different procurements. To do that, we run the following regression:

$$y_{ipjt} = \alpha_{ip} + \beta_1 \cdot X_{jt} + e_{ipjt} \tag{3}$$

where y_{ipjt} is an outcome for procurement i, product p, firm j and time t: the probability that firm j is a kamikaze firm in procurement i to purchase item p at year t and 0, otherwise (columns I to III), and the probability that firm j was a winner of procurement i, item p at year t, and 0 otherwise (columns IV to VII). X_{jt} is either *Was Kamikaze*$_{j,t-1:t-12}$ or *Was Winner in Kamikaze Procur*$_{j,t-1:t-12}$. Was Kamikaze$_{j,t-1:t-12}$ is a dummy equal to 1 if firm j was a kamikaze firm in another procurement in the past 12 months. Was Winner in Kamikaze Procur$_{j,t-1:t-12}$ is a dummy equal to 1 if firm j was a winner in procurement in the past 12 months with the presence of a kamikaze firm.

Table 9 shows the results. Column I shows that firms that were engaging in a kamikaze strategy in the previous year are more likely to continue doing so in the focal procurement. In addition, winning firms in kamikaze procurements in the previous year are less likely to engage in kamikaze themselves in the focal procurement (column II). This result suggests that firms adopt constant roles in their coordinating strategies. Columns III and IV show that previous winners in kamikaze procurements are more likely to continue winning. This, however, could be explained by the fact that these firms are indeed the best providers of goods and services and thus have a higher unconditional probability of winning. Columns VI and

VII, then, remove those firms from the control group that did not win in any procurement in the past year. We see consistent results. In column VII, we see that past winners in kamikaze procurements are particulalry more likely to win in those procurements that also have the observed kamikaze behavior.

We also test switching within the same procurement, but across different items purchased in the same procurement. We implement the following specification:

$$y_{ipjt} = \alpha_{ip} + \beta_1 \cdot X_{ip^*jt} + e_{ipjt} \tag{4}$$

where y_{ipjt} is an outcome for procurement i, product p, firm j and time t: the probability that firm j is a kamikaze firm in procurement i to purchase item p at year t and 0, otherwise (columns I to III), and the probability that firm j was a winner of procurement i, item p at year t, and 0 otherwise (columns IV to VII). X_{ip^*jt} is either *Was Kamikaze*$_{ip^*jt}$ or *Was Winner in Kamikaze Procur*$_{ip^*jt}$. Was Kamikaze$_{jp^*j}$ is a dummy equal to 1 if firm j was a kamikaze firm in procurement i purchasing product $p^* \neq p$. Was Winner in Kamikaze Procur$_{ip^*jt}$ is a dummy equal to 1 if firm j was a winner in procurement i purchasing product $p^* \neq p$.

Table 10 shows the results. The findings are very similar to the ones found across procurements: kamikaze firms in some auctions are less likely to win auctions of other auctions of the same procurement, and winners of some auctions with kamikaze are more likely to win other auctions, specially when these other auctions also have a kamikaze firm.

3.4 Real Effects

This paper finds that the kamikaze behavior has a strong effect on prices of items purchased by government institutions. We further discuss how kamikaze behavior is related to real non-market outcomes. In particular, we first show that purchasing more items in kamikaze procurements leads to higher financial strain on government institutions by affecting the

likelihood that the same item will be purchased in the future. We then study whether this is associated with the negative effects in the public service provision in the context of medical sector.

3.4.1 Institution Budgets

To understand how kamikaze affects future public purchases of the same product, we estimate the following specification:

$$ln(q)_{ap,t+1:t+4} = \alpha_{ap} + \alpha_{pt} + \beta \cdot \$KamikazeProcur(as\%of\$Procur)_{apt} + e_{apt} \quad (5)$$

where the independent variable $KamikazeProcur(as\%of\$Procur)_{apt}$ is the fraction of total value purchased in procurements with kamikaze firms as a fraction of total procured by institution a for item p at year t. The dependent variable is the log of total quantity purchased by institution a for item p during the following 4 quarters.

Column I of Table 11 shows that the higher the value purchased of item p by institution a at year t in kamikaze procurements, the lower quantity purchased for the same item in the subsequent year. Column II shows that the probability of that the institution will initiate another purchase also decreases in the following year. Overall, it seems that kamikaze procurements can affect the likelihood of future purchases due to the rigid budget constraints.

3.4.2 Real Outcomes: Hospital Mortality

We analyze data on hospital mortality for 61 federal hospitals in Brazil obtained from Data-SUS . We then investigate how kamikaze auctions affect the health outcomes of these hospitals. For each purchase of medicine in kamikaze procurements we select all the non-kamikaze procurements of essential medicines for the same disease and month of purchase as control. We then stack these events and compare health outcomes the date of purchase in a "stacked"

DID[11] approach as follows:

$$y_{iet} = \alpha_{ie} + \alpha_{et} + \beta Kamikaze_{ie} \cdot Post_{et} + e_{iet} \tag{6}$$

where y_{iet} refers to the mortality rate of hospital i in event e at time t. Kamikaze$_{ie}$ is a dummy equal to one if the procurement in hospital i for event e is a kamikaze procurement and zero otherwise. Post$_{et}$ is a dummy equal to one after the purchase in event e and zero otherwise.

Table 13 shows the results for this specification. In column I, we can see that kamikaze procurements of essential medicines lead to a 0.31 p.p. higher mortality rate for the particular cause. Columns II and III show that the increase in mortality only happens in non-terminal diseases. This result points out that the purchase of overpriced essential medicines tend to increase the mortality rate, especially for those diseases that could be prevented by the purchase of more essential drugs. Finally, column IV shows that among the main preventable death causes, kamikaze procurements increase the mortality rate by 0.74 p.p.

One concern when comparing hospitals that experienced a kamikaze procurement against those that did not is that the trends in the outcome variable are different pre-treatment. In Figure 6, we provide a visual representation of the effect of kamikaze procurements on hospital mortality. The graph shows that the effect on mortality only comes after the purchase in question. Before the purchase, treated and control hospitals seemed to follow a similar trend.

Overall, these findings suggest that for financially constrained government institutions bid-rigging could reduce budgets available for other procurement auctions and thus reduce the quality of public services provision.

[11] Stacked Difference-in-Differences is a method that helps addressing the recently pointed out limitations of staggered DID (Deshpande and Li, 2019; Baker et al., 2022). These limitations involve including as controls observations that are already treated or eventually treated in the analysis. In the stacked DID, we avoid this issue by only keeping controls firms that are treated during the event window.

3.4.3 Real Outcomes: Road Accidents

In addition to hospital mortality, we also look at another real outcome of kamikaze procurements: road quality. We take information from 952 road repair procurements and compare road quality outcomes around these road repairs. For each road repair kamikaze procurement, we select non-kamikaze road repairs awarded in the same month. We then run the following regression in a "stacked" DID approach similarly as in equation (6) above.

Table 12 shows the results for this specification. In column I, we can see that road repair contracts awarded in kamikaze procurements are associated with a 13.5% higher number of accidents and a 11.5% higher number of victims, respectively. This result is robust to controlling for differences in the extension of these road repairs in km, as seen by the almost identical coefficients in columns II and IV. Figure 7 shows that the effect on accidents only comes after the purchase and that there are no clear differences nor trends before.

4 Conclusion

This study presents evidence of a prevalent bid-rigging tactic that results in excessive pricing in first-price open bid auctions. In the kamikaze strategy, bidders intentionally submit low bids to deter competitors, but then purposely give up the contract so that the second-lowest bidder is declared the winner. This pattern can be observed in up to 15-20% of procurement auctions in Brazil and leads to a 15-17% increase in prices paid. We also find that the ultimate winner and the kamikaze firm are more likely to be located in the same zip code and more likely to share a common owner. In the end, this bid-rigging behavior results in government institutions overspending and negatively impacting the quality of public services, as demonstrated by higher mortality rates in hospitals that purchase more overpriced items due to this tactic.

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Table 1: *Summary Statistics*

	n	mean	std dev	min	median	max
	I	II	III	IV	V	VI
ln(price)	14,967,474	3.11	2.32	-2.30	3.00	9.40
# Participants	14,967,474	6.84	5.51	1	5	165
No. Kamikaze firms	14,967,464	0.36	1.10	0	0	54
# bids per bidder	14,913,088	4.12	5.41	0.50	2.00	32.67
$\sigma(bid)/\overline{bid}$	14,913,075	0.75	0.98	0.00	0.41	5.35

Table 2: *Kamikaze Firms and Procurement Outcomes: Prices*

	$\log(\text{price})_{ipt}$		
	I	II	III
Has Kamikaze$_{ipt}$	0.1690***	0.1497***	0.1501***
	(0.0079)	(0.0060)	(0.0056)
Obs	14,967,464	14,967,464	14,967,464
R^2	0.865	0.870	0.890
Item*Year FEs	Yes	Yes	
# of Participants*Year FEs	Yes	Yes	
Gov Institution*Year FEs		Yes	Yes
# of Participants*Item*Year FEs			Yes

This table compares outcomes of procurements with and without the presence of Kamikaze firms. Kamikaze firms are those that have the lowest bid but do not win the procurement because it does satisfy the final formalities to be declared the winner. We implement the following specification:

$$y_{ipt} = \alpha_{pt} + \alpha_{X_i t} + \beta \cdot HasKamikaze_{ipt} + e_{ipt}$$

Has Kamikaze$_{ipt}$ equals to 1 if a firm has the lowest bid, but does not win procurement i for product p in year t, and 0 otherwise. y_{ipt} is the log of the price of item p procured in procurement i at time t. α_{pt} is a item-year fixed effects; $\alpha_{X_i t}$ are interactions of procurement i characteristics (X_i) and year fixed effects such as # of participants x year fixed effects and government institution x year fixed effects. Column I adds Item-Year and # of Participants*Year fixed effects, effectively comparing procurements with the same item purchased and the same number of participants in the same year. Column II also includes Gov Institution-Year fixed effects. Finally, column III includes Gov Institution*Year and # of Participants-Item-Year fixed effects. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 3: *Kamikaze Firms and Procurement Outcomes: Bidding Competition*

	# bids per bidder$_{ipt}$			$\sigma(bid)/\overline{bid}_{ipt}$		
	I	II	III	IV	V	VI
Has Kamikaze$_{ipt}$	-2.230***	-1.986***	-2.005***	-0.2124***	-0.1910***	-0.1875***
	(0.0298)	(0.0272)	(0.0279)	(0.0066)	(0.0052)	(0.0046)
Obs	14,913,078	14,913,078	14,913,078	14,913,065	14,913,065	14,913,065
R^2	0.195	0.241	0.368	0.363	0.429	0.573
Item*Year FEs	Yes	Yes		Yes	Yes	
# of Participants*Year FEs	Yes	Yes		Yes	Yes	
Gov Institution*Year FEs		Yes	Yes		Yes	Yes
# of Participants*Item*Year FEs			Yes			Yes

This table compares outcomes of procurements with and without the presence of Kamikaze firms. Kamikaze firms are those that have the lowest bid but do not win the procurement because it does satisfy the final formalities to be declared the winner. We implement the following specification:

$$y_{ipt} = \alpha_{pt} + \alpha_{X_i t} + \beta \cdot HasKamikaze_{ipt} + e_{ipt}$$

Has Kamikaze$_{ipt}$ equals to 1 if a firm has the lowest bid, but does not win procurement i for product p in year t, and 0 otherwise. y_{ipt} is the average number of bids per bidder of log of procurement i for item p at time t (columns I to III) and the ratio of the standard deviation of the bid value to the average bid value (columns IV-VI). α_{pt} is a item-year fixed effects; $\alpha_{X_i t}$ are interactions of procurement i characteristics (X_i) and year fixed effects such as # of participants x year fixed effects and government institution x year fixed effects. Columns I and IV add Item-Year and # of Participants*Year fixed effects, effectively comparing procurements with the same item purchased and the same number of participants in the same year. Columns II and V also include Gov Institution-Year fixed effects. Finally, columns III and VI include Gov Institution*Year and # of Participants-Item-Year fixed effects. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 4: *Kamikaze Firms and Procurement Outcomes: Controlling for the Same Winner*

	$\log(\text{price})_{ipjt}$		# bids per bidder_{ipjt}		$\sigma(bid)/\overline{bid}_{ipjt}$	
	I	II	III	IV	V	VI
Has Kamikaze_{ipt}	0.0808***	0.0774***	-1.818***	-1.738***	-0.1573***	-0.1494***
	(0.0037)	(0.0031)	(0.0344)	(0.0389)	(0.0071)	(0.0061)
Obs	14,965,878	14,965,878	14,911,492	14,911,492	14,911,479	14,911,479
R^2	0.935	0.936	0.633	0.648	0.764	0.783
Winner*Item*Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
# of Participants*Item*Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Gov. Institution*Year FEs		Yes		Yes		Yes

This table compares outcomes of procurements with and without the presence of Kamikaze firms. The main independent variable Has Kamikaze_{ipt} is a dummy equal to 1 if procurement i for item p at year t had a Kamikaze firm and zero otherwise. Kamikaze firms are those that have the lowest bid, but do not win the procurement because it does satisfy the final formalities to be declared the winner. The dependent variables are the log of the price for item p purchased in procurement i with winner firm j at time t (columns I and II), the average number of bids per bidder of log of procurement i for item p with winner firm j at time t (columns III and IV), and the ratio the standard deviation of the bid value to the average bid value (columns V and VI). Even columns add Winner*Item*Year – comparing procurements with the same winner, item and year – and # Participants*Item*Year fixed effects comparing procurements with the same number of participants, items, and year. Odd columns go a step further and also add Gov. Institution*Year FEs. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 5: *Kamikaze Firms and Procurement Outcomes: Effects by Kamikaze Intensity*

	$\log(\text{price})_{ipt}$			# bids per bidder_{ipt}			$\sigma(bid)/\overline{bid}_{ipt}$		
	I	II	III	IV	V	VI	VII	VIII	IX
Has Kamikaze_{ipt} (0% to 10% Discount)	0.0824***	0.0643***	0.0625***	-1.845***	-1.592***	-1.609***	-0.1603***	-0.1330***	-0.1318***
	(0.0062)	(0.0044)	(0.0038)	(0.0245)	(0.0241)	(0.0250)	(0.0057)	(0.0041)	(0.0036)
Has Kamikaze_{ipt} (10% to 25% Discount)	0.1723***	0.1484***	0.1509***	-2.834***	-2.540***	-2.559***	-0.2609***	-0.2358***	-0.2283***
	(0.0090)	(0.0067)	(0.0066)	(0.0405)	(0.0351)	(0.0372)	(0.0081)	(0.0065)	(0.0060)
Has Kamikaze_{ipt} (25% to 50% Discount)	0.3573***	0.3294***	0.3362***	-3.024***	-2.795***	-2.837***	-0.3240***	-0.3120***	-0.3065***
	(0.0131)	(0.0115)	(0.0127)	(0.0453)	(0.0381)	(0.0413)	(0.0084)	(0.0072)	(0.0066)
Has Kamikaze_{ipt} (50% to 100% Discount)	0.4574***	0.4430***	0.4548***	-2.488***	-2.405***	-2.488***	-0.2987***	-0.3090***	-0.3091***
	(0.0118)	(0.0103)	(0.0118)	(0.0327)	(0.0275)	(0.0284)	(0.0083)	(0.0074)	(0.0071)
Obs	14,967,464	14,967,464	14,967,464	14,913,065	14,913,065	14,913,065	14,913,065	14,913,065	14,913,065
R^2	0.865	0.870	0.891	0.196	0.243	0.369	0.364	0.430	0.574
Item*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	
# of Participants*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	
Gov Institution*Year FEs		Yes	Yes		Yes	Yes		Yes	Yes
# of Participants*Item*Year FEs			Yes			Yes			Yes

This table compares outcomes of procurements with and without the presence of Kamikaze firms. The main independent variable Has Kamikaze_{ipt} is a dummy equal to 1 if procurement i for item p at year t had a Kamikaze firm and zero otherwise. Kamikaze firms are those that have the lowest bid, but do not win the procurement because it does satisfy the final formalities to be declared the winner. I divide this variable into four based on how much the Kamikaze firm's bid was lower than the winning bid, i.e., 0% to 10%, 10% to 25%, 25% to 50%, and 50% to 100%. We interact The dependent variables are the log of the price for item p purchased in procurement i at time t (columns I to III), the average number of bids per bidder of log of procurement i for item p at time t (columns IV to VI), and the ratio the standard deviation of the bid value to the average bid value (columns VII to IX). Columns I, IV, and VII add Item-Year and # of Participants*Year fixed effects, effectively comparing procurements with the same item purchased and the same number of participants in the same year. Columns II, V, and VIII also include Gov Institution-Year fixed effects. Finally, columns III, VI, and IX include Gov Institution*Year and # of Participants-Item-Year fixed effects. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively. See captions of Table 2 and Table 3 for further details of the specifications.

Table 6: *Number of Kamikaze Firms and Procurement Outcomes*

	$\log(\text{price})_{ipt}$			# bids per bidder_{ipt}			$\sigma(bid)/\overline{bid}_{ipt}$		
	I	II	III	IV	V	VI	VII	VIII	IX
1 Kamikaze Firm_{ipt}	0.0993***	0.0853***	0.0861***	-1.799***	-1.582***	-1.601***	-0.1399***	-0.1239***	-0.1254***
	(0.0051)	(0.0039)	(0.0034)	(0.0218)	(0.0206)	(0.0213)	(0.0050)	(0.0037)	(0.0035)
2 Kamikaze Firms_{ipt}	0.2075***	0.1922***	0.1994***	-2.798***	-2.560***	-2.629***	-0.2655***	-0.2430***	-0.2440***
	(0.0082)	(0.0057)	(0.0054)	(0.0364)	(0.0325)	(0.0344)	(0.0077)	(0.0062)	(0.0058)
3 Kamikaze Firms_{ipt}	0.2965***	0.2770***	0.2916***	-3.154***	-2.915***	-3.028***	-0.3545***	-0.3361***	-0.3352***
	(0.0116)	(0.0088)	(0.0083)	(0.0478)	(0.0433)	(0.0467)	(0.0099)	(0.0084)	(0.0086)
4 Kamikaze Firms_{ipt}	0.3799***	0.3607***	0.3800***	-3.298***	-3.064***	-3.169***	-0.4230***	-0.3975***	-0.4041***
	(0.0153)	(0.0102)	(0.0108)	(0.0549)	(0.0477)	(0.0564)	(0.0129)	(0.0100)	(0.0102)
5+ Kamikaze Firms_{ipt}	0.5331***	0.5128***	0.5527***	-3.313***	-3.085***	-3.242***	-0.5300***	-0.5188***	-0.5175***
	(0.0231)	(0.0190)	(0.0238)	(0.0718)	(0.0622)	(0.0785)	(0.0154)	(0.0127)	(0.0148)
Obs	14,967,464	14,967,464	14,967,464	14,913,078	14,913,078	14,913,078	14,913,065	14,913,065	14,913,065
R^2	0.865	0.870	0.891	0.19661	0.24304	0.36930	0.364	0.430	0.574
Item*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	
# of Participants*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	
Gov Institution*Year FEs		Yes	Yes		Yes	Yes		Yes	Yes
# of Participants*Item*Year FEs			Yes			Yes			Yes

This table compares outcomes of procurements with and without the presence of Kamikaze firms. The main independent variables are dummies equal to 1 if the firm had 1, 2, 3, 4 or more than 5 Kamikaze firms in procurement i for item p at year t and zero otherwise. Kamikaze firms are those that have the lowest bid, but do not win the procurement because it does satisfy the final formalities to be declared the winner. I divide this variable into four based on how much the Kamikaze firm's bid was lower than the winning bid, i.e., 0% to 10%, 10% to 25%, 25% to 50%, and 50% to 100%. We interact The dependent variables are the log of the price for item p purchased in procurement i at time t (columns I to III), the average number of bids per bidder of log of procurement i for item p at time t (columns IV to VI), and the ratio the standard deviation of the bid value to the average bid value (columns VII to IX). Columns I, IV, and VII add Item-Year and # of Participants*Year fixed effects, effectively comparing procurements with the same item purchased and the same number of participants in the same year. Columns II, V, and VIII also include Gov Institution-Year fixed effects. Finally, columns III, VI, and IX include Gov Institution*Year and # of Participants-Item-Year fixed effects. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively. See captions of Table 2 and Table 3 for further details of the specifications.

Table 7: *Characteristics of Kamikaze Firms*

	p(kamikaze$_{ipj}$)		p(win$_{ipj}$)				
	I	II	III	IV	V	VI	VII
young firm$_{ipj}$	0.0324***		-0.0168***				
	(0.0031)		(0.0015)				
small firm$_{ipj}$		0.0389***		-0.0532***			
		(0.0046)		(0.0033)			
p(same muni)$_{ipj}$					0.0317***		
					(0.0019)		
p(same zip)$_{ipj}$						0.0851***	
						(0.0143)	
p(same owner)$_{ipj}$							0.0691***
							(0.0202)
Obs	24,989,145	24,989,145	24,989,830	24,989,830	19,740,737	19,740,737	19,740,737
R^2	0.176	0.175	0.086	0.088	0.166	0.165	0.165
Procurement*Item FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows the characteristics of kamikaze firms. The dependent variables are p(kamikaze$_{ipj}$) – a dummy equal to 1 if bidder j at procurement i for item p is a Kamikaze firm and zero otherwise – in columns I and II, and p(win$_{ipj}$) – a dummy equal to 1 if bidder j at procurement i for item p is the winner and zero otherwise in columns III to VII. Kamikaze firms are those that have the lowest bid, but do not win the procurement because it does satisfy the final formalities to be declared the winner. The independent variables are the probability that firm j was created less than 3 years ago (columns I and III),the probability that firm j is small, as defined by the official government classification (columns II and IV), the probability that firm j is from the same municipality or zip code as the kamikaze firms (columns V and VI, respectively), and the probability that firm j has the same owner as the kamikaze firm (column VII). All columns add Procurement*Item fixed effects. Columns V to VII drop Kamikaze firms from the sample. Standard errors clustered at the firm level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 8: *Kamikaze Firms and Procurement Outcomes: Shared Ownership*

	$\log(\text{price})_{ipt}$			# bids per bidder_{ipt}			$\sigma(bid)/\overline{bid}_{ipt}$		
	I	II	III	IV	V	VI	VII	VIII	IX
$\text{Has Kamikaze}_{ipt}$	0.1677***	0.1488***	0.1487***	-2.248***	-2.003***	-2.020***	-0.2129***	-0.1920***	-0.1881***
	(0.0081)	(0.0061)	(0.0058)	(0.0290)	(0.0264)	(0.0273)	(0.0064)	(0.0049)	(0.0045)
$\text{Has Common Owners}_{ipt}$	0.0804***	0.0556**	0.0084	-0.7030***	-0.5642***	-0.5651***	-0.0307	-0.0181	0.0009
	(0.0232)	(0.0176)	(0.0323)	(0.0533)	(0.0434)	(0.0355)	(0.0193)	(0.0199)	(0.0150)
$\text{Has Common Owners}_{ipt} \cdot \text{Has Kamikaze}_{ipt}$	0.0390^{+}	0.0351*	0.0631*	0.8083***	0.7149***	0.7015***	0.0240	0.0407*	0.0278*
	(0.0203)	(0.0147)	(0.0251)	(0.0504)	(0.0456)	(0.0459)	(0.0198)	(0.0180)	(0.0137)
Obs	14,967,464	14,967,464	14,967,464	14,967,464	14,967,464	14,967,464	14,913,065	14,913,065	14,913,065
R^2	0.865	0.870	0.890	0.182	0.231	0.361	0.363	0.429	0.573
Item*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	Yes
# of Participants*Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Gov Institution*Year FEs		Yes	Yes		Yes	Yes		Yes	Yes
# of Participants*Item*Year FEs			Yes			Yes			

This table compares outcomes of procurements with and without the presence of Kamikaze and shared-owned firms. The main independent variable $\text{Has Kamikaze}_{ipt}$ is a dummy equal to 1 if procurement i for item p at year t had a Kamikaze firm and zero otherwise. Kamikaze firms are those that have the lowest bid, but do not win the procurement because it does satisfy the final formalities to be declared the winner. $\text{Has Common Owners}_{ipt}$ is a dummy equal to 1 if procurement i, item p at year t have at least two firms with the same owner. The dependent variable is the log of the price of item p procured in procurement i at time t. Column I adds Item-Year and # of Participants*Year fixed effects, effectively comparing procurements with the same item purchased and the same number of participants in the same year. Column II also includes Gov Institution-Year fixed effects. Finally, column III includes Gov Institution*Year and # of Participants-Item-Year fixed effects. Standard errors clustered at the item level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively. See captions of Table 2 and Table 3 for further details of the specifications.

Table 9: *Switching Across Procurements*

	p(kamikaze)$_{ipjt}$		p(win)$_{ipjt}$				
	I	II	III	IV	V	VI	VII
Was Kamikaze$_{j,t-1:t-12}$	0.0074***		-0.0013				
	(0.0003)		(0.0014)				
Was Winner in Kamikaze Procur$_{j,t-1:t-12}$		-0.0020***		0.0326***	0.0339***	0.0206***	0.0199***
		(0.0005)		(0.0013)	(0.0016)	(0.0015)	(0.0017)
Was Winner in Kamikaze Procur$_{j,t-1:t-12}$ · Has Kamikase$_{ipt}$					-0.0050***		0.0032*
					(0.0013)		(0.0015)
Obs	83,086,792	83,086,800	83,086,792	83,089,393	83,089,382	76,836,196	76,836,185
R^2	0.341	0.304	0.341	0.148	0.148	0.158	0.158
Sample	All	All	All	All	All	Previous Winners	Previous Winners
Procurement*Item FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows whether kamikaze firms and procurement winners switch positions across procurements. That is, within a procurement-product pair, we compare the probability that a firm j is a kamikaze or a winner in the current procurement auction i based on its past participation in other procurements over the last 12 months. We implement the following specification:

$$y_{ipjt} = \alpha_{ip} + \beta_1 \cdot X_{jt} + e_{ipjt}$$

where y_{ipjt} is an outcome for procurement i, product p, firm j and time t: the probability that firm j is a kamikaze firm in procurement i to purchase item p at year t and 0, otherwise (columns I to III), and the probability that firm j was a winner of procurement i, item p at year t, and 0 otherwise (columns IV to VII). X_{jt} is either *Was Kamikaze*$_{j,t-1:t-12}$ or *Was Winner in Kamikaze Procur*$_{j,t-1:t-12}$. Was Kamikaze$_{j,t-1:t-12}$ is a dummy equal to 1 if firm j was a Kamikaze firm in another procurement in the past 12 months. Was Winner in Kamikaze Procur$_{j,t-1:t-12}$ is a dummy equal to 1 if firm j was a winner in procurement in the past 12 months with the presence of a Kamikaze firm. All columns add Procurement*Item fixed effects. Standard errors clustered at the firm level are presented in parentheses. $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 10: *Switching Within Procurements*

	p(kamikaze)$_{ipjt}$		p(win)$_{ipjt}$				
	I	II	III	IV	V	VI	VII
Was Kamikaze$_{ip^*jt}$	0.0480***		-0.0226***				
	(0.0008)		(0.0013)				
Was Winner in Kamikaze Procur$_{ip^*jt}$		-0.0377***		0.1712***	0.1456***	0.0571***	0.0375***
		(0.0007)		(0.0018)	(0.0020)	(0.0017)	(0.0020)
Was Winner in Kamikaze Procur$_{ip^*jt}$ · Has Kamikase$_{ipt}$					0.1091***		0.1420***
					(0.0019)		(0.0022)
Obs	82,695,885	82,695,950	82,698,357	82,698,462	82,698,453	48,499,901	48,499,893
R^2	0.35112	0.30637	0.14330	0.17834	0.18095	0.20511	0.20696
Sample	All	All	All	All	All	Previous Winners	Previous Winners
Procurement*Item FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows whether kamikaze firms and procurement winners switch positions within procurements. That is, within a procurement i, we compare the probability that a firm is a kamikaze or a winner for a product p based on its participation in other auctions within the same procurement. We implement the following specification:

$$y_{ipjt} = \alpha_{ip} + \beta_1 \cdot X_{ip^*jt} + e_{ipjt}$$

where y_{ipjt} is an outcome for procurement i, product p, firm j and time t: the probability that firm j is a kamikaze firm in procurement i to purchase item p at year t and 0, otherwise (columns I to III), and the probability that firm j was a winner of procurement i, item p at year t, and 0 otherwise (columns IV to VII). X_{ip^*jt} is either *Was Kamikaze*$_{ip^*jt}$ or *Was Winner in Kamikaze Procur*$_{ip^*jt}$. Was Kamikaze$_{jp^*j}$ is a dummy equal to 1 if firm j was a Kamikaze firm in procurement i purchasing product $p^* \neq p$. Was Winner in Kamikaze Procur$_{ip^*jt}$ is a dummy equal to 1 if firm j was a winner in procurement i purchasing product $p^* \neq p$. All columns add Procurement*Item fixed effects. Standard errors clustered at the firm level are presented in parentheses. $^+$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 11: *Kamikaze Procurements on Future Purchases*

	$\log(q)_{ap,t+1:t+4}$	$\text{prob}(q)_{ap,t+1:t+4}$
	I	II
\$ Kamikaze Procur (as % of \$ Procur)$_{apt}$	-0.0288*	-0.0040**
	(0.0137)	(0.0013)
Obs	417,886	2,868,026
R^2	0.958	0.588
Gov Institution*Item FEs	Yes	Yes
Item*Quarter FEs	Yes	Yes

This table shows the effect of kamikaze procurements of product item p by government institution a on future purchases by the same government institution a of the same product item p. The data is collapsed at the government institution a, item p and year t level. The independent variable is the fraction of total value purchased in procurements with kamikaze firms as a fraction of total procured by institution a for item p at year t. The dependent variables are the log of total quantity purchased by institution a for item p during the following 4 quarters, i.e. t+1 to t+4 (column I), and the probability that institution a will purchase item p in the following 4 quarters (column II). All columns add Gov Institution*Item and Item*Quarter fixed effects. Standard errors clustered at the institution-item level are presented in parentheses $^+$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 12: *Kamikaze Road Repair Procurements and Road Accidents*

	log(No. Accidents)$_{iet}$		log(No. Victims)$_{iet}$	
	I	II	III	IV
kamikaze$_{ie}$·post$_{et}$	0.1349***	0.1331**	0.1145**	0.1167**
	(0.0406)	(0.0406)	(0.0359)	(0.0359)
log(extension)$_{ie}$·post$_{et}$		0.0083		-0.0117
		(0.0138)		(0.0095)
Obs	7,343	7,343	7,295	7,295
R^2	0.976	0.976	0.974	0.974
Event*Road	Yes	Yes	Yes	Yes
Event*Year	Yes	Yes	Yes	Yes

This table compares outcomes between road repair contracts awarded via kamikaze vs non-kamikaze procurements. For each kamikaze auction we select non-kamikaze auctions that happened in the same month. We stack these events in a "stacked" DID design as in the following equation:

$$y_{iet} = \alpha_{ie} + \alpha_{et} + \beta Kamikaze_{ie} \cdot Post_{et} + e_{iet}$$

where the dependent variable y_{iet} is either the log of the number of accidents in road repair i, event e and year t (columns I and II) or the log of the number of victims in road repair i, event e and year t (columns III and IV). The main independent variable kamikaze$_{ie}$ is a dummy equal to one if road repair i of event e was awarded in a kamikaze procurement and zero otherwise. Post$_{et}$ is a dummy equal to one after the contracts were awarded and zero otherwise. log(extension)$_{ie}$ is the log of the extension of the road repair in kilometers. Standard errors clustered at the road-event level are presented in parentheses $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Table 13: *Kamikaze Essential Medicine Procurements and Hospital Mortality*

Causes	mortality rate$_{iet}$			
	All	Terminal	Non-Terminal	Main
	I	II	III	IV
kamikaze$_{ie}$·post$_{et}$	0.0031***	-0.0040	0.0035***	0.0074***
	(0.0008)	(0.0028)	(0.0008)	(0.0018)
Obs	68,122	3,291	64,831	16,235
R^2	0.896	0.938	0.891	0.920
Event*Hospital*Cause	Yes	Yes	Yes	Yes
Cause*Event*Year	Yes	Yes	Yes	Yes

This table compares hospital excess deaths outcomes between essential medicine purchased via kamikaze vs non-kamikaze procurements. For each kamikaze auction we select non-kamikaze auctions that happened in the same month. We stack these events in a "stacked" DID design as in the following equation:

$$y_{iet} = \alpha_{ie} + \alpha_{et} + \beta Kamikaze_{ie} \cdot Post_{et} + e_{iet}$$

where the dependent variable y$_{iet}$ is the ratio between deaths and number of inpatients in hospital i, event e and year t. The main independent variable kamikaze$_{ie}$ is a dummy equal to one if the purchase of essential medicine for hospital i in event e was done via a kamikaze procurement and zero otherwise. Post$_{et}$ is a dummy equal to one after the contracts were awarded and zero otherwise. Standard errors clustered at the road-event level are presented in parentheses $^{+}$, *, **, and *** denote significance of 10%, 5%, 1%, and 0.1%, respectively.

Figure 1

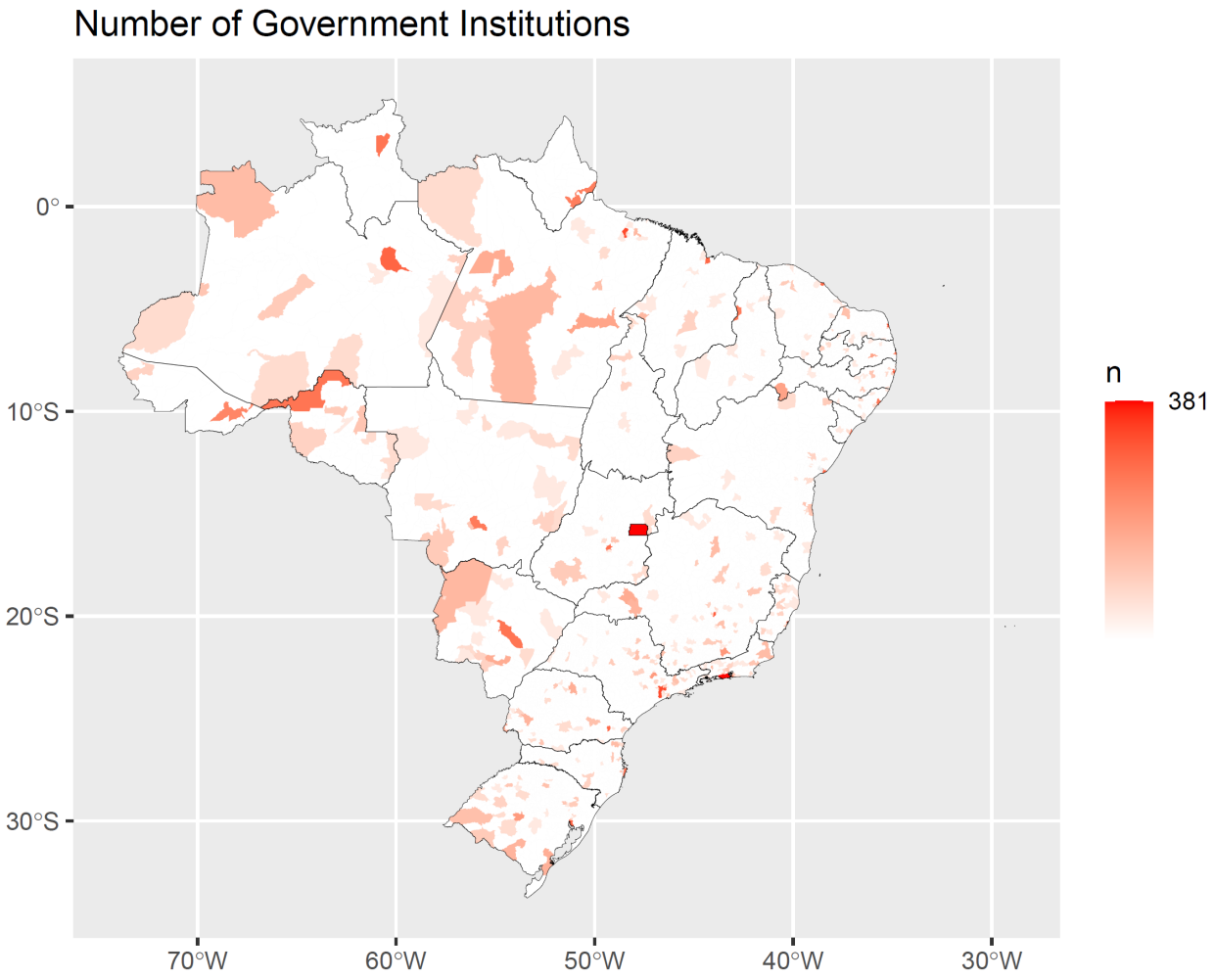

Number of Government Institutions
0°
10°S
20°S
30°S
70°W
60°W
50°W
40°W
30°W
n
381

Figure 2

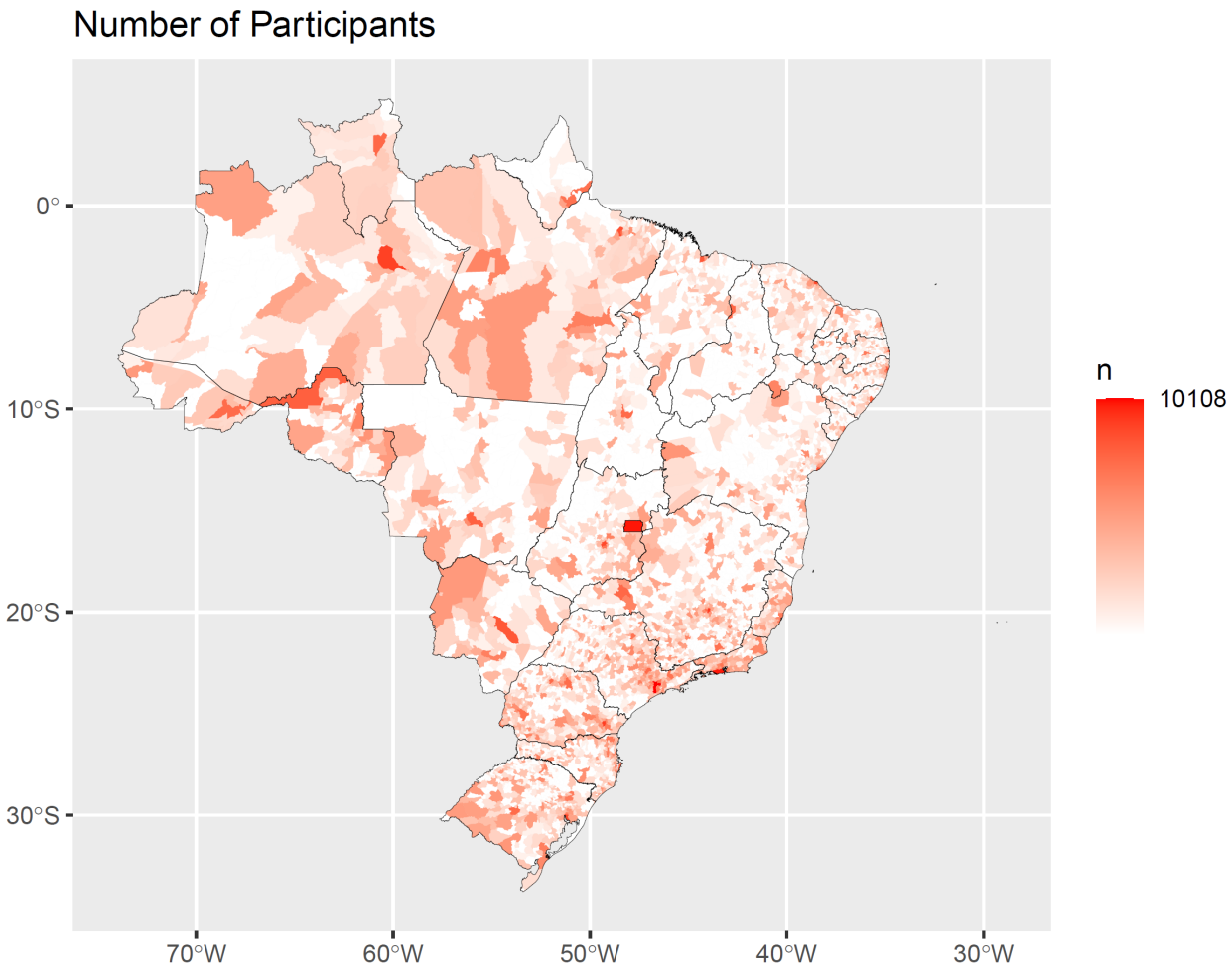
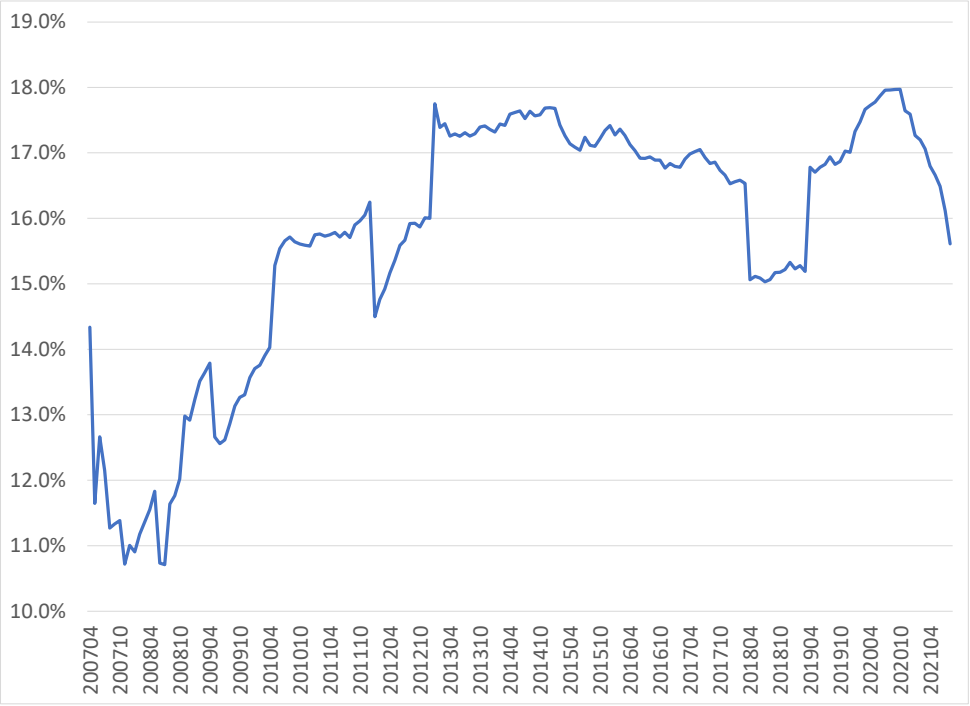
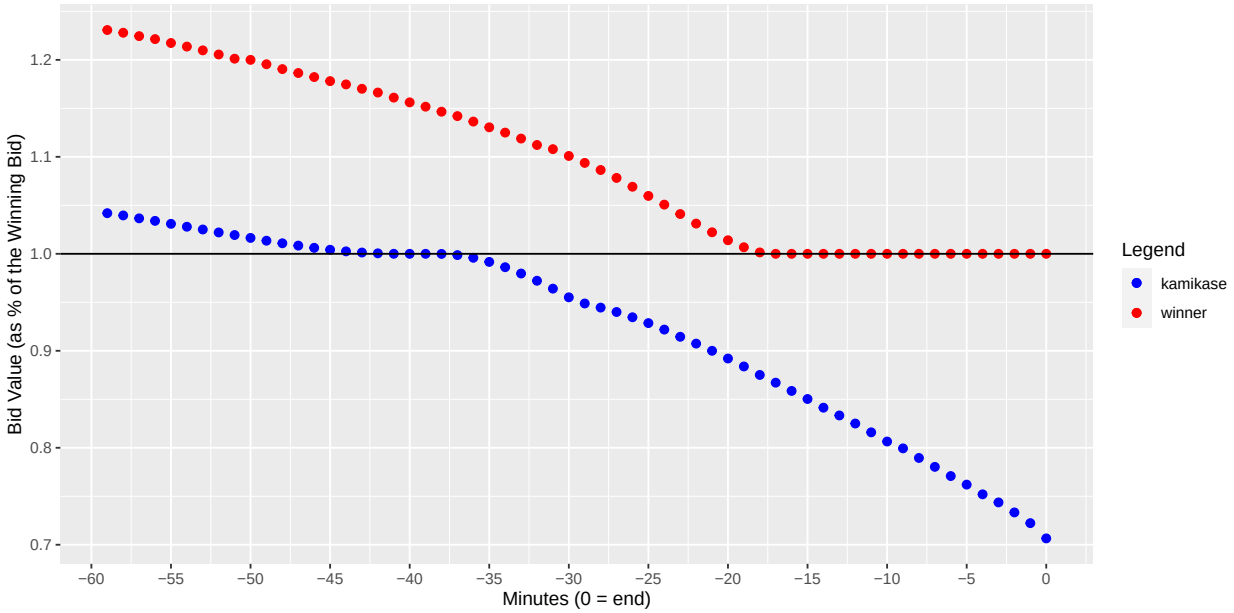

Number of Participants
0°
10°S
20°S
30°S
70°W
60°W
50°W
40°W
30°W
n
10108

Figure 3: *Prevalence of Kamikaze Strategies*



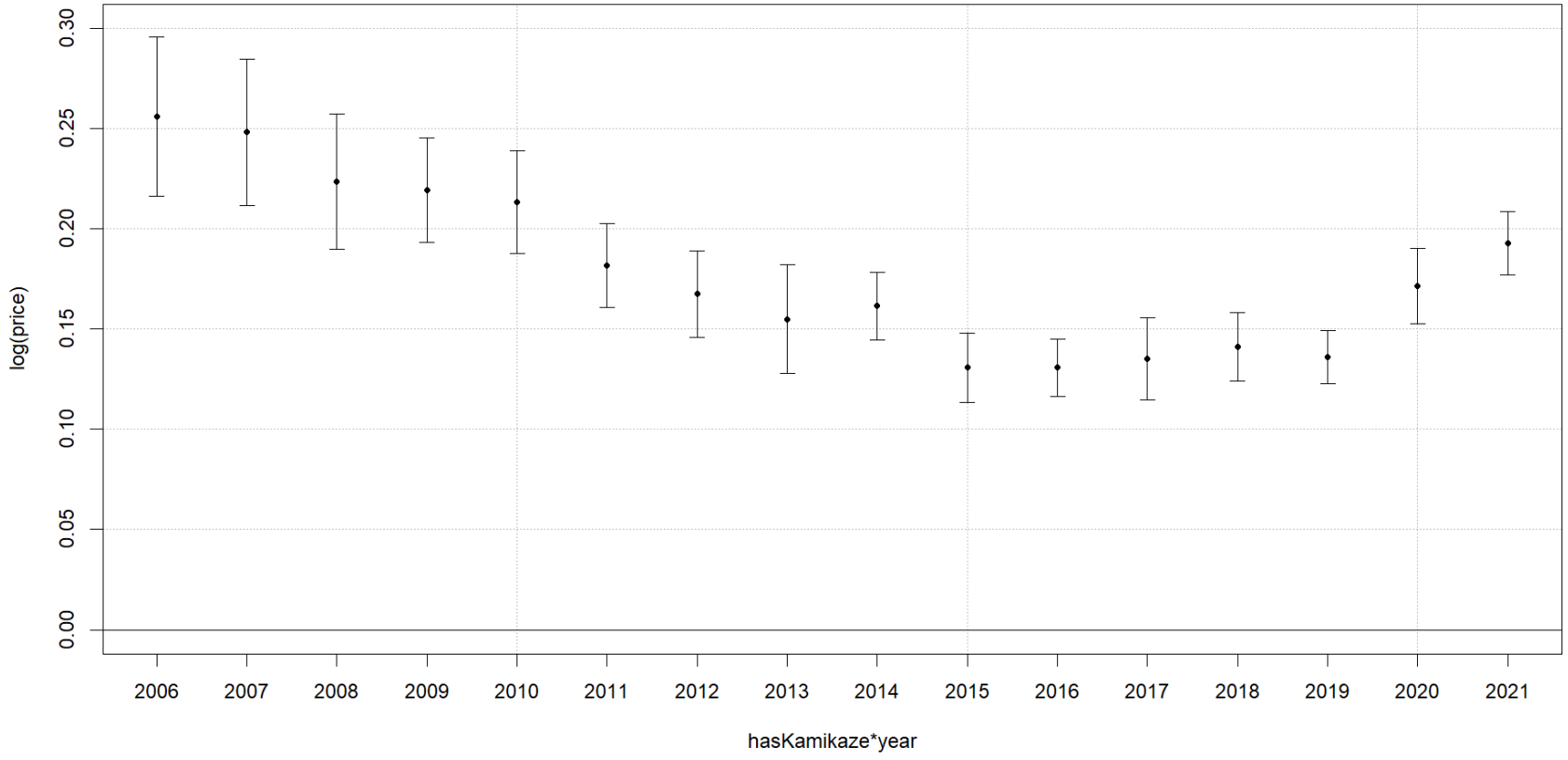
This figure shows the average fraction of auctions with kamikaze in Brazil between 2005-2021. Kamikaze firms are those that have the lowest bid but do not win the procurement because it does satisfy the final formalities to be declared the winner.

Figure 4: *Kamikaze vs Winner Bid*



This figure plots the dynamic development in minutes before the end of the auction of average bid price for kamikaze participants and the winning bidders, expressed as a % of the winning bid.

Figure 5



This figure plots the overpricing effect of kamikaze by year. We estimate equation (1) with a different coefficient for each year by interacting HasKamikaze with a year dummy.

Figure 6: *Excess Deaths in Public Hospitals*

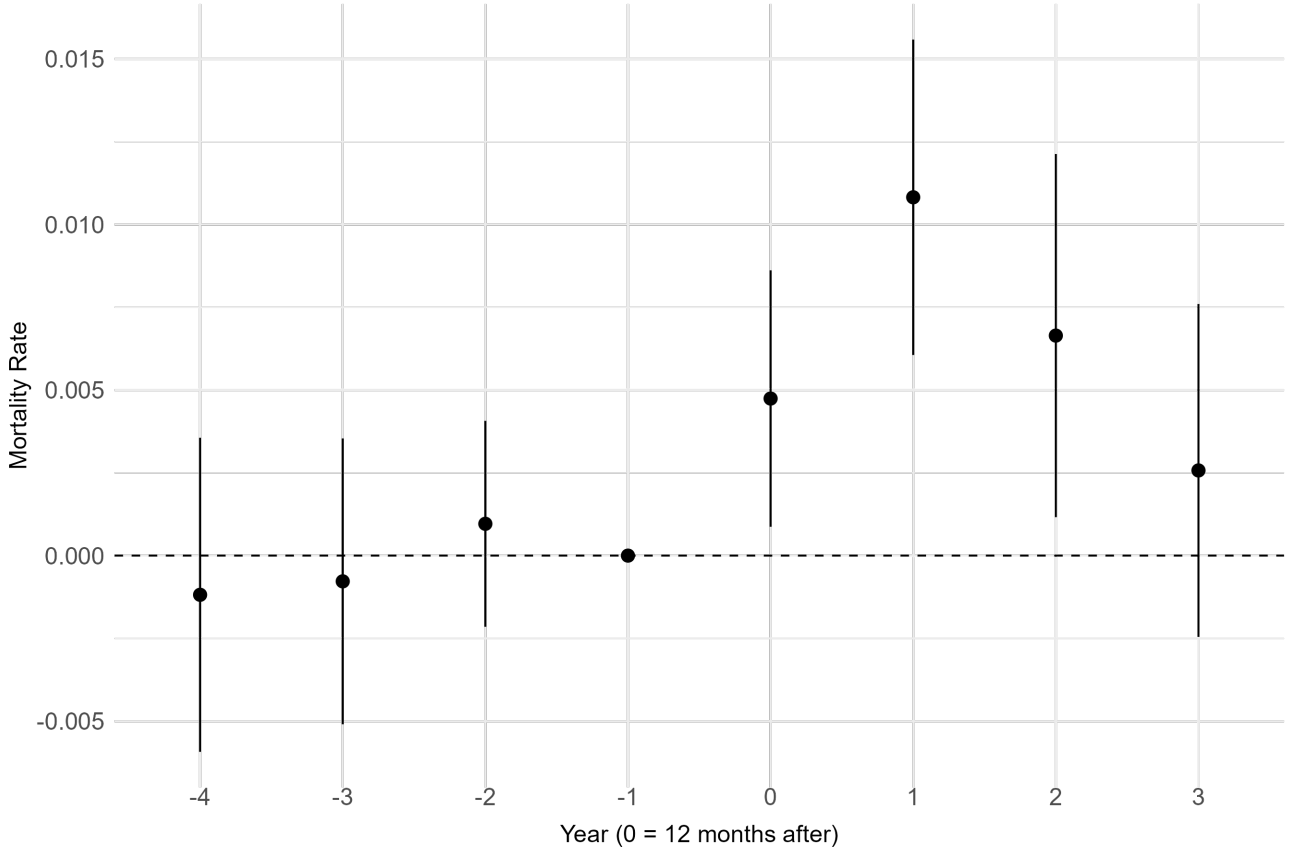
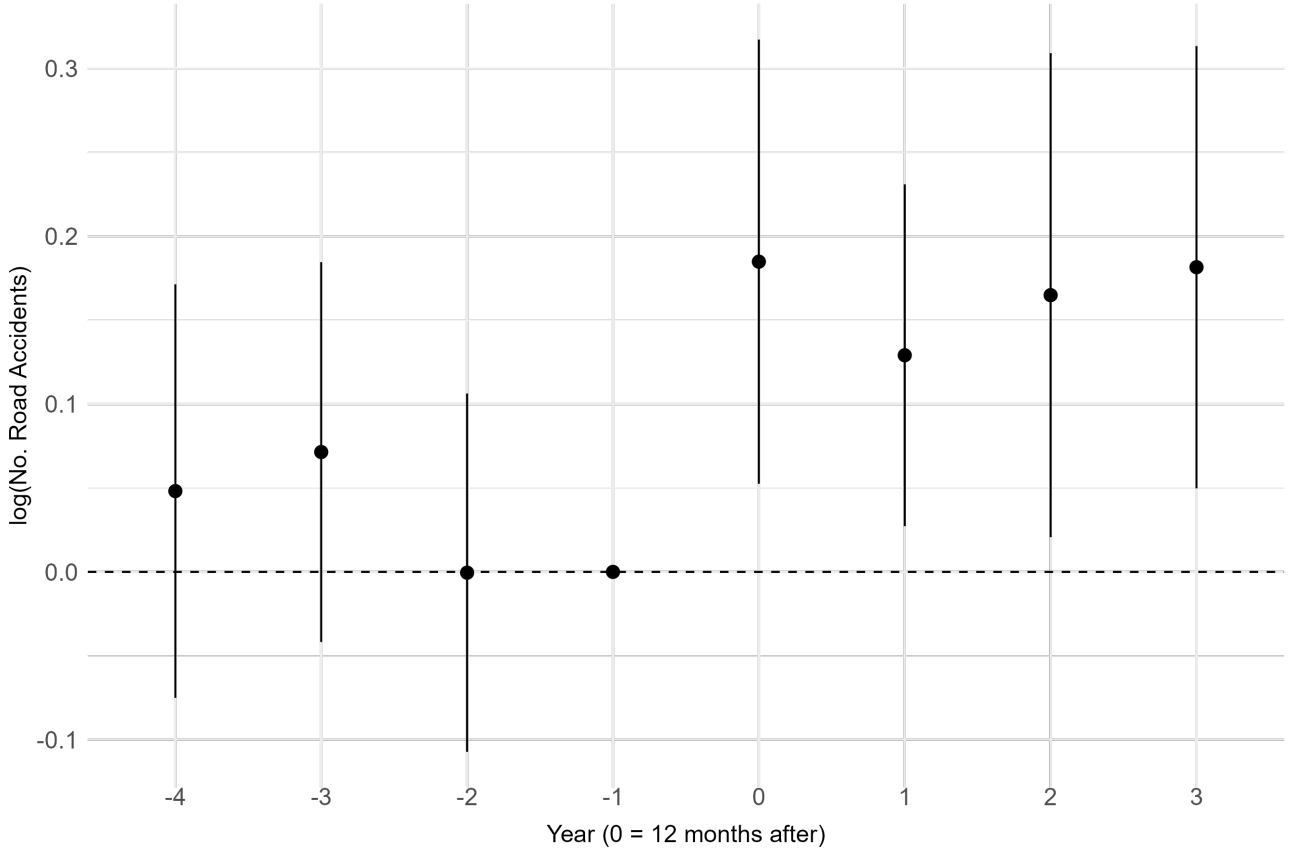


Figure 7: *Number of Road Accidents*



A Internet Appendix

Table A1: *Examples of Products and Brands*

Product		Brand
Description	Unit	
Ballpoint Pen	1 unit	Bic
Flexible Electric Cable	1 meter	Corfio
Gloves for Non-Surgical Procedure	100 units	Descarpack
Battery	1 unit	Elgin
Ethyl Alcohol	1 liter	Itaja
TV	1 unit	LG
Coffee	500 grams	Odebrecht
Coffee	1 kilogram	Pilao
External HD	1 unit	Seagate
Sugar	1 kilogram	Uniao
Mineral Water	20 liters	Villa
Detergent	500 milliliters	Ype
HP Printer Toner Cartridge	1 unit	HP
White Board Pen	1 unit	Pilot
Insulin	3 milliliters	Lantus
Microscope	1 unit	Physis
Gas	1 liter	Petrobras

Table A2: *Government Agencies*

Name of Government Agency	Classification
Universidade Federal do Rio Grande do Sul	Education
Universidade Federal do Pará	Education
Universidade Federal de Pernambuco	Education
Hospital Universitario UFSC	Hospitals
Hospital Universitario Antonio Pedro (UFF/RJ)	Hospitals
Hospital Universitario Gaffree e Guinele (UNIRIO)	Hospitals
Grupamento de Apoio de São José dos Campos	Armed Forces
Grupamento de Apoio de Brasilia	Armed Forces
14 Grupo de Artilharia de Campanha	Armed Forces
Comissao Nacional de Energia Nuclear	Other
Governo do Estado do Ceara	Other
Departamento de Logistica em Saude	Other