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Disamenity or a Signal of Competence? The Empirical Political Economy of Local Road Maintenance

Ben Blemings* and Margaret Bock†

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Abstract

Empirical results find different conclusions than theoretical evidence of how electorates perceive road work. This paper uses a geographically smaller unit of analysis than prior work, political alignment, local election cycles, and difference-in-differences. It finds political distortions in invasive road maintenance timing and rules out maintenance seasonality. Spatial discontinuity plots leveraging ward boundary cutoffs confirm the shift. Results identify new public distortions to road maintenance, local election cycles, which are widespread and frequent. The estimates are used to calculate financial costs of local elections on road maintenance. Local elections have cost medium-large U.S. cities over $185.5 million from 1960-2020.

JEL Codes: H40, H76, R42, R53

Keywords: Road Maintenance, Infrastructure, Political Economy, Election

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Elected officials respond to incentives and one of their goals is to retain their position. Re-election is determined by receiving votes from specific geographic units, which could lead to inefficient spending patterns (Weingast et al., 1981). For infrastructure, politically-motivated behavior has lead to high abatement costs for new road construction as elected officials avoid inconveniencing constituents by routing roads around politically organized urban areas (Glaeser and Ponzetto, 2018).

The consequences of political organization for infrastructure costs and decisions has been studied (Glaeser and Ponzetto, 2018), but a gap remains on exogenous changes to the relative importance of political incentives for infrastructure. Related prior work focusing on changing political incentive importance does not differentiate between types of public spending (Veiga and Veiga, 2007) or assumes that grants to lower geographic levels are unobservable by the constituency (Bracco et al., 2015). This paper focuses on the effect of exogenous changes to the importance of political incentives on infrastructure maintenance, a salient and observable public good.

Existing results find seemingly contradictory signs for the political value of road maintenance/construction. The contradiction is that empirical results suggest road maintenance increases party vote share in a county-level analysis for one state (Huet-Vaughn, 2019), but the theoretical results suggest voters oppose road construction in a city-level context (Glaeser and Ponzetto, 2018). Brueckner and Selod (2006) and Glaeser and Ponzetto (2018) both consider the traffic and disruption of urban interstate construction a disamenity to local residents. However, in a recent empirical test, Huet-Vaughn (2019) finds evidence county-level electorates see highway maintenance as a signal of competence from politicians. The empirical results in Huet-Vaughn (2019) suggest vote-maximizing politicians should strategically locate maintenance in places that are less likely to vote for them in an upcoming election, as that election approaches. The theoretical findings (Brueckner and Selod, 2006; Glaeser and Ponzetto, 2018) suggest vote-maximizing politicians should do the opposite.

One discrepancy between the theoretical (Brueckner and Selod, 2006; Glaeser and Ponzetto, 2018) and empirical results (Huet-Vaughn, 2019) is the geographic level of analysis. Different

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1The focus of Weingast et al. (1981) is legislative bodies, but it generalizes to executive branch officials which are studied here.

2In other words, county-level electorates view interstate maintenance as signal that “things are getting done” by their elected officials.
levels of analysis could be the sole reason the findings differ, but prior empirical work only takes place at a scale larger than the local city level. Previous attempts to estimate the effect of political incentives on urban infrastructure have occurred at the regional (Knight, 2005) or national (Rioja, 2003) level, despite the fact that government agents in the theoretical models (Glaeser and Shleifer, 2005; Brueckner and Selod, 2006; Glaeser and Ponzetto, 2018) are best thought of as being local leaders exercising power at the local level.

In addition to academic interest, this study is directly relevant for infrastructure policy. Burningham and Stankevich (2005) notes that transportation infrastructure is one of the most important assets in some countries, particularly in developing countries, connecting people to jobs, education, healthcare, and other crucial markets. In the United States, public investment in transportation infrastructure has been shown to have important economic effects (Aschauer, 1989; Fernald, 1999; Chandra and Thompson, 2000) at the regional and national level.

State and local government spending on infrastructure makes up over 80% of U.S. total public infrastructure spending. Furthermore, state and local investment in government nonresidential fixed assets like infrastructure reached $304.3 billion in 2018 (Zhao et al., 2019). Figure 1 shows the city of Pittsburgh, Pennsylvania totalled over $80 million in expenditures on highways and streets just in 2017; approximately $15 million was on paving and resurfacing.

The Road Information Program (TRIP) 2020 report notes that driving on deteriorated roads costs U.S. motorists approximately $130 billion a year. Deteriorated roads cause additional vehicle damages, tire wear and increased fuel consumption. Due to the damage caused by deteriorated roads and the large amount of spending on roads and maintenance, uncovering the extent to which political motivations distort road maintenance decisions is important. This paper investigates whether there is a political distortion, from local election cycles, on local road maintenance.

Winston (2013) states that policymakers have wasted resources by investing, or not investing, in infrastructure projects that have not been selected on the basis of careful analysis. Prominent economists also note that not only is the importance of investment in road maintenance often overlooked in the United States, but infrastructure investment will be most effective when it is paired with the right institutions (Malinovskaya and Wessel, 2017). If political motivations (Coate

and Morris, 1995; Glaeser and Shleifer, 2005) shift the timing and location of road maintenance projects at the local (city) level, measuring the source of these shifts is of interest not only to researchers, but also public officials looking to maximize infrastructure quality.\textsuperscript{4} Figure 2 suggests political incentives are relevant for road maintenance in Pittsburgh; the month right before the election (October) has less projects during mayoral election years.

In this paper, temporal variation in intensity of political incentives due to political cycles is used to address whether the number of registered voters of the same political party affects the quantity and location of disruptive road maintenance during the months between the primary and general mayoral elections in the city of Pittsburgh, Pennsylvania.\textsuperscript{5} The findings show road maintenance projects are shifted across months during mayoral election cycles. The alignment of the constituency matters for how these projects are shifted. Shifted maintenance during local election cycles is a previously undocumented public distortion in transportation investment at the city level.

Distance to ward boundaries, where political alignment changes sharply, are leveraged in spatial discontinuity plots. The plots confirm the signs of the shift and offer appealing falsification of the political incentive mechanism. Using estimates from the literature on the cost of maintenance as a function of how long maintenance is delayed (Burningham and Stankevich, 2005), the DD coefficients are used to quantify the infrastructure maintenance financial cost due to local political incentives. These cost calculations, which are conservative due to the relatively uncontested political environment of Pittsburgh, suggest big city local elections have cost over $22 million in political infrastructure costs since 1960. Expanding these findings to all medium-large cities in the U.S., political incentives interfering with local road maintenance decisions have cost over $185.5 million in the past sixty years, or over $3 million a year.\textsuperscript{6}

\textsuperscript{4}Assuming the goal of public officials is not to maximize vote shares as in Coate and Morris (1995), Glaeser and Shleifer (2005), etc.

\textsuperscript{5}A large body of literature examining inter-governmental grants and political incentives uses the term political alignment. That concept is adapted to this context.

\textsuperscript{6}Cities with at least 100,000 people as of 2020 are considered at least medium-sized.
I Literature

I.a General Transportation & Economic Effects of Infrastructure


I.b Political Economy and Infrastructure

I.b.1 Theoretical Political Economy and Infrastructure

Broadly speaking, many results show empirically and theoretically how non-market public institutions cause deviations from policies that maximize social welfare. Early influential work in this literature (Weingast et al., 1981) identifies three sources of bias from political institutions in a theoretical model. One stems from political benefits diverging from economic benefits. Two is the way districting divides the economy into \( n \) disjoint political units (the Law of \( 1/N \)). The third is how revenue is raised through general taxation. Government transfers will be made inefficiently when potential incentives from special interests exist (Coate and Morris, 1995).

Wildasin (1987) states that empirical verification of urban theoretical models, which incorporate political economy, are important for the literature. Despite this contention, empirical investigation of urban-public interaction have few published results at the micro level. Specifically, Glaeser and Shleifer (2005) shows theoretically and through three case study examples, some mayors shape the electorate to benefit their re-election possibilities. The so-called “Curley Effect,” named for the

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7Early literature focused on bureaucratic behavior, legislative institutions, interest group influence, vote-maximizing politicians, and fiscal illusion.

8One reason for this may be due to the detailed data and intricate methods required for hypothesis testing.
infamous Boston mayor’s extraordinary proclivity to pursue politically-minded transfers, shows local, elected officials reallocate public funds when political gains can be accrued.

Political economy has been shown to affect infrastructure. Winston (2013) argues suboptimal public investment in transportation policy manifests itself in traffic delays, budget deficits, and excessive money and time costs. Winston (2013) emphasizes the increasing level of public distortions in public transportation policy.

I.b.2 Political Economy and Infrastructure: Empirical Differences

The conclusions of the model in Glaeser and Ponzetto (2018) are supplemented using an analytic narrative of U.S. road infrastructure in the post World War II era. The narrative simplifies the era into three rough chapters of U.S. national investment in roads: a period of over-investment due to national subsidies, a period of under-investment as the disamenities of construction became clear, and then a period where large sums were spent to mitigate the disamenities. The disamenities of construction explicitly mentioned include noise, pollution, and eminent-domain concerns. The theoretical results in Glaeser and Ponzetto (2018) assume new road construction is a disamenity. Brueckner and Selod (2006) suggests political processes result in more expensive and slower urban transportation investment compared to socially optimal investment.

The disamenity value of road construction in Glaeser and Ponzetto (2018) contradicts findings in Huet-Vaughn (2019). Nationally funded highway maintenance, through the American Recovery and Reinvestment Act (ARRA) supported exclusively along national Democratic partisan lines, increased the vote share of local Democratic candidates. Huet-Vaughn (2019) compares districts geographically closer to the ARRA road signs to districts geographically more distant. Huet-Vaughn (2019) finds districts closer to the physical road signs experienced larger bumps in vote share for Democratic candidates. These results suggest highway road maintenance, funded by the national government, is viewed as a signal of competence by the electorate in New Jersey counties.
I.c Political Alignment and Related Political Variation

I.c.1 Political Alignment

Many studies investigate the effect of political alignment on transfers resulting from federalist systems of government, where nationally collected taxes are distributed to lower levels of government. Solé-Ollé and Sorribas-Navarro (2008) studies Spain’s 900 municipalities over 10 years and finds intergovernmental transfers are more likely among levels of government that are a similar party. Similar empirical investigations have taken place in India (Asher and Novosad, 2017), Brazil (Brollo and Nannicini, 2012), Portugal (Migueis, 2013), and Italy (Bracco et al., 2015). All of these papers find evidence of an “alignment effect”: municipalities that are more politically aligned with an elected official or higher level of government receive more intergovernmental transfers; this effect is usually found to be the strongest right before an election.

Bracco et al. (2015), in addition to reporting evidence of an alignment effect in Italy, develops a theoretical model which assumes rational voters who interpret public good provision as a signal of incumbent competence. This assumption stands in contrast to those made by Glaeser and Ponzetto (2018), which is that new road construction, a public good, is a disamenity. Bracco et al. (2015) also assumes the electorate does not observe the grant allocation, which does not fit the research question in this study, since the grant we investigate is allocated to a visually salient public good, road maintenance (Glaeser and Ponzetto, 2018).

Rioja (2003) finds evidence of substitution away from road maintenance to new “prestige projects” during the dictator’s “election cycle” reduced GDP growth in a sample of Latin American countries. The findings in (Rioja, 2003) imply political distortions can reduce road maintenance spending, which has adverse effects on a country’s GDP. These results hold even when elections are not competitive, showing that political distortions can impact maintenance even when elections are not close.

I.c.2 Local Rule Changes/Temporal and Geographic Variation

Several papers have exploited plausibly exogenous variation in political incentives to study the behavior of elected officials. Changes in local rules, such as those concerned with government spending and re-election, have been extensively studied. Concerning re-election rules, Ferraz and
Finan (2011) finds less corruption from Brazilian mayors who have the ability to be re-elected. Aeidt and Shvets (2012) finds that a pre-election boost in district spending disappears in legislators’ final terms because they are ineligible to be re-elected.  

Temporal variation from local budget cycles has been used as a way to study the behavior of elected officials. Veiga and Veiga (2007) find, in Portuguese municipalities, politicians increase and shift total expenditures towards items highly salient to the electorate in pre-electoral periods. This behavior is consistent with an effort by politicians to signal competence before an election, potentially increasing the chances of re-election. Drazen and Eslava (2010) find results suggesting incumbents change the composition of spending to target potential voters which is present in pre-election periods in Colombian municipalities. This study builds on these by focusing on infrastructure and leveraging differential alignment as control and treatment groups.

Geographic boundaries also serve as a source of exogenous variation. Agrawal (2015) uses state borders to examine discontinuous differences in state retail taxes. Cantoni (2020) studies differences in voting costs (distance to polling location) for individuals that live near a voting precinct border. This study extends approaches that use spatial boundaries for geographic units to a new question.

II Data

II.a Institutional Details

Several institutional details about the city of Pittsburgh are relevant to this research. Pittsburgh is governed under a mayor-city council system; the mayor acts as the head of a nine person council. This council, under leadership of the mayor, decides the location of road maintenance projects on city-owned roads. This institutional setup suggests political incentives could influence road maintenance, particularly as the time until the mayoral general election decreases. Thus, the institutional arrangement in this city is conducive to testing the effect of political incentives from mayoral election cycles on road maintenance decisions.

9There are no rule changes and term limits in Pittsburgh, so they are not applied in our research design.
Additionally, besides the City Controller, the mayor is the only executive official elected through a city-wide vote. The city council members are only elected by votes in their respective districts. This means that the mayor’s constituents are located across the whole city, while the council members’ constituents are only located in the members’ districts. Given these institutional details, using city council votes is not appropriate for studying city-wide maintenance decisions.

The political party in control of Pittsburgh does not change over the sample. The nine city council members have been unanimously Democratic party members since 1933; the mayor has always been a member of the Democratic party since 1934. Due to the relatively low level of political competition for elected positions in the city of Pittsburgh, the focus is on political differences between the makeup of the constituency and the head elected executive official. This approach combines investigation of the head elected official (Glaeser and Shleifer, 2005) with the literature on federal grants and local governments based on political alignment (Solé-Ollé and Sorribas-Navarro, 2008; Bracco et al., 2015).

II.b Wards and Political Alignment

The Pittsburgh ward shapefile is publicly available from the Western Pennsylvania Regional Data Center. Measures of voter registration are annually updated after the May primary elections. This data is publicly available in every year of the sample from the Allegheny County Election Results website.

From the May primary elections files, the number of registered voters of each party is used to construct a measure of the political alignment. Political alignment is defined as \( PA_{wy} = 1 \) if:

\[
PA_{wy} = 1(\overline{PA_{w}} - \overline{PA} > \overline{\Delta A}),
\]

where \( PA_{wy} \) stands for political alignment deviation in a ward in a year, \( \overline{PA_{w}} \) is the mean political alignment in a ward over the entire sample, \( \overline{\Delta A} \) is the median deviation across all 288 (32 wards X 9 years) ward-year combinations. This within-ward deviation as a measure of alignment is the same strategy used by Solé-Ollé and Sorribas-Navarro (2008).

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10 The City Controller is not involved in road maintenance planning.
11 The precinct boundaries are also available for download.
12 Source: https://www.alleghenycounty.us/elections/election-results.aspx
13 Data was scraped from the .pdf files into a usable data format.
14 The distribution of within-ward deviations are shown in Figure A.1a.
Figure 3 displays how wards deviate from the within ward average proportion of registered Democrats in Pittsburgh across wards across all years in our sample. Wards in orange signify relatively unaligned wards in a given year, while navy wards represent wards that were relatively more politically aligned. Mayoral election years (2009, 2013, and 2017) are shown on the diagonal. Figure 3 demonstrates the adequate within- and across-ward variation in political alignment over the sample period.

By ward, the proportion of registered Republican voters is never over 24 percent. This can be seen in Figure A.1b. The lack of competitive politics is the justification for the within-ward deviation approach. Prior literature finds election cycle effects even when there is not much political competition (Rioja, 2003). Finally, little variation in political competition implies the model calculates lower bounds of political distortions.

II.c Maintenance Projects

The road maintenance data for the city of Pittsburgh, Pennsylvania is publicly available via the Western Pennsylvania Regional Data Center. Pittsburgh differs from many other cities in that it publishes a detailed road paving schedule which includes the year a project started, the exact date it finished, and the type of maintenance job it was.\textsuperscript{15} There are $N = 5,978$ maintenance projects recorded in this data set for the period 2009-2017.

For this analysis, only the most heavy/invasive maintenance projects are considered. These include: base repair, mill and overlay greater than three inches and SuperPave.\textsuperscript{16} These project types, compared to lighter maintenance such as overlay and mechanical patching, are more disruptive in terms of noise and air pollution. These heavy projects generally need a longer time to complete, potentially adding travel time to trips along that route, causing the most inconvenience to constituents. The list of the types of maintenance with a short description of what each activity entails is found in Table 1.

\textsuperscript{15}Start date is not observed.
\textsuperscript{16}This classification of “heavy” and “non-heavy” road maintenance projects is based off of the authors’ research and judgement.
II.c.1 Census of Pittsburgh Roads

The universe of roads in Pittsburgh is used to construct the road-segment level data set. The 2018 TIGER/Line shapefile of Allegheny County roads comes from the U.S. Census Bureau website. The 2018 file includes all roads in Allegheny County as of January 1, 2018, ensuring all roads that could have ever been maintained in our sample period are included. Interstates and state routes are excluded to limit the data to only roads the city of Pittsburgh is responsible for maintaining. The roads and projects are displayed in Figure 4.

II.d Analysis Sample

II.d.1 Creation

The road maintenance projects are joined to the political wards using GIS. Specifically, if a project is geographically inside a ward, then it becomes associated with that ward. Each project has an associated date, enabling the creation of a ward-month-year level dataset. Next, the yearly voter registration data is merged to the maintenance projects using the ward numbers.

January-March observations are dropped, because there is almost no maintenance activity that occurs in these months. There are 32 wards over 9 years and 8 months, resulting in a data set of 2,592 observations. December 2017 is dropped, because the majority of these projects were not completed until 2018, which is outside the sample period.

II.d.2 Descriptive Statistics

Table 2 shows the descriptive statistics for the number of completed heavy maintenance projects by alignment and whether it is a mayoral election year. Unaligned means the ward had a lower political alignment than that particular wards’ sample length median of political alignment; aligned means it was higher than the wards’ sample length median. The dependent variable of interest is the number of heavy maintenance projects.17

First, focus on the non-election mean column. Whether more heavy projects are completed in aligned or unaligned areas alternates in each successive month. For example, more heavy maintenance projects are completed in June-Aligned than in June-Unaligned, but the opposite is true for

17Note that dropping December 2017 leads to less observations in December.
July; there are more heavy maintenance projects in July-Unaligned than in July-Aligned. This is consistent with there not being an effect of political alignment in years where there is no mayoral election.

However, in mayoral election years, alignment seems to matter for road maintenance. In a mayoral election year, there is more maintenance completed in unaligned wards than in aligned wards in June-August. In September and October, as the election approaches, the politically aligned wards have more maintenance.

One other takeaway is that there is more maintenance completed in the summer months than in the winter months. Looking at the the total column, there are higher means of maintenance in both aligned and unaligned wards in summer than in fall/winter seasons. The empirical strategy rules out maintenance seasonality as a source of bias.

### III  Method

#### III.a  Econometric Model

The econometric model uses a difference-in-differences approach. The treated groups are wards that have a higher proportion of Democrats (the party of the mayor) than the overall median of within-ward deviations (-0.15). Thus, they are relatively politically aligned. Voter registration numbers are made public every May, even in non-election years. The post-treatment period includes the months between the registration release and the time the ballots are cast in November.

The model follows:

\[
 Maintenance_{myw} = \exp(\beta_1 IEP_{my} + \beta_2 PA_{yw} + \beta_3 PA_{yw} \times IEP_{my} + \mu_w + \phi_t),
\]

in which \( m \) stands for month, \( y \) for year, and \( w \) for ward. \( \mu_w \) is a vector of ward fixed effects to control for unobservable, time-invariant ward-level heterogeneity. \( \phi_t \) is a vector of year and month fixed effects. Maintenance stands for number of completed maintenance projects. IEP stands for the inter-election period, PA stands for the politically aligned indicator variable. The inter-election period = 1 if it is the months of June-October and a mayoral election year. Some regressions
change the months included in IEP to account for how months far and close to the general mayoral election may have conflicting effects.

Poisson estimation is appropriate, because the dependent variable is discrete. Poisson is preferred over negative binomial for two reasons. The first is that errors in the model are likely correlated by ward, so the preferred model estimates cluster-robust standard errors at the ward level. An implication of using cluster-robust standard errors in a Poisson model is that it has been shown to correct for over-dispersion of the dependent variable (Cameron and Trivedi, 2005). Another reason Poisson is preferred for panel data is negative binomial models have been shown to not be “true fixed-effects” models (Allison and Waterman, 2002). To examine sensitivity to model choice, the dependent variable is changed to meters of completed maintenance and the model is re-estimated using OLS after Poisson models are estimated.

III.b Identification

The model deals with the seasonality of road maintenance in two ways. First, it compares politically aligned to politically unaligned wards in the same years and months. Second, it controls for monthly differences using month fixed effects. This ensures results are not driven by seasonal maintenance patterns. Other covariates that are related to maintenance include the price of inputs and weather. It is highly unlikely that these unobservables are different across different wards, making them unlikely to bias $\beta_3$, the key variable of interest.

The identifying assumption is in the absence of the mayoral inter-election period altering political incentives, road maintenance in politically aligned and politically unaligned wards continues trending similarly during the months between the primary and general elections. Only two pre-registration months are observed in each of the three mayoral election years, so the common pre-trends are difficult to observe. An implication of the identifying assumption, which is more visually noticeable, is there are no discernible patterns or differences between aligned and unaligned wards in non-mayoral election years which begin during placebo periods of June-October.

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18 Poisson models still estimate unbiased, consistent coefficients if the conditional mean is correctly specified (Wooldridge, 1999).
### III.b.1 Parallel Trends

Figure 5 presents maintenance over time, disaggregated by alignment, to investigate the implications of the identification assumption visually. Every year of data (2009-2017) is represented by a separate figure, because treated wards change every year as the within-ward political alignment deviation changes relative to the within-ward median.\textsuperscript{19} Mayoral election years (2009, 2013, and 2017) are shown on the diagonal; red vertical lines define the inter-election period. Non-election years are shown in all other figures and use black vertical lines to define the months of interest. In each figure, navy represents politically aligned wards and orange represents non-aligned wards. The figure also complies with the expectation that maintenance is seasonal: more maintenance takes place in the warmer, summer months.

In non-mayoral election years (off-diagonal figures), the trend in completed maintenance projects does not appear systematically different for aligned versus unaligned wards. There also appears to be no differing effect on maintenance completed between aligned and unaligned wards as the month of November approaches. This suggests that approaching the would-be mayoral election month in non-election years does not differently impact road maintenance in aligned and unaligned wards. In 2010 and 2011, the aligned and unaligned wards cross frequently. In 2012 and 2016, the unaligned wards are on a higher level. In 2014 and 2015, the aligned wards are on a higher level. In almost all of these off-mayoral election years, the month to month change looks to be either noise or the trend looks the same. This non-systematic difference/pattern in differences between aligned and unaligned wards in off-mayoral election cycle years supports the implication of the identifying assumption. Namely, there is no clear maintenance pattern or difference between aligned and unaligned wards in non-mayoral election years.

In election years (figures on the diagonal), there is a systematic difference between aligned and unaligned wards during the inter-election period. In June, July, and August of the three mayoral election years, unaligned wards have the same or more maintenance in 7/9 months. In October, aligned wards have more or the same maintenance in all three months. Finally, notice maintenance trends are exactly the same in 2016, the same in the pre-IEP period of 2017, then diverge once the IEP begins in 2017. Figure 5 is consistent with the preliminary evidence in Table 2.

\textsuperscript{19}Using separate figures also helps deal with low amounts of maintenance during winter months.
IV Difference-in-Differences Results

IV.a Political Alignment and Maintenance Timing in Election Years

Table 3 presents the initial results from estimating Equation 1. Panel A, column 1 considers the entire June-October period between voter registration and when votes are cast for the mayoral election. The DD coefficient is not statistically significant. It is possible that opposite effects on either side of the election season are competing in this DD coefficient that aggregates all months in the IEP together.

Column 2 of Panel A does not include June and July in the IEP. Column 3 only includes October in the IEP, the month directly before the mayoral election. The DD coefficient is positive and becomes statistically significant above 95 percent confidence in column 3. Consistent with expectations due to weather concerns, the coefficient on any road maintenance being completed in October, Oct in Election Year, of mayoral election years is negative.

The DD coefficient can be interpreted that even though there is less maintenance during October, specifically October of the mayoral election seasons, there is comparatively more maintenance being completed in politically aligned wards.\(^{20}\) The magnitude of the DD coefficient suggests there are 267 percent more projects in October of election season in politically aligned wards, compared to non-politically aligned wards.\(^{21}\) This sizeable magnitude is consistent with the descriptive statistics of Table 2. The result implies the mayor believes heavy road maintenance is perceived as a disamenity. Therefore, the mayor strategically decreases the amount of invasive projects conducted relatively close to the time of the election in areas of the city that are less politically aligned.

The focus of Panel B is investigating the months further from the time of the election, focusing specifically on the earlier months of the inter-election period. Only considering maintenance projects in June in column 1, the DD estimate is not statistically significant. In column 2, the effect of political alignment during election seasons is negative and statistically significant. Although there are more projects being done in June-August, which is consistent with this time being prime maintenance season and shown by the June-August in election year dummy, those maintenance projects are occurring in primarily non-aligned areas. The magnitude of the DD coefficient can be

\(^{20}\)Note that this holds the effect of October constant with month fixed effects also.

\(^{21}\)The coefficient magnitude is calculated: \((e^{1.30} - 1) \times 100 = 267\) percent.
interpreted as an 118 percent increase in politically unaligned places compared to non-politically
aligned places in June-August of election seasons. This result suggests that heavy road mainte-
nance could also be used as a signal of competence in less aligned areas.

The results suggest that, controlling for seasonal maintenance patterns, there is a detectable
effect of political incentives on road maintenance timing and location. Additionally, the signs are
strongest and opposite in the tail months of the inter-election period. This finding is consistent with
the political incentive argument: the election is most salient to voters the closer it is to the election.
To avoid potentially upsetting or inconveniencing potential voters in the non-aligned areas of the
city close to the election, it appears that the mayor is strategically shifting maintenance out of these
non-aligned areas in October and increasing maintenance in these areas at a time further away from
the election (June-August). The relative magnitudes of the significant DD coefficients suggest there
is a net reduction in the amount of maintenance completed in an election year since there are less
projects substituted into aligned wards during October than are substituted out in June-August. It
also suggests that maintenance projects are both a disamenity and a signal of competence.

IV.b Adjusting Standard Errors For Few Clusters

One potential issue with the estimates in Table 3 is the potential for confidence intervals which
are too narrow; this is a result of a low number of clusters (Cameron and Miller, 2015). Because
of this, the estimated cluster-robust standard errors may have inappropriately strong asymptotic
assumptions. To address the potentially narrow standard errors, a permutation test is used which
is less vulnerable to low amounts of clusters (Fisher, 1935). This procedure is based on Fisher’s
exact p-value. The procedure falsely randomly shuffles political competition z-scores within wards
across different years. This keeps the distribution of political alignment within wards the same.

The placebo distribution of test statistics is displayed in Figure 6. The actual test statistic
from the DD coefficient, IEP X PAUp, in Table 3, Panel B, column 2, is less than 999 of the
false test statistics. This implies an exact Fisher p-value of 1/1000 = 0.001. Thus, adjusting the

22Cameron and Miller (2015) suggests that forty clusters may be okay, ≥ fifty clusters is okay, less than forty could
be problematic. This paper has thirty-two ward-level clusters.
23This is a similar approach to deal with narrow confidence intervals from few clusters as Cunningham and Shah
(2018).
confidence intervals for few clusters on IEP X PAUp for June-August does not reduce the statistical significance from over 99 percent confidence.

Panel B of Figure 6 shows the distribution of Z-statistics for the same procedure, except now the coefficient of interest is IEP X PAUp from Column 3, Panel A, of Table 3. In this case, the actual Z-statistic on IEP X PAUp is greater than 992 out of the 1000 placebo Z-statistics. This implies that the Fisher exact p-value is 8/1000 = 0.008. The results in Figure 6 implies that the statistical significance from the DD models is not merely a result of too few clusters.

V Using Physical Ward Boundaries to Investigate Political Incentive Mechanism

V.a Using Space to Investigate Political Incentives as Mechanism

Several relevant concerns are addressed using spatial regression discontinuity plots. These plots compare road segments on either side of ward borders where the political alignment is different between these wards. This approach leverages a different source of variation: geographic. The geographic variation is how far the project is from being located in a certain ward, based on arbitrarily drawn political ward boundaries, which do not change. Roads close to boundaries are probably similar along many dimensions; the only difference is that road segments on either side are treated by a different level of political alignment.

The estimated DD coefficients could not be interpreted as causal if road maintenance causes changes in the political alignment of wards. Although this is unlikely, the possibility cannot be ruled out in a DD framework. Additionally, if there are omitted third variables which are correlated with the treatment (political alignment) and outcome (road maintenance), then the DD coefficient is biased. Finally, this addresses the criticism of using temporal, possibly small changes in alignment, by instead focusing on geographic variation in alignment.

24 The unobservables that affect road maintenance such as labor costs, weather, auto traffic, etc. are likely similar on either side of the political boundary. This implies unobservables are unlikely to bias the effect of political alignment.

25 If the lack of road maintenance causes a certain ward to become less politically aligned, for instance, this would threaten the causal interpretation of the DD estimates.
V.b Data

V.b.1 Data Construction

The roads of Pittsburgh are split into 1-meter segments. A dummy variable is created for every 1-meter segment to indicate if that segment was maintained for every possible month-year combination in the sample period. There are approximately 210 million segment-month-year level observations.

The distance from the midpoint of these segments to the nearest political ward boundary is calculated using GIS. These distances are converted appropriately to negative values if the political alignment deviation of the ward the project took place in was more negative than the political alignment deviation of the closest bordering ward. The possible closest ward boundaries are restricted to those interior in the city; boundaries defining the city limit or those bordering rivers on one side are dropped as possible closest boundaries. Each boundary is assigned a classification for each year based on the deviation in political alignment of the wards on either side of it.

If a boundary is classified as unaligned, the two wards on either side of the boundary deviated in opposite directions in a given year. An aligned boundary had wards that deviated in the same direction of political alignment in that year. If a maintenance project is located in a ward with positive alignment, but was closest to an unaligned boundary, a positive distance value was assigned to that project; projects in relatively unaligned wards closest to unaligned boundaries were assigned negative distances. For example, if maintenance took place on a 1-meter segment in a ward that deviated towards political alignment that year and that project is closest to a boundary with an unaligned ward on the other side, the distance for that road segment in that year is defined as positive.26

261-meter segments that are located in wards with the largest deviation towards political alignment are assigned positive distances in cases where the two wards on either side of the ward boundary both deviated towards political alignment. 1-meter segments that are located in wards with the smallest deviation towards political unalignment are assigned positive distances in the cases where both wards on either side of a boundary deviated towards political unalignment.
V.c Ward-Level Spatial Discontinuity

V.c.1 Distribution of Roads at the Ward Boundary Cutoff

Figure 7 shows the number of 1-meter road segments by distance to the ward boundary. There is a large increase in the number of 1-meter segments near the ward boundary border/cutoff. The large increase is consistent with roads also serving as ward boundaries. In the following analyses, road segments within ten meters of the border are dropped.\textsuperscript{27} This approach has the advantage of dropping projects that could possibly extend over borders and road segments that may differ substantially due to their use as ward boundaries.

V.c.2 Plots of Boundary Differences in Ward Political Alignment on Maintenance

Figure 8 shows the mean amount of maintenance on either side of the ward boundary cutoff. Observations just to the right of the red line are road segments which are just inside a politically aligned ward. The y-variable is a small number because there are tens of thousands of road segments within each bin and maintenance is a relatively rare outcome. Nevertheless, the y-variable has the interpretation of the probability that the segment is maintained, conditional on distance from being in a more politically aligned ward.

Panel 8a shows that there is a slightly lower chance of a segment being maintained conditional on it being barely within a politically aligned ward during mayoral election year. Panel 8c shows that this effect is not visible in non-mayoral election years. The sign of political alignment in mayoral election year on maintenance is negative, just like in the DD results.

The DD results suggesting more maintenance takes place in aligned areas in October of election year are also confirmed in Panel 8b. There is no discontinuity at the cutoff which would be expected for a more typical RD application. The reason for this is that individuals in the unaligned district can still drive on aligned roads. However, around 90 meters into an aligned ward, maintenance starts to be completed again. In contrast, this resurgence of maintenance 90 meters from the boundary is not observed in the unaligned wards. Furthermore, there appears to be no difference

\textsuperscript{27}This dropping is similar to donut RD approach. This approach is not what the donut approach is typically used for; it is mainly utilized for dealing with those observations most likely to have sorted into/out of treatment.
in maintenance between aligned and unaligned wards during non-mayoral election years in Panel 8d.\textsuperscript{28}

\textbf{V.c.3 Plots of Boundaries With No Change in Political Alignment on Maintenance}

In order to further investigate the mechanism, we investigate whether there is an effect at borders where the political alignment does not change across wards. The results are also presented in Figure 8. In Panel 8e, there is a similar dip at the cutoff to Panel 8a. However, in Panel 8a the maintenance goes to 0 about 50 meters away from the cutoff, but in Panel 8e the maintenance probability increases around 50 meters.

In Panel 8f, there is no maintenance near the cutoff, similar to Panel 8b. The difference is that maintenance on either side of the cutoff increases some distance away from it in Panel 8f, whereas it only increases on the aligned side in October when political alignment changes at the boundary in Panel 8b. Similar to Panels 8c and 8d, there is no detectable effect of the cutoff in non-mayoral election years in Panels 8g and 8h. Overall, these findings at the “placebo” boundary cutoffs confirm that it is not just a boundary effect, but the effect of changing political alignment in mayoral election years.

\section*{VI Calculating Political Incentives Costs for Road Maintenance}

Table 4 replicates Table 3 with a new dependent variable. Instead of the count of completed maintenance projects, now meters of completed maintenance and OLS are used. The same groups of months as in Table 3 are statistically significant above 95 percent. The DD coefficient in column 4 is interpreted as 605.76 meters less maintenance are completed in aligned wards during June-August of election year. The DD coefficient in column 1 suggests that 565.48 of that maintenance is substituted into politically aligned wards in October of election year. The estimates from Table

\textsuperscript{28}Figure 8d does not contain years where there is a national election. The focus of this paper is the effect of local political incentives, however Figure A.2 also shows there may also be national political incentives which affect local maintenance. The figure is consistent with the idea that maintenance is deployed to increase travel time to polls in unaligned wards, making marginal costs of voting higher.
4, along with some supplemental data, allow a direct calculation of the cost of political incentives for road maintenance in Pittsburgh.29

The findings are 605.76 meters of road maintenance are delayed by 3-5 months from the June-August period until October. Splitting the 3-5 month difference, all road maintenance is assumed to be delayed by four months. Delayed road maintenance causes the cost of maintenance to be higher (Burningham and Stankevich, 2005). Taking the numbers from Burningham and Stankevich (2005), an exponential curve is fit to their two data points and shown in Figure 9.30 The equation of the fitted exponential curve is: \((1.0153 \times \exp(0.5796 \times \text{delayed years}))\). Plugging in 4/12 for “delayed years,” this equation calculates delaying maintenance by four months causes maintenance to be 1.231 times more expensive.

Using this multiplier requires knowing undelayed, per meter maintenance costs. The cost of 1 meter of road maintenance in Pittsburgh is $45.55 per meter on average. For each year, the per meter average cost is calculated by taking the total paving expenditures in Figure 1 and dividing by the total length of maintenance. Then, the average across years is calculated, weighted by the expenditure amount in each year. This is done to account for years that happened to have larger amounts of spending on paving.31 The cost of the delayed meters multiplied by the cost multiplier extrapolated from Burningham and Stankevich (2005) (605.76 meters * $45.55 cost/meter * 1.231 delay multiplier) implies an additional cost of $33,966 due to political incentives per mayoral electoral cycle.

Second, there are 605.76 meters less maintenance in politically aligned wards in June-August, but only 565.48 additional meters in politically aligned wards in October. This suggests 40.28 meters of heavy road maintenance are not completed in each mayoral election cycle. For reference, one small pothole is considered to be about 1 square meter, so one mayoral election cycle causes 40.28 small potholes in Pittsburgh.32 33

29We only quantify the cost for road maintenance. There are likely other costs such as health outcomes, like in Bauernschuster et al. (2017).
30A point is added at (0,1) to reflect that 0 delay does not make maintenance more expensive.
31Not weighting like this does not change the average per meter cost by more than $1.92 per meter.
33Additional costs of potholes that are not included in the estimates are potential damages to vehicles attributable to potholes and potential time costs due to slower commutes caused by potholes.
Assume the election cycle potholes are not repaired right away and are repaired at some point before the next election. For simplicity, they are all assumed to be repaired in two years (splitting the difference between 0 and four years later.) At 40.28 meters and a cost of $45.55/meter, the initial cost of this foregone maintenance is $1,835. Given a two-year delay multiplier of 3.236, the total cost of the roadwork that was not substituted from June-August in the same year is $5,938.\textsuperscript{34} Adding together both the cost of the roads that are delayed during the season, $33,966, and the roads that are assumed to be maintained in at a later time, $5,938, is a total cost of $39,904 due to one mayoral election cycle in Pittsburgh. For reference, the per capita income for a Pittsburgh resident in 2017 was $51,187.

\textbf{VI.a Across Comparable Cities}

So far, the focus has been on one local election cycle in one city; however, local election cycles are widespread and fairly frequent. Estimates of these costs across the U.S. as a whole are provided. Comparable cities from the Federal Highway Administration’s list of urban areas with more than 750,000 residents in 2018 are used.\textsuperscript{35} Specifically, the one-election-cycle delayed maintenance costs found for Pittsburgh, $39,904, are multiplied across the forty-seven cities found in the Federal Highway Administration’s list of urban areas with more than 750,000 residents in 2018. This brings the total cost of maintenance delays from one U.S. local election cycle to $1,875,488 in cities with over 750,000 residents.

To use more comparable cities, several variables from the Federal Highway Administration data are used to exclude cities measurably dis-similar from Pittsburgh. Variables used include population, population density, total highway miles, highway miles per capita, highway miles travelled per capita, AADT, etc. Because Pittsburgh sits near the average for these variables, cities not within two standard deviations of the average of each variable are dropped for not being comparable. Table 5 shows both the forty-seven cities that were originally included and a description of the variable that caused ten cities to be dropped to build a more accurate comparison group. Using \textsuperscript{34}This is conservative, because the road maintenance could be put off much longer than two years.\textsuperscript{35}Source: \url{https://www.fhwa.dot.gov/ohim/ohn00/ohn2p11.htm}
these comparable thirty-seven cities instead, the total cost of one U.S. local election cycle for only similar, large cities is $1,476,448.\textsuperscript{36}

Differently/smaller sized cities are also likely to suffer from mayoral election cycle distortions.\textsuperscript{37} According to World Population Review (2020), there are 19,495 incorporated cities, towns, and villages in the United States and 14,768 have populations under 5,000, making them very different than Pittsburgh. However, 310 cities are considered medium-sized, meaning the city has a population of at least 100,000.

Additionally, local election cycles take place fairly frequently, so a time period over which to calculate costs must be chosen. There are three periods of road construction in recent U.S. history according to Glaeser and Ponzetto (2018); the second one begins in 1960. This recent period is characterized by increasing political organization and opposition to new construction, so it is used as the period over which local elections are increasing the cost of maintenance. Since 1960, sixty years ago, there have been fifteen local election cycles in thirty-seven comparable cities.\textsuperscript{38} Multiplying the cost over these large cities over the last 60 years, over $22 million dollars has been lost due to shifted/delayed maintenance from U.S. local election cycles since 1960. Multiplying the cost over cities with a 2020 population of at least 100,000, over the last sixty years, over $185.5 million dollars has been lost due to shifted/delayed maintenance from U.S. local election cycles.

VI.b Low Political Competition Means Estimates are Lower Bounds

In addition to lack of inclusion of other costs of potholes, another factor that would cause costs to be underestimated is if the distortion due to political incentives is larger in other cities. This is a fair concern, especially given that Pittsburgh has not had a Republican mayor since 1934 and the nine person city council has been entirely Democratic since 1933. To understand how much potential there is for under-estimation of costs due to more political competition in other cities, compared to the Pittsburgh baseline, data on party of mayors is gathered going back to 1960.\textsuperscript{39}

\textsuperscript{36}All dollar figures are in nominal dollars.

\textsuperscript{37}Larger cities likely pay public servants a higher wage, so there may be more incentive to capture the office (The Business Journals, 2018). On the other hand, the opportunity cost of being mayor is lower in other cities because wages tend to be higher in dense cities (Glaeser and Maré, 2001).

\textsuperscript{38}Assuming a local election occurs every four years.

\textsuperscript{39}Data was collected from city websites and publicly available information. Some cities have incomplete information regarding the political party of their mayor over time. Nevertheless, this constructed variable shows the variability of cities relative political “competitiveness” across the county.
Table 5 lists the number of Republican mayors for each of the forty-seven cities from the original Federal Highway Administration list. Number of Republican mayors is an appropriate approximation of political competition because the closer this number is to the midpoint of the number of local elections since 1960 (0,15), the more times the office has changed party control. Of the forty-seven cities on this list, thirty-one have had at least one Republican mayor, implying they are more politically competitive than Pittsburgh. The average number of Republican mayors is 2.33, suggesting that some other cities may be orders of magnitude more competitive than Pittsburgh. This gives quantitative perspective to the degree of political competitiveness of Pittsburgh compared to other cities, which supports the claim that the cost estimates are conservative when multiplied across other similar cities in the U.S.

VII Conclusion

The main result is that politically aligned wards have less maintenance projects in months farther from the election, but more maintenance projects in months close to the election. The results are not caused by maintenance seasonality, too few clusters, or relying solely on temporal variation. The coefficients suggest road maintenance is both a disamenity and a signal of competence. City officials seem to think that they will be given credit for maintenance, but that it does inconvenience the constituency. To boost their vote shares at the margin, elected officials do extra road work in unaligned areas in the summer (June-August) of an election year. This leads voters to credit them for maintaining roads, but does not cause salient maintenance delays around the time the ballots are cast. To make up for this shift, the officials must shift additional maintenance into aligned areas near election time of mayoral elections.

There are some limitations to this study. First, other cities are not investigated, because historical maintenance data is not publicly available for other cities. The data includes only maintenance projects on existing roads, not construction of new roads. Construction is the main topic of interest in Glaeser and Ponzetto (2018), but maintenance is a close substitute. The maintenance data includes an end date but not an exact start date, so the exact amount of maintenance time for each project is unknown. Finally, the city of Pittsburgh is not politically competitive relative to other

\[40\] Often times city websites only include ongoing maintenance.
large cities. Low political competition suggests the findings could be lower bounds of the political incentive mechanism’s effect on local road maintenance.

These findings contribute to the literature in three primary ways. First, it extends political budget cycle analysis to a salient, observable public good. Part of this contribution is using a difference-in-differences model and spatial discontinuities, which leverage observable political alignment and are not vulnerable to bias from seasonal maintenance.

Second, it further investigates the relationship between political incentives and infrastructure, particularly the seemingly dissonant findings between Glaeser and Ponzetto (2018) and Huet-Vaughn (2019). The findings of this paper suggest there is less dissonance than initially perceived; road maintenance can function as both a disamenity and a signal of competence. It does not appear that the geographic level of analysis is responsible for the difference in previous findings (Glaeser and Ponzetto, 2018; Huet-Vaughn, 2019).

Third, the results document a new source of political distortions to infrastructure maintenance: local election cycles. This new source of political distortion can be added to several already proposed by Winston (2013). The cost of this political distortion to infrastructure maintenance is calculated across cities with at least 100,000 residents (in 2020) and found to cost at least $185.5 million. These results and cost calculations provide a stark warning to policy-makers concerning road maintenance decisions; allowing politics to enter the maintenance decision-making process will harm the fiscal position of cities by increasing expenses at no benefit other than for political gain. The unnecessary costs from political incentives could put municipalities in a worse position to adjust to shocks to their finances, such as the Great Recession and COVID-19. It may be interesting in future work to investigate whether other specific types of public investment are affected.

Detter and Fölster (2017) suggests a way to reduce the impact of political concerns is to have financial asset managers make decisions. This has the drawback of reducing accountability, but a potential benefit of reducing distortion due to political incentives. At least in the city of Pittsburgh, one election costs less than the income per capita of a Pittsburgh resident, making this option not obviously beneficial. In a more politically competitive city with more distortions, this option warrants further consideration.
Figure 1: Pittsburgh Expenditures (2009-2017)

Note: Graph charts the expenditures on roads and road maintenance in the city of Pittsburgh for the length of the sample (2009-2017). The navy line represents total expenditures on highways and streets (construction, repair, etc.), while the orange-dashed line represents the expenditures just on paving and resurfacing. Sources: Pittsburgh Comprehensive Annual Financial Reports (https://pittsburghpa.gov/controller/cafr) and Pittsburgh Capital Budgets (https://pittsburghpa.gov/council/capital-budgets)
Figure 2: Monthly Completion of Invasive Road Maintenance

Note: Graph displays sum of heavy paving projects per year in the city of Pittsburgh from 2009-2017. The red line represents years when there is a mayoral election. The blue line represents years that do not have a mayoral election. Mayoral elections are held in 2009, 2013, and 2017. Numbers represent raw project, not adjusted to yearly averages. Red-dashed lines mark the length of the inter-election period. Non-election years refers to non-mayoral election years, thus it includes 2012 and 2016 which are national election years.
Figure 3: Within-Ward Political Alignment

Note: Within-ward political alignment deviations are shown across Pittsburgh wards for all years of the data (2009-2017). Mayoral election years are shown on the diagonal. Deviations in alignment within a ward are measured as 0.675 standard deviation changes from that same ward’s median political alignment measure. Here, the proportion of registered Democratic voters is used to proxy for political alignment. If a ward became “less politically aligned” (less registered Democrats) relative to its average alignment across the sample time period, it is shown in orange above as a negative change (-); “more politically aligned” (more registered Democrats) is shown in navy above as a positive change (+). Between 0 and 0.675 standard deviations from the median are shown in lighter shades of these respective colors (Small negative change: (-); small positive change: (+)). Greater than 0.675 standard deviations from the median in either direction are represented by darker shades of their respective colors (Large negative change: (-)(-); large positive change: (+)(+)).
Figure 4: Maintenance Projects and Roads Overlayed Above Political Wards

Note: This map of Pittsburgh shows the total universe of city-maintained roads and where maintenance occurred during the sample period. The black lines are all city-maintained roads, and the orange lines show segments where maintenance occurred. Thick black lines denote ward boundaries.
<table>
<thead>
<tr>
<th>Type of Maintenance</th>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Repair</td>
<td>Removing damaged pavement, determining cause of failure and appropriate solution, resurfacing of road</td>
<td>Heavy</td>
</tr>
<tr>
<td>SuperPave</td>
<td>Pavement mix designed to combat deformation and low temperature cracking</td>
<td>Heavy</td>
</tr>
<tr>
<td>Mill and Overlay (SuperPave)</td>
<td>Existing pavement removed, milled, surface overlaid with SuperPave pavement</td>
<td>Heavy</td>
</tr>
<tr>
<td>Mill and Overlay, ≥ 3”</td>
<td>Existing pavement surface removed, milled to a depth of greater than 3 inches, surface overlaid with new asphalt pavement</td>
<td>Heavy</td>
</tr>
<tr>
<td>Non-Heavy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill and Overlay, &lt; 3”</td>
<td>Existing pavement surface is removed, milled to a depth of less than 3 inches, surface is overlaid with new asphalt pavement</td>
<td>Non-Heavy</td>
</tr>
<tr>
<td>AC Overlay</td>
<td>Pavement is placed down on top of existing pavement, no milling of existing road</td>
<td>Non-Heavy</td>
</tr>
<tr>
<td>Mechanical Patching</td>
<td>Small areas and irregularities patched over</td>
<td>Non-Heavy</td>
</tr>
<tr>
<td>Profile Milling</td>
<td>Just the edges of the road are milled down</td>
<td>Non-Heavy</td>
</tr>
</tbody>
</table>

Note: Types of maintenance projects completed in Pittsburgh are shown above. Only **heavy** maintenance classifications are used in the main analysis.
<table>
<thead>
<tr>
<th></th>
<th>Non-Election Year</th>
<th></th>
<th>Election Year</th>
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<th>Total</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Maintenance Mean</td>
<td>SE</td>
<td>Maintenance Mean</td>
<td>SE</td>
<td>Maintenance Mean</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Before Inter-Election Period</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>April-Unaligned (n=144)</td>
<td>1.45 (0.54)</td>
<td></td>
<td>0.31 (0.19)</td>
<td></td>
<td>1.07 (0.37)</td>
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<tr>
<td>April-Aligned (n=144)</td>
<td>1.96 (0.52)</td>
<td></td>
<td>0.65 (0.29)</td>
<td></td>
<td>1.52 (0.36)</td>
<td></td>
</tr>
<tr>
<td>May-Unaligned (n=144)</td>
<td>2.34 (0.58)</td>
<td></td>
<td>4.35 (1.21)</td>
<td></td>
<td>3.01 (0.56)</td>
<td></td>
</tr>
<tr>
<td>May-Aligned (n=144)</td>
<td>1.84 (0.47)</td>
<td></td>
<td>2.50 (0.77)</td>
<td></td>
<td>2.06 (0.40)</td>
<td></td>
</tr>
<tr>
<td><strong>Total (n=576)</strong></td>
<td>1.90 (0.26)</td>
<td></td>
<td>1.95 (0.39)</td>
<td></td>
<td>1.92 (0.22)</td>
<td></td>
</tr>
<tr>
<td><strong>Inter-Election Period</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>June-Unaligned (n=144)</td>
<td>2.44 (0.80)</td>
<td></td>
<td>1.52 (0.90)</td>
<td></td>
<td>2.13 (0.61)</td>
<td></td>
</tr>
<tr>
<td>June-Aligned (n=144)</td>
<td>3.61 (0.80)</td>
<td></td>
<td>0.98 (0.31)</td>
<td></td>
<td>2.74 (0.55)</td>
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</tr>
<tr>
<td>July-Unaligned (n=144)</td>
<td>1.47 (0.42)</td>
<td></td>
<td>4.31 (1.01)</td>
<td></td>
<td>2.42 (0.45)</td>
<td></td>
</tr>
<tr>
<td>July-Aligned (n=144)</td>
<td>2.13 (0.44)</td>
<td></td>
<td>2.00 (0.74)</td>
<td></td>
<td>2.08 (0.39)</td>
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</tr>
<tr>
<td>August-Unaligned (n=144)</td>
<td>3.41 (0.67)</td>
<td></td>
<td>3.77 (0.81)</td>
<td></td>
<td>3.53 (0.52)</td>
<td></td>
</tr>
<tr>
<td>August-Aligned (n=144)</td>
<td>2.70 (0.67)</td>
<td></td>
<td>1.77 (0.52)</td>
<td></td>
<td>2.39 (0.48)</td>
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</tr>
<tr>
<td>September-Unaligned (n=144)</td>
<td>0.67 (0.22)</td>
<td></td>
<td>0.98 (0.40)</td>
<td></td>
<td>0.77 (0.20)</td>
<td></td>
</tr>
<tr>
<td>September-Aligned (n=144)</td>
<td>2.50 (0.45)</td>
<td></td>
<td>2.58 (0.87)</td>
<td></td>
<td>2.53 (0.42)</td>
<td></td>
</tr>
<tr>
<td>October-Unaligned (n=144)</td>
<td>2.93 (0.73)</td>
<td></td>
<td>0.38 (0.19)</td>
<td></td>
<td>2.08 (0.50)</td>
<td></td>
</tr>
<tr>
<td>October-Aligned (n=144)</td>
<td>1.50 (0.38)</td>
<td></td>
<td>1.21 (0.39)</td>
<td></td>
<td>1.40 (0.28)</td>
<td></td>
</tr>
<tr>
<td><strong>Total (n=1,440)</strong></td>
<td>2.33 (0.19)</td>
<td></td>
<td>1.95 (0.22)</td>
<td></td>
<td>2.21 (0.15)</td>
<td></td>
</tr>
<tr>
<td><strong>After Inter-Election Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November-Unaligned (n=144)</td>
<td>1.29 (0.33)</td>
<td></td>
<td>0.56 (0.28)</td>
<td></td>
<td>1.05 (0.24)</td>
<td></td>
</tr>
<tr>
<td>November-Aligned (n=144)</td>
<td>0.79 (0.24)</td>
<td></td>
<td>0.38 (0.14)</td>
<td></td>
<td>0.65 (0.17)</td>
<td></td>
</tr>
<tr>
<td>December-Unaligned (n=120)</td>
<td>0.06 (0.05)</td>
<td></td>
<td>0.00 (0.00)</td>
<td></td>
<td>0.05 (0.04)</td>
<td></td>
</tr>
<tr>
<td>December-Aligned (n=136)</td>
<td>0.01 (0.01)</td>
<td></td>
<td>0.00 (0.00)</td>
<td></td>
<td>0.01 (0.01)</td>
<td></td>
</tr>
<tr>
<td><strong>Total (n=544)</strong></td>
<td>0.54 (0.11)</td>
<td></td>
<td>0.28 (0.10)</td>
<td></td>
<td>0.46 (0.08)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The mean count of heavy maintenance projects per ward in each month-alignment classification is shown, separated by whether it is a mayoral election year (2009, 2013, 2017) or not. Descriptions of heavy projects are shown in Table 1. There are three election years and six non-election years in the data. The mean count of heavy maintenance over the total nine years is also shown. Alignment classification is determined by within-ward deviations in political alignment in a given year. N is the number of wards that fall into each month-alignment classification over the length of the data (2009-2017). SE = standard error.
Figure 5: Political Alignment and Maintenance Projects Trends in Mayoral Election Cycles

Note: Election years (2009, 2013, and 2017) for the mayor are shown on the diagonal using red vertical lines to define the inter-election period. Non-election years, representing the counterfactual inter-election periods in which the mayor is not up for election, are shown in all other figures and use black vertical lines to define the inter-election period. The navy series in each year represents the maintenance projects in wards that had a higher within-ward deviations towards being more politically aligned with the mayor (higher deviations towards more registered Democrats for a given ward-year). The orange series in each year represents the maintenance projects in wards that had higher within-ward deviations towards being politically unaligned.
Table 3: How Narrowing Months Affects Number of Heavy Maintenance Projects

Panel A: Removing Summer Months

<table>
<thead>
<tr>
<th></th>
<th>(1) Jun-Oct</th>
<th>(2) Aug-Oct</th>
<th>(3) Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Alignment Above Deviation Median (PAUp)</td>
<td>-0.16 (0.13)</td>
<td>-0.24** (0.12)</td>
<td>-0.24* (0.12)</td>
</tr>
<tr>
<td>Jun-Oct in Election Year (IEP)</td>
<td>0.03 (0.33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td>-0.22 (0.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug-Oct in Election Year (IEP)</td>
<td></td>
<td>-0.26 (0.21)</td>
<td></td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td></td>
<td>0.22 (0.25)</td>
<td></td>
</tr>
<tr>
<td>Oct in Election Year (IEP)</td>
<td></td>
<td></td>
<td>-1.77*** (0.57)</td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td></td>
<td></td>
<td>1.30*** (0.50)</td>
</tr>
<tr>
<td>Treated Observations</td>
<td>240</td>
<td>144</td>
<td>48</td>
</tr>
</tbody>
</table>

Panel B: Removing Months Near Election

<table>
<thead>
<tr>
<th></th>
<th>Jun</th>
<th>Jun-Aug</th>
<th>Jun-Oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Alignment Above Deviation Median (PAUp)</td>
<td>-0.20 (0.12)</td>
<td>-0.07 (0.12)</td>
<td>-0.16 (0.13)</td>
</tr>
<tr>
<td>Jun in Election Year (IEP)</td>
<td>-0.68 (0.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td>-0.35 (0.62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun-Aug in Election Year (IEP)</td>
<td></td>
<td>0.46* (0.26)</td>
<td></td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td></td>
<td>-0.78*** (0.21)</td>
<td></td>
</tr>
<tr>
<td>Jun-Oct in Election Year (IEP)</td>
<td></td>
<td>0.03 (0.33)</td>
<td></td>
</tr>
<tr>
<td>IEP X PAUp</td>
<td></td>
<td>-0.22 (0.20)</td>
<td></td>
</tr>
<tr>
<td>Treated Observations</td>
<td>48</td>
<td>144</td>
<td>240</td>
</tr>
<tr>
<td>Observations</td>
<td>2560</td>
<td>2560</td>
<td>2560</td>
</tr>
</tbody>
</table>

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors clustered at the ward level are shown in parentheses. Estimates are from Poisson conditional fixed effect model, shown in Equation 1. Ward, month, and year (uninteracted) fixed effects are included in every column. Grouping months by relative distance to the election are shown in columns 1-3. Panel A isolates the months closest to the election, while Panel B isolates the months furthest from the election. IEP stands for inter-election period. PAUp stands for political alignment. The DD coefficient of interest for every column in both panels is “IEPxPAUp.” Treated observations denote the number of ward-month-year observations which are 1 for IEPxPAUp.
Panel A: June-August DD Coefficient Placebo Z-Statistics Distribution

Panel B: October DD Coefficient Placebo Z-Statistics Distribution

Figure 6: Randomization Inference

Note: Political alignment is shuffled within wards, across years. This leaves the distribution of alignment within-ward the same. Panel A: The test statistics displayed are from estimating IEP X PAUp in the Panel A, column 2 of Table 3 under falsely randomly assigned political alignment within ward across years. The actual test statistic is lower than the falsely randomized test statistics in 999/1000 permutations. In Panel B: The test statistics displayed are from estimating IEP X PAUp in Panel B, column 3 of Table 3 under falsely randomly assigned political alignment within ward across years. The actual test statistic is greater than the falsely randomized test statistics in 992/1000 permutations.
Figure 7: Number of 1 Meter Road Segments by Distance to Ward Boundary

Note: 1 segment per year kept, because political alignment changes yearly.
Figure 8: Ward-Level Spatial RD Plots, Combining Tests and Falsification

Note: Panels D and H drop out national election years, 2012 and 2016. Blue dots are politically unaligned, red dots are politically aligned. X-axis is distance to more politically aligned ward. Within 10 meters of boundary dropped due to the likelihood they are exactly on the border.
Table 4: Continuous Meters

<table>
<thead>
<tr>
<th></th>
<th>More Maintenance</th>
<th>Entire IEP</th>
<th>Less Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEP</td>
<td>-881.34***</td>
<td>-295.13**</td>
<td>-59.49</td>
</tr>
<tr>
<td></td>
<td>(218.48)</td>
<td>(137.40)</td>
<td>(202.73)</td>
</tr>
<tr>
<td>IEP * PA</td>
<td>565.48**</td>
<td>323.81</td>
<td>-69.37</td>
</tr>
<tr>
<td></td>
<td>(254.61)</td>
<td>(213.18)</td>
<td>(161.45)</td>
</tr>
<tr>
<td>Treated Observations</td>
<td>48</td>
<td>144</td>
<td>240</td>
</tr>
<tr>
<td>Observations</td>
<td>2560</td>
<td>2560</td>
<td>2560</td>
</tr>
</tbody>
</table>

Note: * p < 0.1, ** p < 0.05, *** p < 0.01 Estimates are from OLS two-way fixed effects models. Model includes ward, year, and month (uninteracted) fixed effects. Standard errors, clustered at the ward level, are shown in parentheses. DD coefficient of interest is “IEPxPA.” The dependent variable is meters of road maintenance in a ward-month-year.
Figure 9: The Cost of Road Maintenance Delays in this Context

Note: Exponential function extrapolated from two points which are noted in Burningham and Stankevich (2005). We added a point at (0,1), because it is likely there is no extra cost from no delay. This reduces the R-squared from 1 to 0.9995.
<table>
<thead>
<tr>
<th>Urban Area</th>
<th>Variable Outside of Two SD from Mean</th>
<th>Number of Republican Mayors Since 1960</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York Northeastern NJ, NY</td>
<td>Urbanized Population ↑</td>
<td>3</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>Urbanized Population ↑</td>
<td>2</td>
</tr>
<tr>
<td>Chicago - Northwestern IN, IL</td>
<td>Federal-Aid Urbanized Land Area ↑</td>
<td>0</td>
</tr>
<tr>
<td>Philadelphia, PA</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>San Francisco - Oakland, CA</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Dallas - Ft. Worth, TX</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Washington, DC</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>Daily Vehicle Miles per Capita ↑</td>
<td>0</td>
</tr>
<tr>
<td>Boston, MA</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>San Diego, CA</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>Daily Vehicle Miles per Capita ↑</td>
<td>2</td>
</tr>
<tr>
<td>Minneapolis - St. Paul, MN</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Miami - Hialeah, FL</td>
<td>Persons per Square Mile ↑</td>
<td>6</td>
</tr>
<tr>
<td>Phoenix, AZ</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Baltimore, MD</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>St. Louis, MO</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Denver, CO</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Tampa - St. Petersburg, FL</td>
<td>% of Travel Served by Freeways ↓</td>
<td>3</td>
</tr>
<tr>
<td>Cleveland, OH</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>San Jose, CA</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Ft. Lauderdale - Hollywood, FL</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Pittsburgh, PA</strong></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Norfolk - VA Beach - Newport News, VA</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>Total Freeway Miles per Urbanized Population ↑</td>
<td>1</td>
</tr>
<tr>
<td>Sacramento, CA</td>
<td></td>
<td>0</td>
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<tr>
<td>Riverside - San Bernardino, CA</td>
<td></td>
<td>1</td>
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<tr>
<td>Portland - Vancouver, OR</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>San Juan, PR</td>
<td>Daily Vehicle Miles per Capita ↓</td>
<td>NA</td>
</tr>
<tr>
<td>Las Vegas, NV</td>
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<td>1</td>
</tr>
<tr>
<td>Cincinnati, OH</td>
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<td>4</td>
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<tr>
<td>Orlando, FL</td>
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<tr>
<td>San Antonio, TX</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Buffalo - Niagara Falls, NY</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Oklahoma City, OK</td>
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<td>5</td>
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<tr>
<td>New Orleans, LA</td>
<td>Daily Vehicle Miles per Capita ↓</td>
<td>0</td>
</tr>
<tr>
<td>W. Palm Beach - Boca Raton - Delray Bch, FL</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Columbus, OH</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Memphis, TN</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Indianapolis, IN</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Providence - Pawtucket, RI</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Jacksonville, FL</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Salt Lake City, UT</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Louisville, KY</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Note: Urbanized areas in the United States with populations above 750,000 people, listed in order of population. ↑: two standard deviations above the mean of all cities listed; ↓: two standard deviations below the mean of all cities listed. Source: Federal Highway Administration (https://www.fhwa.dot.gov/ohim/ohn00/ohn2p11.htm) Number of Republican mayors since 1960 measures the relative political “competitiveness” of the cities on the list.
References


A Online Appendix
Figure A.1: Distributions of Political Alignment

Panel A: Within-Ward Alignment Cutoff

Panel B: Raw Republican Percentage Proportion

Notes: N = 288 ward-year observations
Figure A.2: Ward-Level Spatial RD Plot October, Non-Mayoral Election, National Election Included

Note: Picture includes national election years.