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HIGHWAY TO HITLER

Nico Voigtlaender
Hans-Joachim Voth

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ABSTRACT

Democracy is not an absorbing state; transitions to autocratic rule have been frequent throughout history and often followed periods of instability under democratic rule. In this paper, we ask whether autocrats can win support among voters by showcasing their ability to restore order and to "get things done." We analyze a famous case – the building of the highway network in Nazi Germany. Highway construction began shortly after Hitler became Chancellor, and was one of the regime's signature projects. Using newly collected data, we show that highway construction was highly effective in boosting popular support, helping to entrench the Nazi dictatorship. These effects are unlikely to reflect direct economic benefits. Instead, highway construction signaled economic "competence" and an end to austerity, so that many Germans credited the Nazi regime for the economic recovery. In line with this interpretation, we show that support for the Nazis increased particularly strongly where highway construction coincided with greater radio availability – a major source of propaganda. The effect of highways was also significantly stronger in politically unstable states of the Weimar Republic. Our results suggest that infrastructure spending can win "hearts" for autocracy when "minds" are led to associate it with visible economic progress and an end to political instability.

Nico Voigtlaender
UCLA Anderson School of Management
110 Westwood Plaza
C513 Entrepreneurs Hall
Los Angeles, CA 90095
and NBER
nico.v@anderson.ucla.edu

Hans-Joachim Voth
University of Zurich
Department of Economics
Schönberggasse 1
CH-8001 Zurich
and CREI
voth@econ.uzh.ch

A online appendix is available at http://www.nber.org/data-appendix/w20150

> "…while a decade of Weimar parliaments had produced only talk and sketches, a mere three years of National Socialism had built a thousand kilometres of traversable superhighways… Their very existence seemed to verify the Nazi thesis that the state must be given a free hand, if it were to restore Germany to her former glory." (Shand 1984, p.194).

1 Introduction

In the last 200 years, democracy has spread around the globe. In 1816, less than 1% of world population lived in democracies. In 2015, the figure stood at 58%. However, progress has not been a one-way street: Between 1920 and 1938, the number of democratic states in the world fell from 20 to 13, and the share of the population living in democracies declined from 20.5% to 14.8%.[1] History shows that there is no "end of history" (Fukuyama 1992); seemingly permanent triumphs of democracy and liberal values can be remarkably fragile. Nor is democratic fragility necessarily an issue of the past: Among younger cohorts of European and the U.S. citizens, an ever smaller share considers it essential to live in a democracy. In the U.S., the share declined from more than 70% among the 1930s birth cohort to about 30% for the 1980s cohort.[2]

For democracy to fail, autocracy has to triumph. Authoritarian leaders rarely rule by force alone, and many rely on popular support (Egorov and Sonin 2014). How do authoritarian rulers convince voters to discard and disregard their democratic rights? The decline of democracy is often associated with (perceived) social disorder. In these circumstances, dictatorships may look appealing to the masses because of their capacity to restore order (Finer 2002; Djankov et al. 2003). As Easterly and Pennings (2016) recently noted, the view that economic growth is easier to engineer under strong autocratic regimes has recently gained in prominence, with China and Singapore often cited as leading examples.[3] Similarly, Birdsall and Fukuyama (2011) observed that "political leaders in the developing world now associate efficiency and capability with autocratic political systems." Thirty percent of US

[1] Boix et al. (2012), Vanhanen (2010).

[2] Foa and Mounk (2016). The question asked is whether respondents feel "it is essential to live in a country that is governed democratically," where "Feeling strongly" corresponds to a rating of 10 on a 10-point scale.

[3] See also Friedman (2009). Jones and Olken (2005) show that changes in the leadership of autocracies lead to sharp changes in economic performance; Besley and Kudamatsu (2008) model the institutional features of autocracies that can increase their chances of success.

respondents in the 2010 World Value Survey thought that it would be "good or very good to have a strong leader" that does not have to "bother with parliaments and elections" (Foa and Mounk 2016). But do shows of efficacy, indeed, buy hearts and minds for budding dictators? It may instead be true that entrenched dictators are more effective, rather than effective dictators becoming entrenched.

In this paper, we aim to identify the causal effect of effective policy implementation on autocratic consolidation. We study a concerted effort to showcase an authoritarian state's ability to accomplish ambitious goals in a short space of time: the construction of the *Autobahn* in Nazi Germany. Initially, the Nazi grip on power was far from absolute. In an election that was neither free nor fair in November 1933, many voters opposed the Nazi regime. In several major cities, more than a quarter of votes were cast against the Nazi Party. By mid-1934, the regime was increasingly under strain. The regime's popularity amongst the middle class and workers was falling; conservative elites were increasingly dismayed by Nazi lawlessness, and President von Hindenburg threatened military rule. *Time Magazine* in July 1934 quoted Adolf Hitler as saying: "Don't forget how people laughed at me 15 years ago when I declared that one day I would govern Germany. They laugh now, just as foolishly, when I declare that I shall remain in power!"

And yet, by the late 1930s, the Nazi regime had become one of the most popular in German history. Historians speak of a "consensual dictatorship",[4] where public order had been restored after the chaos of the Weimar Republic's dying years, the economy had returned to full employment, and Hitler's foreign policy triumphs had restored Germany's greatness on the international stage (Evans 2006). Social democratic agents reporting on sentiment in the Reich saw no support for regime change amongst their constituency of industrial workers (Evans 2006). Even a decade after WWII, almost half of all Germans opined that Hitler would have been "one of the greatest German statesmen had it not been for the war" (Möbius 2013: 257).[5] We argue that *Autobahn* construction made an important contribution to the regime's popularity.[6] Announced by Adolf Hitler himself within days of taking office,

[4] Aly (2005) and Bajohr (2005).

[5] In another survey, some 10% opined that even with the war, Hitler was the greatest German statesman of all time, whose eminence would only be accepted in the future (Noelle and Neumann 1956: 135).

[6] Saiz (2005) notes a close association between dictatorships and highways, but argues that this is explained by their use as instruments of repression.

motorway construction was primarily intended to reduce unemployment. Within 9 months of coming to power, Hitler broke ground on the first stretch of motorway in the fall of 1933. It was only in the summer of 1934 that Hitler established himself in a position of supreme power. Following Hindenburg's death, he received overwhelming support in a referendum in August 1934 that combined the positions of chancellor and president, concentrating singular authority in the hands of the *Führer*.[7] The August 1934 referendum was held just 10 months after the November 1933 vote. Between these two dates, road construction had begun in earnest. Where the new roads were being built, opposition against the regime declined significantly. Figure 1 illustrates our main finding, by showing the change in support for the Nazi regime by distance to *Autobahn* construction.[8] Where the new roads ran, the Nazis significantly gained support, and the closer locations were to highway construction, the greater the gains. The simple analysis in Figure 1 – based on taking averages by distance – implies a vote gain from highway construction of 2.4 percentage points when going from a distance of 60 km to less than 10, relative to average opposition votes of 10%.[9] More detailed calculations suggest persuasion rates of proximity to highway construction of 8-17% – similar but towards the upper end of the magnitudes documented for canvassing or politically biased news in other elections (Della Vigna and Gentzkow 2010). These results reflect local differences in voting; for the country as a whole, effects were likely larger.

Motorway planning may have followed a political lead after 1933. To deal with potential endogeneity, we construct least-cost paths between terminal cities that were to be connected by highways. Building costs reflect the roughness of the terrain, the number of rivers to be traversed, etc. We use these least-cost paths as an instrument for actual construction, excluding the terminal cities themselves from the analysis. Our IV results confirm the OLS estimates both in terms of magnitude and statistical significance. This is true also when we restrict the analysis to the subset of connections that any road planner would have had to build, linking Germany's largest 20 cities.

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[7] In addition to the referendum, the wholesale murder of the SA-leadership and other prominent anti-Nazis in the *Night of the Long Knives* allowed Hitler to consolidate his powers.

[8] Since the election in 11/1933 and the referendum in 8/1934 are not strictly comparable, we use the difference in standardized vote shares with mean zero and standard deviation one.

[9] The difference of 2.4 p.p. corresponds to 0.47 standard deviations of our standardized vote measure.

Voting results from the Nazi period cannot be taken at face value. Intimidation was massive, and there is some (limited) evidence of fraud. Nonetheless, we argue that information about popular support can be extracted from vote shares. First, support for the Nazi government was far from universal. Opposition was not impossible, and it varied importantly over time and space. For example, in Garrel, Lower Saxony, in August 1934, only 60 percent of voters supported Hitler. In Wendlingen, officials recorded support of 99.9 percent.[10] Second, our measure of increases in support comes from comparing voting results in hundreds of German cities before and after the start of *Autobahn* construction – and the Nazis were already in power during the first election in November 1933. This makes it less likely that cross-sectional differences in intimidation or fraud accounted for electoral success; only a *differential* increase in intimidation or fraud in areas with *Autobahn* construction could contaminate our results. Finally, we perform a number of "election forensics" tests and find no evidence for a relationship between *Autobahn* construction and fraud.

What accounts for the *Autobahn*'s success in winning "hearts and minds"? Immediate improvements to transport can be ruled out – very few Germans had cars, and the roads were not ready for use by the time of the plebiscite in 1934. Economic benefits were also probably small: Ritschl (1998, 2003) estimates that only a small part of declining unemployment can be explained by *Autobahn* construction; instead, the "employment miracle" was driven by an economic upswing that had already started in 1932 before the Nazis took over the government. We find that areas with initially high unemployment did not show a greater increase in Nazi support when roads were built. This makes it unlikely that direct *local* economic benefits were key.

Instead, we argue that highway building "worked" because it signaled the government's 'competence': Nazi propaganda – with highways as a concrete result to show – created the wide-spread belief that Hitler's fiscal policy generated the economic upturn. In this way, *Autobahn* building signaled that the Nazi government's preferences were aligned with those of the population. To do so, overcoming the perceived weakness of the parliamentary

[10] We do not assume that the aggregate share of "yes"-votes cast is a reliable indicator of actual support for the regime (Evans 2006). Instead, we exploit cross-sectional variation. Even large cities recorded substantial differences: In Aachen, for example, 24% voted "no"; in Nuremberg, on the other hand, only 4.6% voted against Hitler becoming both Chancellor and President.

system and the 'gridlock' of Weimar politics was essential.[11] Building the roads showed off the ability to get things done; it also demonstrated an effective end of the austerity policies of the pre-1933 era that had been implemented by successive Weimar governments (Shand 1984). Goebbels' propaganda, using radio, press, and film, exploited the highways as powerful symbols of an energetic government overcoming "democratic gridlock" and the widely-lamented disorder of the Weimar Republic (Evans 2006). We find evidence of a synergy between propaganda and highway construction – where radio signal strength was high and the new roads were under construction, pro-Nazi votes increased particularly strongly. On the other hand, without radio coverage, the roads themselves had a negligible effect on voting behavior.

Similarly, the effect of highways on Nazi support was stronger the greater regional political instability was before 1933. Weimar Germany was composed of 16 federal states, each with its own parliament and executive. The states that had seen unstable government in 1919-33 show systematically larger vote-winning effects of highway construction. This is in line with the view that the Hitler regime demonstrated its determination and organizational ability by highway construction, and that this was particularly attractive in areas of the country where political turmoil had been common. Our results suggest that infrastructure spending can win "hearts and minds" for autocracy – especially when people associate it with nationwide (economic) progress and with a regime's ability to overcome the perceived gridlock under democratic rule.

The paper proceeds as follows. We review the related literature in Section 2, and then explain the historical background and context of motorway building in Section 3. Section 4 presents our data. In Section 5, we show the main empirical results. Section 6 presents instrumental variable results, and Section 7 examines channels through which the Nazi regime's road building influenced voting. Section 8 demonstrates the robustness of our findings, and Section 9 concludes.

[11] Speeches by conservative politicians – and not only the Nazis – frequently featured references to an alleged lack of speed and decisiveness in democratic decision-making. Indeed, even before Hitler's seizure of power, plans for a new, authoritarian constitution were being proposed by many conservative politicians (cf. Stackelberg and Winkle 2013).

2 Related Literature

Our work contributes to research on the political economy of regime change (Acemoglu and Robinson 2000), elections and the entrenchment of dictatorships (Egorov and Sonin 2014; Simpser 2013; Jessen and Richter 2011), the role of elections in autocracies (Gandhi and Lust-Okar 2009) and on interactions between the military and old elites (Finer 1976; Acemoglu, Ticchi, and Vindigni 2010). Closely linked is work on the origins of totalitarian dictatorships, much of which emphasizes differences between normal autocracies and regimes like the Nazi dictatorship or Communist rule in Russia. Theories of "mass society" focus on industrialization and the associated rise of a large group of economically marginal individuals who have lost their traditional roots (Ortega y Gasset 1993; Arendt 1973). These in turn are said to create a fertile recruiting ground for totalitarian ideology, from both the left and the right.[12] Schmitt (1926), on the other hand, emphasized the need for an – alleged – external or internal threat for totalitarian states to consolidate.

Our work also relates to the rich literature on the electoral benefits of income transfers and infrastructure spending, and on the effects of infrastructure projects. There is evidence that politically motivated income transfers and federal spending can affect voting behavior (Manacorda 2011; Levitt and Snyder 1997), but aggregate patterns are often inconclusive (Stein and Bickers 1994). In a classic paper, Berman et al. (2011) examine under what conditions an occupying force can win the 'hearts and minds' of the occupied, and conclude that public service provision can have a decisive effect in reducing opposition. Also, public spending is often targeted at areas with a more informed electorate (Strömberg 2004).[13] Recent research has also generated new insights into the economic effects of major infrastructure projects. While an early literature had concluded that the invention of the railways did not matter significantly for growth (Fogel 1964), there is now ample evidence that, for example, the building of India's national railway network reduced transport costs, and increased trade (Donaldson forthcoming). Similarly, better access to transport

[12] Applications of this approach to the German context include Shirer (1960) and Stern (1972).

[13] Along the same lines, Finan and Mazzocco (2014) show that politicians with greater electoral incentives transfer more resources to areas where they expect higher political returns. Larreguy et al. (2015) show how central-government policy interventions boost support for the federal incumbent while reducing the influence of local politicians.

infrastructure in China and Prussia boosted GDP (Banerjee et al. 2012; Hornung 2015)[14] and increased land values (Donaldson and Hornbeck 2016). There are also well-documented effects on urban layout (Baum-Snow 2007), city growth (Duranton and Turner 2012) and skill premia in urban areas (Michaels 2008).

Relative to the existing literature, we make a number of contributions: First, we demonstrate the political benefits of infrastructure spending on electoral outcomes, helping to entrench the Nazi dictatorship. At a crucial, moment when the Hitler regime needed to showcase its popularity, *Autobahn* building boosted support. We thus contribute to a rich literature that studies regime change in general and the rise of the Nazis in Germany more specifically (King et al. 2008; Bracher 1978; Ferguson and Voth 2008). Second, we show how even unfree elections under a brutal dictatorship can be used to make inferences about changes in regime popularity and its determinants. Third, we offer suggestive evidence on the conditions under which elections can boost support for an autocratic regime – a key question in the literature on voting in non-democratic settings (Gandhi and Lust-Okar 2009). We find that road building was most effective in swaying voters who had previously supported moderate parties, or who were skeptical of the Nazis, such as Catholics. On the other hand, in areas with high support for the communists (such as worker strongholds), highways were less effective in garnering votes. Lizzeri and Persico (2001) argue that in electoral regimes where the margin of victory matters, public goods are more likely to be provided, and pork barrel spending is lower. Our result on the Nazi regime building highways is related, but it goes further. Goebbels' propaganda emphasized that roads are public goods. This generated important synergies with actual construction, enabling the regime to show near-universal support. In this sense, the *Autobahn's* success in boosting pro-regime votes relied more on a perceived 'competence' channel (Rogoff 1990) than on any direct economic benefits. Thus, we provide evidence in support of arguments that autocracy may be attractive to voters because of its alleged ability to 'get things done' (Djankov et al. 2003). In line with this hypothesis, we present evidence that the effect of motorways on regime support was markedly greater in federal states that had seen greater political instability before 1933.

[14] In contrast, Faber (2014) finds adverse effects of highways on GDP growth in newly-connected peripheral counties in China.

3 Historical Background

In this section, we briefly describe motivations behind the building of the *Autobahn* network and its antecedents. We also discuss the nature of early Nazi elections and the growing strength of the regime.

3.a Motorway building under the Nazis

In building the motorway network, the Hitler government pursued two aims. First, it aimed for a propaganda success, signaling its competence as well as a symbolic break with past economic policies, especially austerity (Ritschl 2003). This aim was pursued vigorously and with success – many elderly Germans still point to the motorway network to argue that the Nazi regime had some positive sides, too. Second, the Nazi government sought to create employment.

Road building became a government priority immediately after the 'seizure of power' by the Nazi Party. At the Berlin Motor Show – only 11 days after becoming Chancellor – Hitler presented far-reaching plans for the 'motorization' of Germany, with provisions for tax subsidies, road-building, and cheaper, compact cars.[15] By the summer of 1933, a new publicly-owned company had been founded to build and operate highways Germany-wide. Plans for the network built on work by a private think tank, the STUFA (Vahrenkamp 2010). In some cases, the exact trajectory of the actual roads was decided by Hitler himself, who insisted on scenic routes.

To maximize work creation and to demonstrate that the government was serious about road building, construction began at many points simultaneously. Figure 2 shows the 1934 highway network. Thick black segments were under construction; double-ruled segments were approved for construction, but not yet begun; and light grey lines indicate planned segments not yet approved for construction.[16] In 22 locations, construction was under way

[15] In the Rhineland, another – unrelated – project connected Bonn and Cologne. Konrad Adenauer, later Chancellor of the Federal Republic of Germany, coordinated the building in a bid to reduce unemployment. This first highway opened in 1932. At the time, Italy had already completed the first high-speed roads reserved for car traffic.

[16] We digitized the September 1934 map from Todt (1934), which is the closest available to August 1934. The transition between highway segments "approved for construction" and "under construction" in Figure 2 is fluid, and even the historical maps are not completely clear about the exact timing when construction began. For example, a few smaller segments are listed as "under construction" in the May 1934 map, but as "approved for construction" in the November 1934 map. We use "under construction" as our main 'treatment' variable, and

less than a year after the start of the project. Among the first segments to be built were the link from Frankfurt to Darmstadt and on to Stuttgart, from Berlin to Hanover, the connection Bremen-Hamburg-Lübeck, Leipzig towards Munich, and Munich-Stuttgart. None of them were actually open for traffic by the time of the plebiscite in August 1934.

Highway construction began on a large scale only after the November election in 1933 – a fact that we exploit in our empirical analysis. Figure A.1 in the appendix shows employment in *Autobahn* construction, by month, for the period 1933-34, using data from Humann (2011). Employment in November 1933 was 3,000 men, 5% of the level reached by August 1934, and earlier months had seen even more minute numbers of workers used for highway construction. By April 1934, construction got under way on a significant scale, with 20,000 men employed. In August, the number had almost tripled again, to 59,000. While August did not yet constitute the high water mark of *Autobahn* employment, it was higher than in any preceding month, reaching 50% of the all-time peak of highway employment (June 1936; 121,000 workers).

Together with rearmament, the *Autobahn* is widely seen as a key part of Keynesian demand stimulus by the Hitler government. In line with the regime's propaganda, many observers took it for granted that building the new highway network reduced unemployment substantially. John Maynard Keynes himself, in the introduction to the German edition of his *General Theory,* argued that Nazi spending policies after 1933 exemplified the superiority of totalitarian regimes in implementing the "right" policies to overcome the slump.[17] Quantitative research has since established that neither military spending nor highway construction were probably responsible for Germany's recovery after 1933 (Ritschl 1998). Initially planned to employ up to 600,000 workers, motorway building never came close to creating such a number of jobs. At its peak, only 121,000 Germans were working in highway construction (Humann 2011).[18] Instead, the rapid rise in output under Hitler is

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document the robustness of results to including "approved for construction" in Section 7.e. Whenever we refer to "highways" in the following, we mean segments that were listed as "under construction."

[17] Keynes (1936). Scholars from Karl Schiller (1936) to Richard Overy (1975) argued along similar lines.

[18] This should be compared with a decline in unemployment from 6 million in January 1933 to 2.5 million in the summer of 1934.

typically explained by the strength of a cyclical upswing, helped by an end to deflation and declining uncertainty over the economy.

From the very beginning, Nazi propaganda exploited the motorway. The regime emphasized highway construction as an integral part of its war on unemployment (*Arbeitsschlacht*).[19] At the behest of Propaganda Minister Josef Goebbels, building time tables were coordinated to ensure that work started simultaneously at many locations all over Germany. Instead of finishing stretches of motorway one after the other, thus maximizing use value, construction took place all over the country (Shand 1984). Hitler turned the first sod of earth for building the *Autobahn* in September 1933. The weekly news reel shows him addressing a huge crowd of workers. He reminded them that the Nazi regime had asked for four years to show what it could do. Proclaiming the highways a "gigantic undertaking," he argued that the roads would bear witness to "our [the regime's] devotion, our diligence, our ability, and our decisiveness" (Schütz and Gruber 1996). In the first month of the newly-founded *Autobahn* company's existence, the *Völkischer Beobachter* – the leading Nazi Party paper – made construction progress front-page news no fewer than four times. Radio similarly played a prominent role – the start of construction was broadcast live to millions of listeners, including speeches by Hitler and Goebbels.

The regime celebrated the opening of each new stretch of motorway. The first segment was finished in May 1935. Some 90,000 supporters lined the road as Hitler was driven from Frankfurt to Darmstadt. By 1936, some 1,000 km of road (out of 9,000 planned) had been finished; the simultaneous opening of 17 segments of motorway was used for ceremonies all over Germany. Each event was extensively covered on the radio, with special programs and live reporting. In addition, the press and the news reels reported extensively (Schütz 1995).[20]

Why was highway building prioritized at all, instead of other public works programs or the construction of schools and hospitals? Road building as a make-work measure had been discussed extensively during the Great Depression, but no large-scale construction had taken place. The actual building of the highways signaled a regime change – a willingness to overcome years of austerity (Ritschl 2003). As the introductory quote on p.1 emphasized,

[19] Literally, "battle for labor."

[20] In addition, the *Autobahn* was also celebrated as an aesthetic innovation. The *Autobahn* company commissioned a number of artists to produce paintings of road segments, bridges, ramps, and construction work. A book containing reproductions of these paintings sold over 50,000 copies (Vahrenkamp 2010).

party propaganda never tired of telling readers and listeners that the new highways were incontrovertible proof of how a strong state was making Germany great again. In its early phase, the Autobahn project had symbolic character: "Hitler breaking new ground … – the picture became an icon of the year immediately after 1933, a symbol for everything *Autobahn* construction seemed to stand for: energy, directness and dynamism of the national socialist movement…" (Schütz and Gruber 1996, p.43).

Interestingly, motorway workers themselves were typically skeptical of the Nazi regime – a fact that works against our finding. While supporters of highway construction had expected workers to be recruited locally, they were instead often drafted from among the unskilled and unemployed to work far from their homes. Workers often lived in barracks, where they were subjected to harsh discipline and earned a low wage. Many sympathized with the Social Democratic Party or the Communists. Sometimes, disaffected workers painted anti-Nazi slogans on lorries used for motorway construction (Evans 2006). In one incident, workers demanded extra pay and went on strike, singing "The International" – the anthem of the workers' movement. Work only resumed after the ringleaders were sent to Dachau concentration camp.

Overall, the *Autobahn's* direct benefits were limited. Germany's car ownership rate in 1933 was low – approximately one quarter of England's or France's. Most transport of goods and people took place via rail. The new regime intended to boost the German car industry by all means possible, and not simply via road-building. Hitler had high hopes for the automobile industry as a future source of employment, and because its factories could easily be converted to war production. A tax exemption for the purchase of new automobiles from March 1933 onwards boosted car production, and accelerated the recovery of private car purchases (which had begun to rise in the fall of 1932). Between 1932 and 1938, the total number of cars, motorcycles, and trucks on German roads doubled (Evans 2006).

There were also fewer military advantages to road-building than is commonly believed. While the invasion of Austria used the Autobahn to move tanks, and the growth of the motorcar industry indirectly benefitted the German armed forces, almost all troop and supply movements before and during World War II were by rail. Since the Hitler government planned wars of aggression that would take troops far beyond the borders of the Reich, the importance of internal communications was limited (Evans 2006). If there was an

aspect of road building that mattered militarily, it was motor vehicle production. Boosting the mobility of army units was a general aim of most armed forces after 1920 (van Creveld 1977). Increasing car ownership and the number of trucks in Germany was considered desirable because private vehicles could be confiscated in wartime. Indeed, the invasion of France used some 15,000 trucks requisitioned from private industry (Vahrenkamp 2010).

3.b 1933 Elections and the 1934 Plebiscite

We use two principal measures of Nazi support at the polls – votes for the NSDAP in November 1933, and the share of "yes"-votes in the plebiscite in 1934. In addition, we use the NSDAP vote share from the March 1933 election in a placebo exercise. Figure 3 illustrates the timeline of elections and highway building.

When Germans went to the polls in March 1933, the Hitler government had already been in power for over a month. Nonetheless, elections were still relatively fair, with intimidation at the polls limited compared to what happened on later occasions. The Communist Party had been banned, but all other parties that had competed during the last free election in November 1932 were still on the ballot in March 1933. Despite a massive propaganda campaign (Adena et al. 2015), the NSDAP failed to win an absolute majority, receiving 44 percent of the vote.

In November 1933, the regime held fresh elections. Over the summer, all parties except the NSDAP had been banned. In addition to Nazi MPs, the NSDAP list before the voters also contained 22 "guests" – mostly prominent members of the right-wing elite who were largely aligned with the party's aims, and were asked to participate to give the new parliament marginally broader representation. On average, the Nazi Party won 92 percent of the popular vote, more than doubling its vote share from March.[21]

Voting in November 1933 was not free and fair; storm troopers collected many voters at home if they had failed to show up, and they stood guard at the voting booths. There, citizens were strongly "encouraged" to vote publicly so that everyone could witness their support of the Nazi regime. Evans (2006), commenting on elections under the Nazis, observes that

[21] In parallel with the parliamentary election, voters were also asked to approve Germany's leaving the League of Nations. This proposal was wildly popular since the League of Nations was closely associated in the minds of Germans with the (hated) Versailles settlement that saddled Germany with a massive reparations bill (Evans 2006). This referendum received 95% support.

> "Intimidation was particularly evident during the national plebiscites and elections that Hitler held from time to time… Under the Third Reich, plebiscites and elections became propaganda exercises in which the regime mobilized the electorate, by all means at its disposal, to provide the appearance of popular legitimacy for controversial measures."

Despite these intimidation measures, opposition was not zero. On average, eight percent of all Germans voted against the Nazi list (by spoiling their ballot papers – voting "no" was not possible in Nov. 1933). In some areas, there was massive opposition – in the old Hanseatic city of Lübeck, for example, 40,824 voters failed to vote "yes" for the NSDAP list, out of 111,911 votes cast – a proportion of 36.5 percent. Hamburg and Berlin registered similar levels of dissent, with 27 and 26 percent of voters refusing to support the Nazi list, respectively. At the opposite end of the spectrum, in Pirmasens, only 218 out of 31,371 votes were spoiled – equivalent to 0.7%.[22]

The plebiscite in August 1934 followed the death of the ailing President Hindenburg. The official merging of the offices of President and Chancellor removed the last de facto checks and balances that the Nazi state had inherited from the Weimar constitution. While overall support was high, and despite massive pressure on the population, the typical German town or city actually saw fewer votes in favor of the proposition to make Hitler both Chancellor and President than there had been "yes" votes for the party list in November 1933 – 89.9% voted with yes in August 1934.[23]

3.c Crisis and Entrenchment of the Nazi Dictatorship 1933-34

After coming to office, the Nazi leadership lost no time asserting administrative and political control. Police forces everywhere were brought under the control of Nazi politicians; violence against opponents – suspected or real – was frequent in the first half of 1933 (Evans 2006). As storm troopers (SA) instituted their own kind of justice all over Germany, talk of a "second revolution" grew louder – a transformation even more radical in nature than the initial seizing of power.[24]

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[22] There are also several smaller towns where support reached 100%.

[23] While the November 1933 election (for the Nazi Party) and the 1934 referendum (for Hitler in person) are clearly distinct, there is no obvious downward bias – right down to the end in 1945, Hitler personally was much more popular than the Nazi Party.

[24] The SA grew out of street-fighting paramilitaries; its leaders envisioned themselves as a Nazi People's Army, and many pursued dreams of a far more left-wing agenda including wholesale nationalization of many

Despite its ruthlessness in seizing power, the regime was much less firmly established during its first 18 months than later. Opposition to the regime increased as lawlessness spread. Conservatives who had hoped that the Nazis' entry into government would increase their own mass appeal were disappointed. Middle class voters who had supported the NSDAP before 1933 feared wider chaos (Behnken and Rinner 1980), and workers – never very supportive of the Nazis – were growing even more skeptical. As one leading historian of the Nazi regime described the situation in the summer of 1934:

> The moment was … critical for the regime. … enthusiasm of the 'national revolution' in 1933 had discernibly fallen off ... The brownshirts were not the only section of the population to feel disappointed .... Social Democratic agents reported to the exiled party leadership in Prague that people were apathetic, constantly complaining, and telling endless political jokes about the Nazi leaders. Nazi meetings were poorly attended … The educated classes feared that the disorder caused by the stormtroopers might spill over into chaos or, worse, Bolshevism. (Evans 2006)

As the year 1934 wore on, the Nazi leadership increasingly feared that the conservatives around von Papen and Hindenburg could join forces with the army, and overthrow the Hitler regime (Evans 2006). The increasingly senile Paul von Hindenburg was still President, and one of his personal favorites, Franz von Papen (a former Chancellor) served as Vice Chancellor. In June 1934, von Papen gave a famous speech before university students in Marburg. He warned against a second revolution, decried violence and lawlessness by the SA, and condemned the personality cult of Hitler. Thereafter, his public appearances were often greeted with the shout "Heil Marburg." *Time Magazine*, reporting on the incident, concluded that "if Adolf Hitler came home with a swelled head and hot new ideas for dictatorship from his visit to Benito Mussolini, certainly last week he was dexterously chilled and shrunk..." and concluded that he was not a "real dictator." In the summer of 1934, the Defence Minister, General Werner von Blomberg, threatened Hitler with the imposition of martial law and a government by the army if the SA was not brought to heel (Wheeler-Bennett 1964). Eventually, Hitler had both the leadership of the SA and leading

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industries ("a second revolution"). Threats to Hitler's leadership, however, were largely invented to justify the crackdown on the SA in the summer of 1934.

conservatives murdered, claiming that the victims had been plotting to overthrow the government (the so-called "Röhm Putsch," after the head of the SA).

The conflicts and threats of the summer of 1934 show that the Nazi regime was still far from its later, omnipotent position, and that popular support could by no means be taken for granted. Indeed, knowledgeable observers concluded that there was "evident shakiness in high Nazi places" and that "Adolf Hitler [got] the scare of his career" (Time July 2, 1934). It is for these reasons that winning the "hearts and minds" of the population mattered, and why the regime cared about being able to showcase overwhelming popular support. It was only after Hitler became both Chancellor and President, and after a large share of the population publicly supported the *Führer*'s expanded powers, that the regime became fully entrenched.

4 Data

We use voting records for more than 3,000 towns and cities, covering the entire area of Weimar Germany (Statistisches Reichsamt 1934). These data are combined with demographic and socio-economic information from the 1925 and 1933 censuses (Falter and Hänisch 1990). To this, we add geographical information from maps of the (planned and built) German motorway network, whose construction began after the summer of 1933, as well as information on vehicle ownership, radio signal strength, and political stability of Weimar states.

4.a Data on Highway Plans and Construction

As shown in Table 1, of the 3,276 towns and cities in our sample, 2,015 were within 20 km of the planned *Autobahn* according to the general plan (shown in Figure 2). A little more than a third (1,261) were further away. Out of the 2,015 locations close to the planned network, 1,097 saw actual construction within 20 km by the summer of 1934 – some 54% of the planned total.

Some socio-economic characteristics differed between towns close to the highway network and more distant ones. Table 2 gives an overview, showing the sample mean of a variety of socio-economic variables from the 1925 and 1933 German censuses in column 1, the average for cities within 20 km of the highway network (planned or built) in column 2, and the means for cities with and without actual highway construction, among those near the planned network (columns 3 and 4). Cities near the planned highway network were more

populous than the rest; unemployment, the blue-collar share, and industrial employment were also somewhat higher, while there were fewer Catholics than in the sample overall. The share of Jewish population was the same. Next, a comparison of columns 3 and 4 shows that construction began in those parts of the planned network that were closer to larger, more industrial cities, and in more Protestant areas. This gives rise to endogeneity concerns, because support for the Nazis also varied with socio-economic factors. In our empirical analysis we address this issue in a variety of ways, by adding explicit controls and city fixed effects, entropy weighting to create a balanced sample, and the use of least-cost-paths as an instrument for actual highway location. Importantly, pre-existing support for the Nazi regime did *not* affect systematically the location of highway construction, as shown by the balanced NSDAP vote share in March 1933 in Table 2. We explore this in more detail below, showing also that there were also no differential pre-trends in Nazi support before highway construction started.

4.b Elections and Plebiscites

Our main analysis focuses on the change in the share of votes supporting the Nazi regime between the November 1933 election and the 1934 plebiscite. As a proxy for initial Nazi support, we also use the NSDAP vote share in the March 1933 election – after Hitler had been appointed as Chancellor, but when other parties were still permitted at the polls. Figure 4 plots the share of "pro-Nazi" votes in the three elections we focus on. Since elections after March 1933 were no longer fair and free, the officially registered support for the regime at the polls surged until November 1933. Between November 1933 and August 1934, the share of pro-Nazi votes declined somewhat – if we want to disregard the fact that the nature of the vote changed, too. The dispersion of vote shares also declined after March 1933, as the regime used intimidation and other forms of pressure to reduce measured opposition.

To make the different elections comparable, we rescale vote shares in our empirical analysis, transforming electoral 'pro-Nazi' votes for each election into a standardized variable with zero mean and unit standard deviation. In addition, we compute a broad and a narrow measure of Nazi support. The former (NS_{broad}) is defined as the share of yes votes relative to all *eligible* voters. This variable counts nonvoters as opposition to the Nazi regime – which in many cases is justified given the high pressure for turnout (see Section 3). The narrow measure (NS_{narr}) is defined as the share of yes votes relative to *actual* voters; it is thus

unaffected by voter turnout (and by potential unobserved spatial variation in the pressure to vote).[25] We use NS_{broad} as our main outcome variable, and document the robustness of results using NS_{narr}.

4.c Radio

From the 1920s onwards, Germany had a highly developed, government-owned system of radio stations (Bausch 1956). By the 1930s, governments regularly used radio programs to bolster support (Adena et al. 2015). There is detailed data on the number of radio subscribers in various parts of Germany, and on the strength of radio signals. Since the purchase of a radio subscription may itself be a function of political preferences, we follow Adena et al. (2015) and focus on city-specific signal strength, as determined by the power and location of transmitters interacting with terrain characteristics.[26] We find that listenership increased with signal strength in a flexible non-parametric estimation (see Appendix A.6 for detail).

4.d Political Instability of Weimar States

Germany's first attempt at democracy, the Weimar Republic, was not noted for its political stability. Governments both at the national and state level changed with alarming frequency. The perceived "chaos" of democratic governance was often contrasted with order under the Emperor until 1918, and instability was one key reason why support for democratic rule waned. As the novelist Stefan Zweig (1942) observed:

> In 1923, the swastikas … disappeared and Hitler was almost forgotten… only after a few years, he resurfaced, and a wave of discontent carried him forward. The inflation, unemployment, [and] the political crises had disturbed the German people deeply; an incredible desire for order spread amongst the German people... And whoever promised order … immediately had hundreds of thousands behind him.

Nevertheless, some federal states showed relative stability, with the same prime ministers and parties in power for long consecutive stretches of time. Prussia is one notable example (Orlow 1986). To capture these state-level differences, we follow Satyanath, Voigtländer

[25] Note that both measures count invalid votes as opposition to the Nazi regime. In fact, the November 1933 election did not allow for a "no" vote, or for votes for any other parties. Thus, conditional on voting, invalidating the ballot was the only way for voters to express their discontent with the Nazi regime. The 1934 referendum, in contrast, included an option to vote "no." This is another reason why the two elections are not directly comparable, motivating our use of standardized vote shares, rather than comparing levels.

[26] We use predictions from the irregular terrain model. Ruben Enikolopov kindly provided us with city-specific signal strength data for all locations in our dataset from the implementation of the radio diffusion model in Adena et al. (2015).

and Voth (2017), who measure political stability as the first principle component of three indicators: the percentage of time that i) the longest-serving state government was in office, ii) the longest-serving party was in office (possibly in different coalitions), and iii) whether a state was governed by at least one party from the "Weimar coalition." In combination, these three variables capture political turmoil at the federal state level during the Weimar period. [27]

5 Main Empirical Results

In this section, we show that support for the Nazi regime increased significantly more where the new motorways were being built. Before presenting econometric estimates, we first illustrate our main finding. Figure 5 maps changes in support for the Nazi regime between November 1933 and August 1934.[28] The darker the red on the map, the greater the (residual) electoral gains of the Nazi Party. Solid black lines are roads under construction; dashed ones, roads approved but not yet being built. On average, areas through which the new highways passed saw much greater gains in support for the Nazis than the rest. This is particularly true in East Prussia, the North of Germany, in the West around the Ruhr, and in the area around Frankfurt. While there are areas with significant increases in support without road-building (such as along the shoreline of the North Sea near Holland), they are relatively rare.

5.a Baseline results: Change in Nazi support, November '33 – August '34

In the following, we present our baseline specifications, estimating regressions of the form:

$$\Delta NS_i = \alpha + \beta D_i + \gamma X_i + \varepsilon_i \qquad (1)$$

where ΔNS_i is the change in (standardized) pro-Nazi votes between November 1933 and August 1934 in city i, D_i is its distance to the nearest highway segment under construction, X_i is a vector of controls, α is a constant, and ε_i is the error term. If D_i was randomly assigned, β would reflect the causal effect of motorway building on support for the Nazi regime. We present OLS results first, and then discuss potential challenges to identification, followed by IV results.

[27] Satyanath et al. (2017) ended their coding period before the Prussian coup d'état in July 1932, which is often considered the beginning of the end of the Weimar democracy. We use their original measure, but have also extended their coding period to January 1933 as a robustness check.

[28] We plot effects after accounting for log city population and unemployment in 1933, as well as regional fixed effects corresponding to 77 administrative districts in Weimar Germany (*Regierungsbezirke*).

In Table 3, Panel A, we first show the simplest specification without controls in column 1. We find a negative and highly significant coefficient on distance to highways. To gauge its magnitude, we calculate the implied vote change (in percentage points) when going from one to 100 km distance to highway construction.[29] This yields a vote gain of 2.9 p.p. In column 2, we add our baseline controls as well as the Nazi Party vote share in the preceding November 1933 election. The coefficient on highways declines but remains highly significant, and it rises again when we add fixed effects for 77 administrative districts in column 3. Adding the latter means that we exploit only the distance to highway segments within each district, differencing out any regionally-based shifts in voting patterns. Our results in column 3 thus imply that, relative to all the other towns in the same district, those closest to the new highways saw particularly large gains in Nazi support.

In terms of control variables, the negative coefficient on initial pro-Nazi votes in November 1933 is significant and negative, which reflects a mechanical effect – places with close-to-100% support could hardly gain additional votes. The coefficient on city population size is negative and significant – more populous places saw less of an increase in Nazi support. Finally, the coefficient on unemployment is ambiguous, switching signs and becoming insignificant when we add district fixed effects.

In column 4, we add additional socio-economic controls – the share of blue-collar workers, of Jews, of Catholics, and of industrial workers – the significance of the distance-to-highway variable is not affected, but it declines somewhat in size. Finally, we define a dichotomous variable that takes on value one for towns or cities that were within 20 km of highways under construction, and zero otherwise. In columns 5 and 6, we use this alternative variable to repeat the specifications from columns 2 and 3.[30] We again find highly significant coefficients that suggest an increase in support by 0.12 standard deviations (corresponding to an increase in pro-Nazi votes by about one percentage point) if

[29] To obtain vote differences in levels for Nov'33-Aug'34, we multiply the result for standardized vote differences by the standard deviation of vote differences in levels.

[30] Note that these regressions essentially reflect a difference-in-difference specification, where `treatment' is a dummy for highway proximity. Thus, treatment effects are estimated as changes in pro-Nazi votes before vs. after highway construction, in areas near vs. distant from highway segments. The full diff-in-diff specification (running regressions with Nazi votes in levels for Nov'33 and Aug'34, with city and year fixed effects) yields almost identical results (available upon request).

a town was close to the *Autobahn.* Appendix A.2 shows that alternative cut-offs for distance to highways lead to very similar results.

Panel B of Table 3 presents results that account for spatial correlation. We consider cities with less than 3 degrees distance (about 200km-330km) as 'neighbors,' assigning them a non-zero spatial weight.[31] The coefficients on distance to highway under construction are very similar to our main results in Panel A of Table 3, both in terms of magnitude and significance. This suggests that our results are not confounded by spatial correlation.

For completeness, Panel C of Table 3 presents results using unstandardized changes in pro-Nazi votes as dependent variable. This specification relies on the (debatable) assumption that vote shares in the November 1933 election and in the August 1934 referendum are comparable. Nevertheless, we find very similar effects of highway construction on Nazi support.

5.b Persuasion rates

How effective were highways in winning voters for the Nazi government? And how large were electoral gains overall? We gauge the effectiveness of highway building by looking at persuasion rates – the extent to which exposure to the highway was associated with voters switching from opposition to support of the government (Della Vigna and Gentzkow 2010). Panel C of Table 3 reports our estimates of persuasion rates – the share of voters who changed their minds because of highway construction. To calculate these rates, we assume that, in the log-linear specification (cols 1-4), voters in areas further than 100 km from the highway were not affected, thus forming our 'control' group. With this, using the method in Della Vigna and Gentzkow (2010), we calculate the increase in Nazi support in when going from 100 km of distance to highway construction to 1 km, relative to the share of voters who were left to be persuaded to support the Nazi regime. For the dummy specifications in cols 5 and 6, we assume that treatment is zero beyond 20 km distance. We find substantial persuasion rates, ranging from of 8 to 17% for the log-linear specification, and 6% in the

[31] One degree difference in latitude corresponds to 111 km, and one degree difference in longitude, to 69 km (measured at 50°N, the latitude of central Germany). When estimating the spatial correlation model with district fixed effects, we use the 35 electoral districts (*Wahlkreise*) of Weimar Germany, instead of the 77 *Regierungsbezirke*; the latter is too restrictive for the estimation procedure to converge.

dummy specification.[32] Note that these figures are a lower bound; nationwide increases in Nazi support due to highways are not captured by the persuasion rates.

5.c Voting patterns before and after highway construction

Are our baseline findings in Table 3 specific to the period November 1933 to August 1934, when road building got under way in earnest – or do they reflect pre-existing differences or differential trends?

To examine this question, we first add the last relatively free election of March 1933 to our analysis. We find that votes for the Nazi Party in March 1933 were not significantly correlated with distance to highways that would be built from late 1933 onwards (see Table A.4 in the appendix for detail). Next, we examine the *change* in Nazi support before and after highway construction began on a large scale. This striking difference in effects is illustrated in Figure 6.[33] The left panel serves as a placebo, illustrating the change in pro-Nazi votes between March and November 1933, when only very little highway construction had taken place. There is essentially no relationship between distance to highways and change in Nazi support. This pattern changes dramatically after November 1933, when highway building took off: The right panel of Figure 6 shows that by August 1934, it was the areas closest to the highway that saw the biggest relative gains in Nazi support. The difference between the coefficients in March/November 1933 and August 1934 is crucial for our argument. It implies that distance from the highway only becomes a predictor of Nazi support after construction began on a large scale – after November 1933.

Next, we generalize the analysis by using panel regressions. We estimate the relationship

$$NS_{it} = \alpha_i + \delta_t + \beta D_i \times \delta_t + \gamma X_i \times \delta_t + \varepsilon_{it} \qquad (2)$$

where NS_{it} are pro-Nazi votes in city i in election t, D_i is city i's distance from the nearest highway segment under construction, X_i is a vector of city-level controls, α_i and δ_t are city and election fixed effects, and ε_{it} is the error term. Note that we interact D_i and all controls with year dummies. This allows the coefficients on distance to highways and controls to vary in each period, thereby also effectively running placebo tests for the periods before

[32] For comparison – the voting studies surveyed by Della Vigna and Gentzkow (2010) show a range of persuasion rates in elections of 2 to 20%, with an average of 11.9%.

[33] Given that regular scatterplots with every data point would become too crowded for visual interpretation, we use binscatter plots, grouping the x-axis into 25 equal-sized bins. To allow for a more immediate interpretation of the x-axis, we use distance in km, rather than log-km. Results are very similar when we use logs instead.

road construction began.

We present our panel results in Table 4. In columns 1-4, we pool election data on the success of the Nazi Party from the early years of dictatorship (Mar. 1933- Aug. '34). We find a negative and significant coefficient on distance to highway construction only for the August 1934 election; for all earlier elections, the interaction with the highway distance variable reveals no statistically significant or economically meaningful relationship. The non-results for March and November 1933 also imply that *Autobahn* construction was not used to reward districts with strong previous support for the Nazis; in other words, `favoritism' in the sense of Burgess et al.'s (2015) finding for Kenya is probably not present in our data. These results are robust and hold when we interact our baseline controls (population and unemployment) with year dummies (col 2), when adding lagged Nazi Party votes (col 3), and when we add interactions of additional socio-economic controls with the year dummies (col 4).

In the last two columns in Table 4, we use data from all elections with city level data during the period 1924-34.[34] We estimate both with fixed effects only (col 5), and with extended controls and lagged Nazi votes (col 6). Again, the 1934 referendum is the only period that shows a statistically significant relationship between Nazi support and distance to highway construction.

Overall, there is no evidence that Nazi support was either high (Table A.4, col. 1) or already growing (Table 5) in places where highways were (later) built. Instead, the entire effect of highway construction on electoral outcomes appears suddenly, and only for the period November 1933–August 1934.

6 Identification

Given the highways' propaganda value, we should be concerned that their trajectories may have been chosen for political reasons. In this section, we return to our main period of analysis (Nov. 1933 - Aug. 1934), estimating specification (1). We perform two analyses. First, we show that even within a narrowly defined subsample – areas with planned

[34] The NSDAP was banned from the 1924 election as a result of the failed Beerhall putsch. Members of the banned NSDAP reconstituted themselves as a party under the label NSFP, which put forward joint lists with the DVFP. The DVFP absorbed much of the Nazi vote in the May 1924 election (Striesow 1981), and we use its standardized vote share in the panel in 1924.

highways – we find a strong relationship between actual construction and Nazi support. Second, we instrument actual highway construction between given city pairs with terrain characteristics that made road building technically feasible and cheaper.

6.a Subsample analysis – Areas with planned highways only

So far, we have compared locations close to actual highway segments with all other places in Germany. In the following, we focus on the subset of the data that will eventually be part of the highway network: By excluding areas that will never receive the highway, we are increasing the similarity of towns and cities in our sample. The relevant variation now arises only from differences in timing of construction – and not from selection of cities that (eventually) get highways nearby.

In Table 5, col 1, we first add the minimum distance to any type of highway segment (planned, approved for construction, or under construction) to our specification. The corresponding coefficient is small, positive, and insignificant, while the coefficient on distance to highway under construction remains quantitatively unchanged (compared to our main results in Table 3) and statistically highly significant. Next, we limit the sample to locations within 20 km of any type of highway segment. This means that we exclude about 1,000 towns and cities in our sample. Nevertheless, the coefficient on distance to highway under construction remains large and significant with and without controls (cols 2 and 3). If we use a simple dichotomous variable for highway construction within 20 km, we find that this is associated with pro-Nazi votes increasing by 0.23 standard deviations in the basic specification (col 4); when adding district fixed effects and all controls, it still adds 0.06 standard deviations to Nazi support (col 5). When we restrict the sample further, to those places within 5 km of the highway, we find an even bigger coefficient – an increase in Nazi support by 0.12 standard deviations, after the use of all controls and district fixed effects (col 6). The fact that coefficients continue to be large and significant even in a highly restricted subsample strengthens our confidence that it is actual roadbuilding progress that created an additional ‘swing’ in favor of the Nazi regime.

6.b IV-Results: Least cost paths

The Hitler government, in planning its network, had to decide which cities to connect – and where the road would run between them. Our results could be affected by endogeneity bias if the Nazis targeted areas that were more likely to increase their support for the regime even

in the absence of highway construction. The Nazis could also have planned and built highways to reward (newly) loyal districts, or strong local Nazi officials may have been more successful at both attracting the highway and swaying voters. On the other hand, OLS results could also be downward biased, if Nazi officials built highways where it was more difficult to win new supporters. Endogeneity concerns cannot be dismissed out of hand – for example, Hitler himself intervened in the planning of the road from Munich to Salzburg, although largely on aesthetic grounds (Vahrenkamp 2010).

To address possible endogeneity concerns, we instrument for actual highway building with least-costs paths. Road construction cost is highly sensitive to the slope of the traversed terrain. We use the *Cost Path* tool in ArcGIS to calculate the cheapest way to connect city pairs that appear in official German publications as terminal cities that were to be connected in the first wave of highway construction.[35] Figure 7 plots least-cost paths (LCPs) and actual highway construction that began before August 1934. They overlap to a large extent. Even where the LCP does not coincide exactly with the actual motorway trajectory, differences are typically small. The only larger deviations are in North Germany, where the terrain is generally flat and small differences in cost can lead to quite different paths.

Least cost paths have substantial explanatory power for actual highway construction: Out of the 3,276 towns and cities in our sample, about one-half (1,602) lie within 20 km of a least cost path. Of these, 1,404 (87.6%) also lie within 20 km of the actually planned highway network, and 914 (57.1%) of them saw actual construction activity by the summer of 1934. In contrast, of the 1,674 towns and cities that were more than 20 km away from least-cost paths, only 183 (10.9%) saw construction.

Our instrumental variable is the distance of each city from the least cost paths (LCPs). Crucially, all regressions exclude the 38 terminal cities, i.e., the end points between which LCPs are computed. Before presenting our IV results, we briefly discuss their interpretation.

[35] We compute least-cost paths for all 38 city-pair connections listed in Jahnke (1936). See Appendix A.1 for details. Related work using geographical characteristics or earlier transport infrastructure for identification includes Baum-Snow (2007), Donaldson and Hornbeck (2016), Banerjee et al. (2012), and Faber (2014). We do not use the network analysis as implemented by Faber (2014), for example, who uses Kruskal's minimum spanning tree algorithm to pin down a cost minimizing network structure. As Figure 2 confirms, the Nazi building of the Autobahn did not follow a network logic, with an increasing set of cities connected to existing roads. Instead, the regime initially connected city pairs, and it started to build in multiple disconnected locations all over the country – delaying the opening of the first useable road, but making the project more visible.

Importantly, least cost paths affect the *planning* of highways, while the electoral effects we are interested in are due to actual *construction.* Planning of highways translated into highway construction in *some* districts by 1934 – depending on the timing of construction. Our IV strategy estimates the average effect of highway construction on pro-Nazi votes for those cities whose 'treatment status' (proximity to highway construction) was affected by the instrument (proximity to LCPs). Using common IV terminology, we estimate the average treatment effect for "compliers" (cities where proximity to LCPs did results in construction). In contrast, cities close to LCPs where no construction occurred by 1934 ("never-takers") do not affect our estimate.

Table 6 presents our IV results. We first show results for the reduced form, regressing change in support for the Nazi Party on distance to LCPs. We find strong and significant negative coefficients, both without controls (col 1) and with the full set of controls (col 2). In column 3, we perform a placebo analysis for vote gains over the period March-November 1933, showing that distance to LCPs does not predict Nazi vote gains before highway construction began. Next, we turn back to our main period of analysis and demonstrate the strength of our instrument (cols 3 and 4). The first stage is powerful, with F-statistics above 500. Finally we present the IV results in columns 5 and 6. We find highly significant coefficients on instrumented distance to highways in the second stage, with comparable – albeit larger – magnitude than our OLS estimates in Table 3.[36]

7 Channels

Why did the *Autobahn* succeed in winning "hearts and minds"? To gain insight into likely mechanisms, we first show that one alternative interpretation of our results – differential intimidation and manipulation – is unlikely. We then look at evidence for direct economic or other "use" benefits of highway construction. Finally, we analyze if there are alternative channels, in particular, road building as a signal of government 'competence.'

7.a Intimidation and manipulation

One obvious concern with our data is that (changes in) votes reflect the regime's repressive activities rather than voter preferences. For example, public officials may have been under

[36] When all controls and district fixed effects are included (col 6), the IV coefficient is almost twice as large as its OLS counterpart in the same specification (col 4 in Table 3, Panel A). This may be due to measurement error in the actual location of highway construction (see footnote 16).

greater pressure to show that "their" districts supported the regime if the new highways passed through their constituency, leading to more intimidation at the polling station. We point to three empirical regularities that make this unlikely.

First, the modal German municipality saw a *decline* in Nazi support between November 1933 and August 1934. The differential outperformance of municipalities close to highways comes (on average) from smaller declines, and not from larger increases in support. If local party bosses forged results, it made little sense to do so and then still show declining support for the regime. This contradicts the alternative interpretation that the party was simply in a better position to manipulate results in places with highway construction.

Second, as we show below, areas with poor radio coverage showed no effects of highway building. It was only in areas with good radio reception that highway building was associated with greater support. Differential increases in the ability to manipulate and intimidate were not dependent on the radio – local party bosses, if they profited from highway construction in terms of power, would have done so with or without radio signal strength.

Third, the Nazi regime brought intense pressure to bear on the population to vote in its favor – supporting the party and saying "yes" in the referenda. Higher turnout can, of course, be a sign of genuine support – or it can reflect intimidation. Voter turnout, in turn, affects our broad measure of Nazi support (pro-Nazi votes relative to *eligible* voters). To tackle this issue, we use an alternative, narrow measure for change in Nazi support (pro-Nazi votes relative to *actual* voters), which is unaffected by voter turnout. Table A.7 in the appendix confirms our OLS, IV, and restricted sample results when using this alternative measure for Nazi support.[37] In combination, these three points make it unlikely that road construction itself led to greater intimidation of voters.

Could our results be driven by manipulation of votes after the election? We implement four tests proposed by Hicken and Mebane (2015):

1. **2BL:** Benford's Law – the empirical regularity that lower digits occur more often

[37] Total turnout grew by 0.3% in places without the highway, and by 0.6% in those within 50km of highway construction. Even if everyone pressed to vote was also forced to vote for the Nazis, this cannot have accounted for more than a 0.3% gain in the yes-share. The actual gain is 1.4% in the 50km band around the highway (and if we examine the co-movement of turnout and yes-votes in general, the implied gain from pushing up turnout by 0.3% is even smaller).

than higher digits in most sets of numerical data (such as the set of city population sizes of a country).[38]

2. **LastC:** Beber and Scacco (2012) point out that, without manipulation, values of the final digit of the vote count in an unmanipulated election should be distributed uniformly.
3. **C05s:** A binary variable is constructed that takes value one when the vote count for the winning party is either 0 or 5. In a variant of the Beber and Scacco argument, the expected value of this dummy should be 0.2.
4. **P05s:** This test looks at the final digit of the rounded percentage of votes for the winning party. An overabundance of zeros and fives may signal to authorities that vote counters have complied with their superiors and fulfilled their duty of providing fraudulent results. A mean greater than 0.2 of this variable may indicate fraud.

Figure 8 visualizes the statistics for the four tests, using deviation from mean tests with bootstrapped confidence intervals (the corresponding numbers are shown in Table A.2 in the appendix). We find no systematic evidence of violations across the four tests: none of the means in the full sample ("all") differs significantly from the expected value in the absence of fraud (shown by the horizontal line in each panel of Figure 8). We also present results for the subsamples with below- and above-median proximity to highway construction ("close" and "far", respectively). Only in one case – the 2BL test for the 1934 election – is the test statistic significantly different from the expected value under "no fraud." But even in this case, the test value does not differ significantly between the subsamples that are close vs. far from highways under construction. For all remaining election forensics tests, the statistics are tightly distributed around the expected values under "no fraud."

Hicken and Mebane (2015, p.39) argue that "an election fraud will not necessarily trigger all of the statistics and tests, but we think a genuine fraud will in general set off many of them." Given that *none* of the test results shows that locations close to the highway had more fraud, we are confident that our results are not driven by manipulation.[39]

[38] Previous papers using Benford's Law to detect electoral fraud include Pericchi and Torres (2011) and Mebane (2006). The method itself is controversial (Deckert et al. 2011).

[39] In Appendix A.3, we present results that go beyond the mean-comparison tests proposed by Hicken and Mebane (2015). For 2BL and LastC, we present chi-square tests that examine whether the whole distribution deviates from Benford's Law and uniform, respectively. The 2BL chi-square test suggests fraud overall, but there is no evidence for *differential* fraud by distance to highways. The reliability of this test, however, is questionable since it may also reflect other factors such as the grouping of voters into aggregation units (see Hicken and Mebane (2015) and the sources cited therein). The LastC chi-square test, in turn, shows no indication whatsoever for election fraud (with p-values close to one in the 1934 referendum).

7.b Direct Benefits of Highway Construction

Can our results be explained by locals benefitting directly from highway construction, e.g., due to job creation? The historical record does not offer much support for this hypothesis. Highway segments were constructed by construction workers brought from distant locations with little or no involvement of local workers. While some of the outside workers' pay may have found its way into the local economy,[40] the numbers involved were almost always small (Ritschl 2003).

In Table 7, we investigate potential direct benefits econometrically, by splitting the sample into above- and below-median observations in terms of unemployment and vehicle density. If the economic benefits of highway construction were key in garnering support, we should expect that it created larger electoral gains in areas where economic distress during the Great Depression was most severe. We do not find evidence for this mechanism – cols 1 and 2 in Table 7 show that if anything, the effect of highways was stronger for cities with low initial unemployment (although the difference in coefficients is not statistically significant).

Direct effects could also come through vehicle ownership and the greater use-value of automobiles. Germany as a whole had quite low vehicle ownership, with only 674,000 cars on the road (including buses) in 1934, plus another 984,000 motorcycles – equivalent to 10 cars and 15 motorcycles per 1,000. Any benefits from using these vehicles would have had to be anticipated in August 1934, since new roads only opened from 1935 onwards. In cols 3 and 4 of Table 7, we stratify the sample by the density of motor vehicles (including buses, motorcycles, and cars, available at the province level from Frik 2004). There is no evidence of greater electoral gains in areas with higher vehicle ownership; the coefficients on distance to highway are very similar and (marginally) significant in both subsamples. Our results thus suggest that direct economic benefits are unlikely to account for the effect of highway construction on local Nazi support.

7.c Radio propaganda and "competence"

Next, we examine an alternative hypothesis – that highway building convinced people of the regime's competence and having the population's best interests at heart. For this to be true, the new roads' construction had to be framed as a major accomplishment of the regime. We

[40] There may also have been other indirect local benefits: construction crews organized film showings, and construction sites became a popular destination for weekend trips (Eichner-Ramm 2008).

therefore expect that, if this supposition is true, there would be a synergy between road building and exposure to government propaganda. To proxy for propaganda, we use the Nazi regime's most powerful tool – the radio. Our analysis uses both city-level radio signal strength and – to account for potential endogeneity – predicted radio listenership based on signal strength (see Section 3.c).

Table 8 analyzes the relationship between radio coverage, highway construction, and Nazi vote gains. First, we split the sample into areas with above- and below-median radio signal strength. In the latter, signal strength was too low for good radio reception, except for enthusiasts who purchased high-quality receivers (see Appendix A.6). In these areas, we find only a small and insignificant relationship between distance to highways and Nazi vote gains (col 1). On the other hand, in areas with above-median signal strength (col 2), we find a strong coefficient on highway construction, which is significantly larger (in absolute value) than the coefficient in column 1, with a p-value of 0.01 for the difference. Next, we turn to predicted radio listenership and run regressions in the full sample, including interaction terms. The results in column 3 show that (predicted) radio listenership based on signal strength is strongly positively associated with Nazi support, while the interaction term with distance to highway construction is strongly negative.[41] This suggests that proximity of the *Autobahn* had a larger effect on electoral support when combined with radio propaganda – which turned every segment opening and every "round" number of kilometers completed into a major media event. Could it be that our interaction results are driven by remote areas that had neither highway construction nor radio coverage? We address this point in column 4, by excluding all areas that were more than 20 km from any planned, approved, or built highway segment. That is, we only include areas that would eventually be connected by highways, according to the 1933 plans. We again find a negative interaction term that is – if anything – even stronger than the one in column 4.

Figure 9 illustrates the implied complementarity between highway construction and radio coverage: In areas with predicted listenership below 20%, there is no relationship between distance to the nearest highway segment and Nazi vote gains. The relationship becomes negative and significant for predicted listener shares of 30%, with a coefficient on distance

[41] Because radio transmitters tended to be located close to large cities (Adena et al. 2015), we include – in addition to our baseline controls – a dummy variable for locations within 20 km of cities with more than 500,000 inhabitants in 1933.

about -0.1, which reflects our baseline estimate. At a listenership share of 40% (the top 10 percent observed in the data), the coefficient on log distance is -0.2. This corresponds to persuasion rates of about 30% when going from 100 km to 1 km of highway distance – a high value indeed (Della Vigna and Gentzkow 2010).

7.d Highways and political instability at the state level

Authoritarian regimes often garner support by promising a return to order and stability under a strong government. German voters may have valued road building not only because of perceived economic stimulus – it may also have signaled government effectiveness. Since the support of middle class Germans for the Weimar Republic was undermined by political turmoil, we hypothesize that areas with more state-level instability saw larger gains in support for the Nazi regime – and all the more where the new roads were close. To test this hypothesis, we use the data on state government stability from Satyanath et al. (2017), as discussed in Section 4.d.

Table 9 shows the regression results for political stability. We first divide our sample into three groups – above-median stability, below-median stability, and Prussia. The main reason for not including Prussia in either group is that it would dominate the sample – it accounts for more than half of all observations.[42] In the more stable states, we find only a small and insignificant effect of distance on Nazi support (col 1). In the low-stability areas, however, the coefficient on distance is more than four times larger (col 2), and the difference in coefficient size is highly significant. Prussia shows an intermediate score (col 3), with significant but smaller effects than in the highly unstable states. Table 9, column 4 reports a full regression specification including interaction effects. We find a significant and positive interaction effect, meaning that political stability curtails the (negative) effect of distance to highways. This pattern is illustrated in Figure 10 – the more stable a federal state was before 1933, the lower the impact of road construction on Nazi support. Also, the coefficient on Weimar state stability is negative and significant, suggesting that more stable states

[42] In addition, Prussia's initial role as "a bulwark" of democracy in Weimar Germany was gutted in a coup-d'état by the central government in July 1932. Thus, when the NSDAP came to power in Berlin in January 1933, Prussia had seen both a period of relatively stable government, followed by a period of turmoil at the end of the Weimar Republic. Our regressions also include dummies for the three states that were already governed by the NSDAP before January 1933: Mecklenburg-Schwerin, Oldenburg, and Thuringia.

generally saw smaller increases in regime support.[43] The final column of Table 9 reports a robustness check, using an updated measure of the instability indicator in Satyanath et al. (2017), where we extend the coding from the original period 1918-June 1932 (before the central government's coup-d'état in Prussia) to January 1933, when the NSDAP took over the central government. The coefficients and significance levels are almost unchanged.

It seems likely that issues relating to order and government effectiveness were more salient in states where parliamentary 'chaos' was more common. The fact that in these states, support for the Nazis grew more as a function of highway proximity than in stable states suggests that the Nazi regime scored an important symbolic victory by road-building: showcasing the rapid and highly effective implementation of a large-scale project may have boosted support for the Nazi regime because it conveyed information about the ability and willingness to "get things done," overcoming the perceived indecisiveness of the parliamentary system.

7.e Highways Approved for Construction (but not yet built)

So far, we have focused on the distance to highway segments *under construction*. The map shown in Figure 2 also contains segments that were approved for building, but that were not yet listed as "under construction." As discussed in Section 3.a, the transition between the two is fluid – approved segments likely had engineers staking out the trajectories, and the public knew that the highway was coming. In Table 10, we use both the distance to highways under construction, and to approved highway segments.[44] We begin with the full sample. The coefficients on both distance to approved roads and to constructed segments are statistically significant and of similar magnitude (col 1). Using the minimum of both distances also yields a negative and significant coefficient (col 2). These findings are confirmed in columns 3 and 4, where we control for distance to any (planned/approved/constructed) highway, and restrict the sample to cities located within 20 km from any highway segment. Overall, the evidence thus suggests that there are no crucial differences between highway segments under construction and those approved for

[43] This does not reflect convergence from lower initial support in Nov. 33 in low-stability states – average yes-votes for the regime were 88% in states with above-median stability, and 90% in the more unstable ones. Thus, if anything, it was harder to generate extra support in unstable states.

[44] The two distances are highly correlated since approved segments typically connect to those under construction. Thus, the results need to be interpreted with caution.

construction. This finding helps to shed light on the mechanism by which highways affected Nazi support. Segments that were merely approved for construction did not (yet) enjoy any direct employment effects or other demand spillovers. Our results thus support the interpretation that highways affected Nazi support by signaling competence in promoting economic progress and social order, and not through immediate local economic effects.

8 Robustness

In this section, we demonstrate the robustness of our findings. We examine issues of balancedness and address the potential endogeneity of terminal cities for the highways. We also present results from placebo tests, different measures of distance to highways, and we use matching estimation. The majority of tables reporting robustness checks are shown in the appendix, but their results and interpretation are summarized here.

8.a Balancing the Sample

As we discussed above, covariates are not balanced when comparing cities with and without highway construction (see Table 2). In Table 11, we address this issue by using entropy weighting to effectively create a balanced sample. This method follows Hainmueller (2012); to implement it, we use the 20 km distance threshold to define the treatment and control group. Entropy balancing reweights the control group data (cities with more than 20 km distance to highway construction) to match the mean of covariates in the 'treatment group' (cities within 20 km of highway construction).[45] We confirm the magnitude and significance of our main result in the full sample (cols 1 and 2). In addition, in column 3 of Table 11, we restrict the sample to cities within 20 km of any highway. There, entropy weighting creates a balanced control group from all cities that saw approved or planned (but no actual) construction within 20 km. We obtain very similar results in this more restrictive specification.

8.b IV Results for the "Top 20" Highway Network

Above we used a set of terminal cities from a Nazi-era publication as nodes for the new highway network. The nodes themselves might have been chosen so as to expose the cities *between them* to highway construction. While inherently unlikely, we nonetheless address

[45] Table A.6 in the appendix shows that entropy balancing delivers an almost perfectly balanced control group, with the mean of all correlates deviating by less than 0.1% from the corresponding mean in the treated group.

this point by constructing an 'objective' highway network that most sensible road planners would have built.

We start with the assumption that connecting the largest 20 cities was a given. Even *if* the Nazi leadership had picked terminal cities to influence people in towns in between, it would always have built connections between the country's largest cities. We compute LCPs only for those connections listed in Jahnke (1936) where both terminal cities belong to the top-20 in terms of population in 1933. This reduces the number of city pairs from 38 to 18. In Table A.5 in the appendix, we repeat our IV analysis, using only these "top-20" least-cost path connections.[46] We find strong and highly significant results that closely resemble those in Table 6.

8.c Sample Splits

Table 2 showed that cities with and without highway construction differed along several dimensions: pre-existing voting preferences, population size, unemployment, industrial employment, and the share of Catholics. We partially addressed this issue above in Section 8.a, using entropy balancing. In Table 12, we provide additional results, stratifying the sample by the most important control variables. Throughout, we report p-values for the null that coefficients in the respective subsamples are the same.

Table 12, Panel A, stratifies the sample by political preferences in March 1933. Where the Nazi Party was already polling strongly, the highway made less of a difference – the coefficient on distance to highway construction is significantly smaller in col 2, compared to col 1. The opposite is true for areas with substantial support for parties in the political center (SPD, Zentrum, and BVP). Here, the highway worked particularly well as a tool to change the voting behavior of the population (as shown by the significantly larger coefficient in col 4, as compared to col 3). In areas with massive Communist support, however, highway worked less well – vote gains were less affected by distance to the *Autobahn* (cols 5 and 6). This suggests that the highways were less effective in overcoming opposition at the opposite

[46] There is still substantial overlap between the top-20 network and 1934 building: Out of the 1,052 cities that lie within 20 km of the "top 20" LCPs, and 668 (63.50%) saw actual construction activity by the summer of 1934. In contrast, of the 2,224 towns and cities that were more than 20 km away from "top-20" LCPs, only 429 (19.3%) saw construction.

ideological extreme.[47] In other words, highway construction worked best in persuading voters in the political center – social groups that longed for a return of the order, stability, and perceived effectiveness of the state under the Empire (Peukert 1993).

In panel B of Table 12, we stratify by religious composition and city size. Where Catholics were more numerous than average, highway building led to particularly high gains in August 1934 (cols 1 and 2). Catholics had been much more resistant to the Nazi message than Protestants until 1933, in part because they had their own party representing their interests, the Zentrum (Falter 1991), but also because the Catholic Church warned about the dangers of National Socialism (Spenkuch and Tillmann 2017). However, Catholics were not as fervently opposed to the Nazi regime as communists. Catholics constitute an important part of the moderate voters represented in cols 3 and 4 of panel A. Thus, the results here underline that highways seem to have influenced voters closer to the political middle.[48] Jews accounted for only half a percent of the German population; there is no difference in changes in support for the Nazi Party depending on their population share (cols 3 and 4 in Panel B of Table 12). There is also no difference by city size – additional vote gains for the Nazis were as big in small towns as in big cities when they were close to the highway (cols 5 and 6).

8.d Placebo Tests

To ensure that our regressions do not pick up the effect of geographical features associated with transport infrastructure (which may have benefited disproportionately from a general revival of economic conditions), we also perform placebo regressions. In Table A.8 in the appendix, we use two other forms of transport in exactly the same way as the *Autobahn* – rivers, and railways.[49] We find no consistent association between distance to these alternative means of transport and support for the Nazi Party. This makes it unlikely that the

[47] We find further support for this interpretation when stratifying our sample by socio-economic characteristics that were associated with strong opposition to the Nazi regime: Areas with above-median blue-collar workers or industrial workers (the main recruiting ground for the Communist Party) also show significantly smaller effects of *Autobahn* construction.

[48] In our baseline results, the share of Catholics is strongly *negatively* related to the Nazi vote gain between Nov 1933 and Aug 1934 (col 4 in Table 3; coefficient not reported separately but available upon request). This makes it unlikely that our results are confounded by convergence of Nazi support in Catholic areas. The data suggest that this convergence had already happened between March and Nov. 1933 – over this period, Nazi vote gains are strongly positively related to the share of Catholics.

[49] We take data on historical trajectories of canals and railways from HGIS – the historical information system for Germany. For each town, we code up distance to the nearest railway line or river.

highway effects simply capture a general swing of voters towards the Nazis in locations with good communications and access to transport infrastructure.

8.e Matching Results

To demonstrate that our results are not driven by violations of the linearity assumption, and to further address unobserved heterogeneity, we also perform nearest-neighbor matching. The results are reported in Table A.9 and discussed in more detail in the appendix. We match with two sets of variables – the baseline controls (log population, unemployment in 1933, and Nazi Party support in 11/1933), and the extended set (which adds socioeconomic factors such as the share of Jews, of Catholics, of industrial employment, and of blue collar workers). We use either 3-neighbor-matching or 1-neighbor, to form comparison groups with a high degree of similarity in control variables. In addition, we restrict the control group to cities from the same district (77 *Regierungsbezirke*) as the treated observation. We also experiment with defining towns and cities within either 20 km or 5 km of the highway as treated, and we restrict the range of locations from which propensity score neighbors can be drawn to cities in the vicinity of the overall planned highway network. In all specifications, we find large, significant effects. Matching estimation suggests that places "treated" with the highway show 0.1 to 0.18 standard deviations higher increases in support for the Nazi Party overall, confirming the magnitude of our OLS estimates.

9 Conclusion

How democratic reversals occur and come to last for long periods of time is generally not well understood.[50] We focus on the entrenchment of dictatorship in a case with major implications for world history: the consolidation of the Hitler government in Germany after 1933. It went from an initially relatively fragile dictatorship to a firmly entrenched regime. Our results strongly suggest that the Nazis won "hearts and minds" through the construction of the world's first high-speed road network, the *Autobahn*: Where the new roads were

[50] The empirical literature has identified some factors, such as negative economic shocks and the brevity of democratic rule, that can prejudice chances of democracy (Linz and Stepan 1978, Persson and Tabellini 2009; De Bromhead, Eichengreen and O'Rourke 2013).

being built by the time of the 1934 plebiscite, electoral support for the dictatorship increased significantly.[51]

The effects are both quantitatively important and likely to be causal. Persuasion rates indicate that more than 10% of Germans previously opposed to the regime changed their minds as a result of highway construction – and this is likely a lower bound because our estimates do not reflect aggregate vote changes. We confirm our findings when we predict where road-building should occur based on terrain features and the associated cost of construction. We also show that distance to the 1934 *Autobahn* construction is unrelated to Nazi support in prior elections, before highway construction began, and that other transport infrastructure does not have similar predictive power.

Why did motorway building reduce opposition to the regime? Car ownership rates were low, and the roads did not open to traffic before 1935. Also, job creation due to highway construction was probably limited. This rules out direct benefits as a major source of support Crucially, highway construction stood for a new set of economic policies, substituting government-led intervention and demand stimulus for austerity. After the perceived incompetence and chaos of Weimar politics, many Germans were impressed by the *Autobahn's* rapid progress. The motorways were officially referred to as "roads of the *Führer*," and the regime lost no time connecting the declining unemployment rate in the aggregate with this public works program. While perceived competence and energy affected voting in the country as a whole, the regime's accomplishments were directly visible in districts where the *Autobahn* was being built. Accordingly, this is where the regime scored its greatest successes – and all the more so if radio coverage was good, exposing locals to the Nazi propaganda that heavily exploited highways as a signal of regime competence. Thus, our results suggest an important complementarity between *aggregate* propaganda and the *local* visibility of the proclaimed progress.

While the true effect of highway building on the post-depression upturn was probably modest (Ritschl 1998, 2003), the regime succeeded in convincing the German public (and many foreign observers, including John Maynard Keynes) that the *Autobahn* played an important role in reviving the German economy. The *Autobahn* also demonstrated the new

[51] This finding is in contrast to earlier research on highway construction under dictatorships, which had highlighted the importance of repression and military use (Saiz 2005).

government's determination and abilities in a convincing fashion, along the lines of Rogoff (1990). This interpretation is supported by our finding that highways had a particularly strong effect on swaying voters in states that had been politically unstable during the Weimar Republic. In other words, the road building showcased Nazi Germany's ruthless energy, organizational effectiveness, and its determination to return Germany to its former role of pre-eminence in the world – thus winning "hearts and minds."

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FIGURES

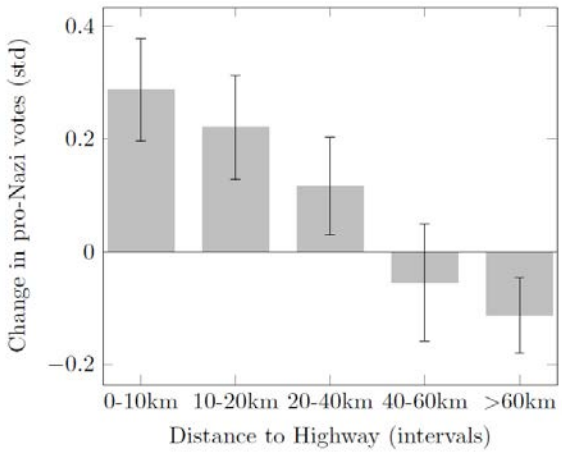

Figure 1: Change in Nazi support, Nov. 33 and Aug. 34, by distance to highway

Note: The figure shows the difference in standardized pro-Nazi votes between the November 1933 election and the August 1934 referendum, for different distance brackets to highway segments under construction (approximately corresponding to distance quintiles). Bars indicate the average change in (standardized) Nazi support; the black lines, the 95% confidence interval.

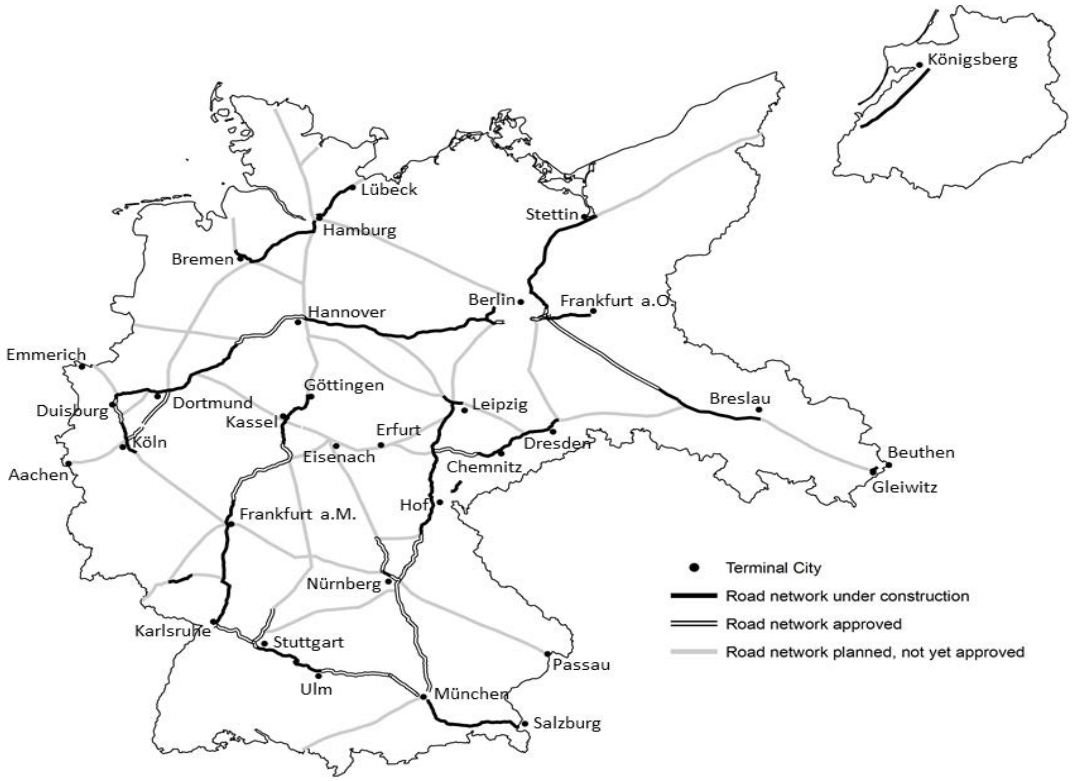

Figure 2: German Highway Network by 1934

Note: Location of highway segments from Todt (1934). Map geo-coded by authors.

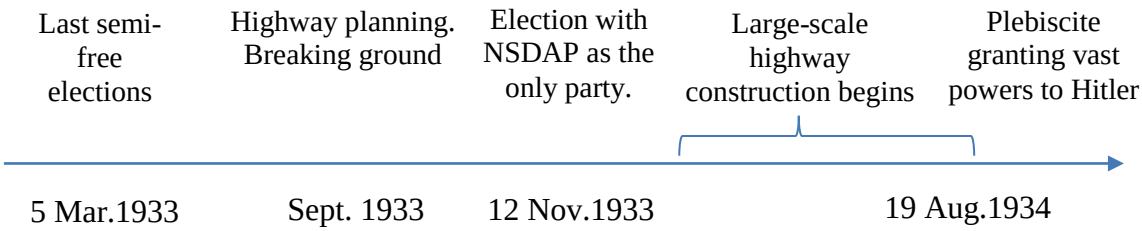

Figure 3: Timeline of events

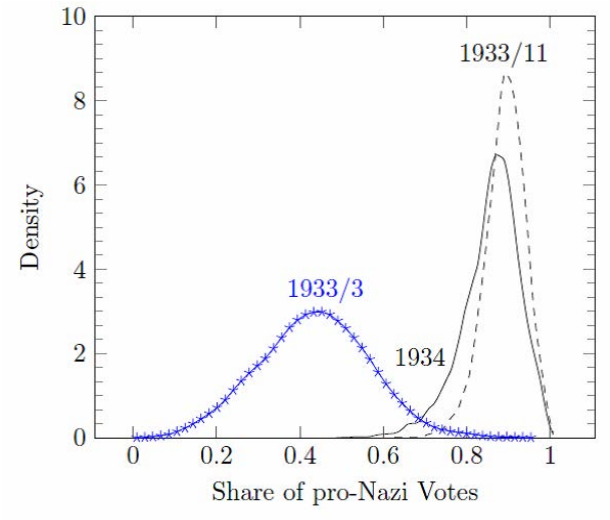

Figure 4: Support for the Nazi Regime, 1933-34

Note: The figure shows the distribution of pro-Nazi votes across cities in Germany in the March 1933 election, the November 1933 election, and in the August 1934 referendum.

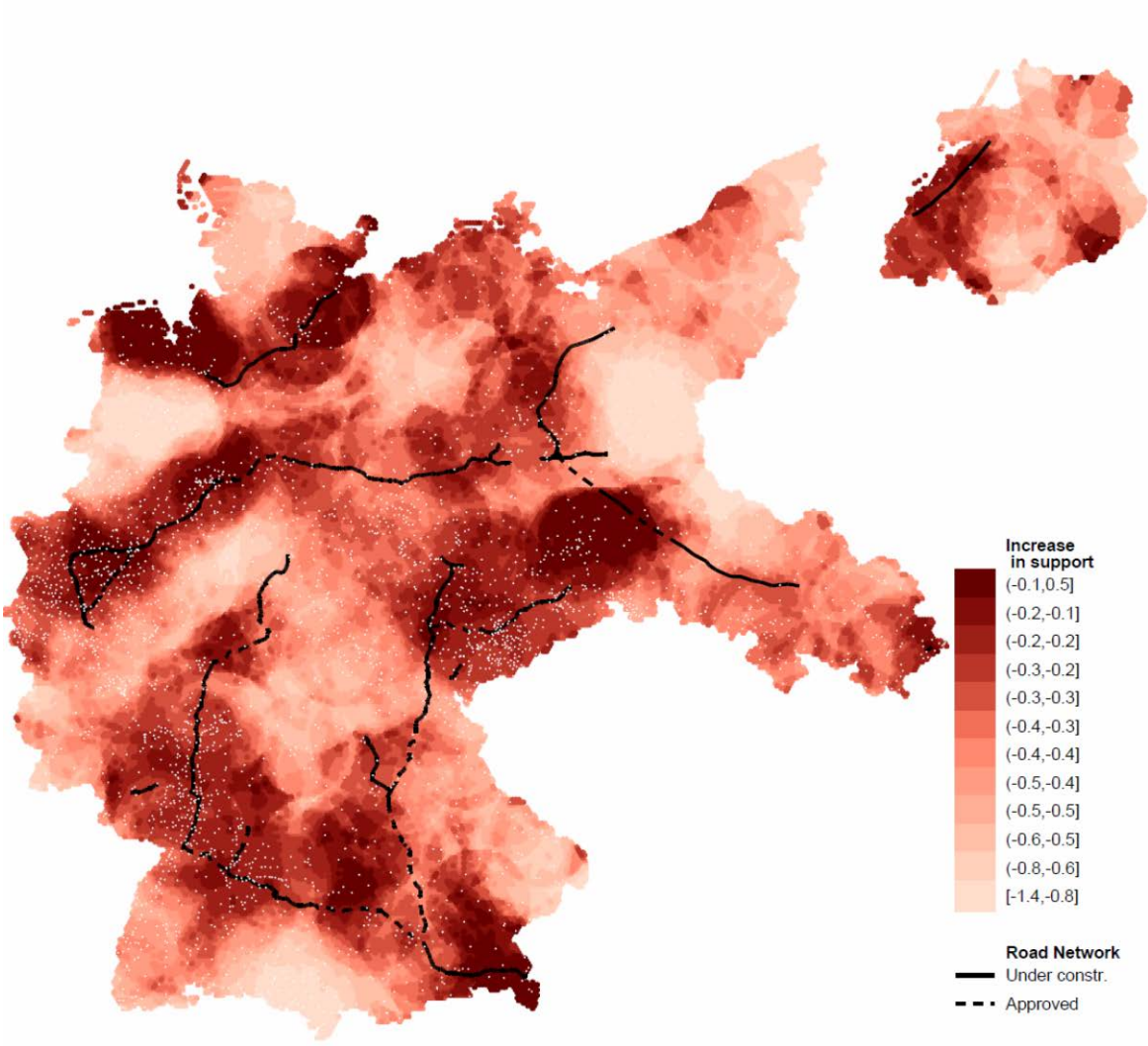

Figure 5: Shift in favor of the Nazi Regime between Nov. 33 and Aug. 34

Note: The figure shows the difference in standardized pro-Nazi votes between the November 1933 election (before highway construction had begun in earnest) and the August 1934 referendum (when large-scale highway construction had started). The figure shows residual variation, after controlling for city population, unemployment, and fixed effects for 77 administrative districts (*Regierungsbezirke*). Small white dots in the figure indicate towns and cities in our dataset.

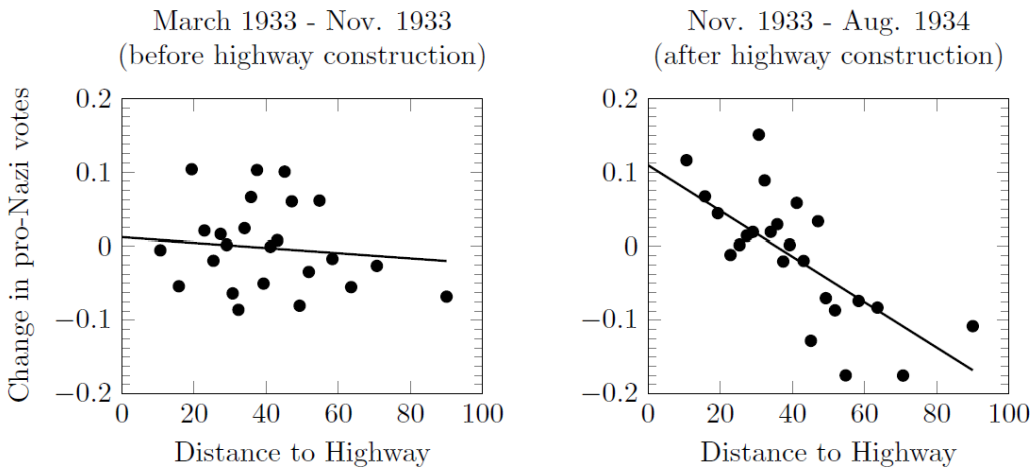

Figure 6**:** Change in pro-Nazi votes, before and after highway construction began

Note: The figure shows the difference in standardized pro-Nazi votes between the March and Nov. 1933 elections (left panel), and between the Nov. 1933 election and the August 1934 referendum (right panel), as a function of distance from highway segments that where under construction by 1934 (construction began in the autumn of 1933). The underlying regressions include the baseline and additional controls listed in Table 2, as well as fixed effects for 77 administrative districts (*Regierungsbezirke)*. For ease of exposition, the binscatter plot groups the x-axis into 25 equal-sized bins.

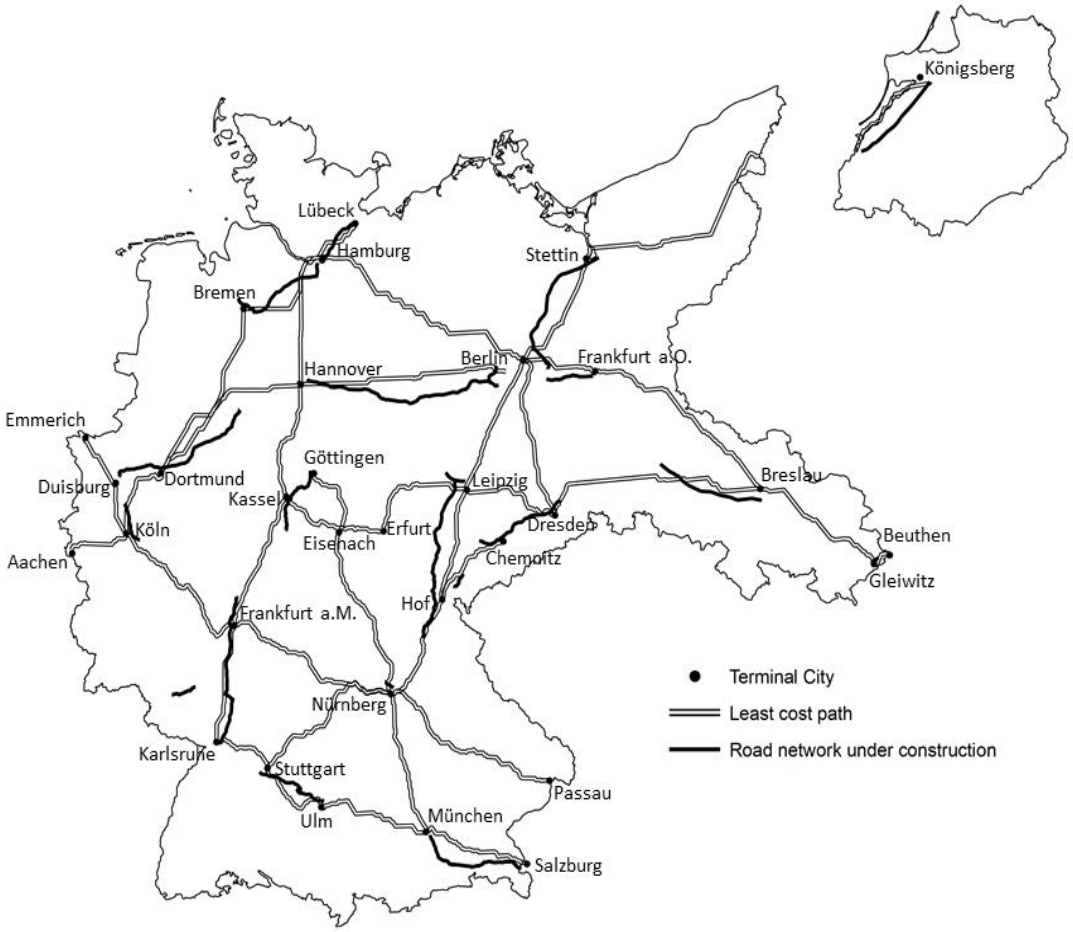

Figure 7: Least Costs Paths and Actual Highway Construction

Note: Location of highway segments from Todt (1934). Least-cost paths between terminal cities computed by authors.

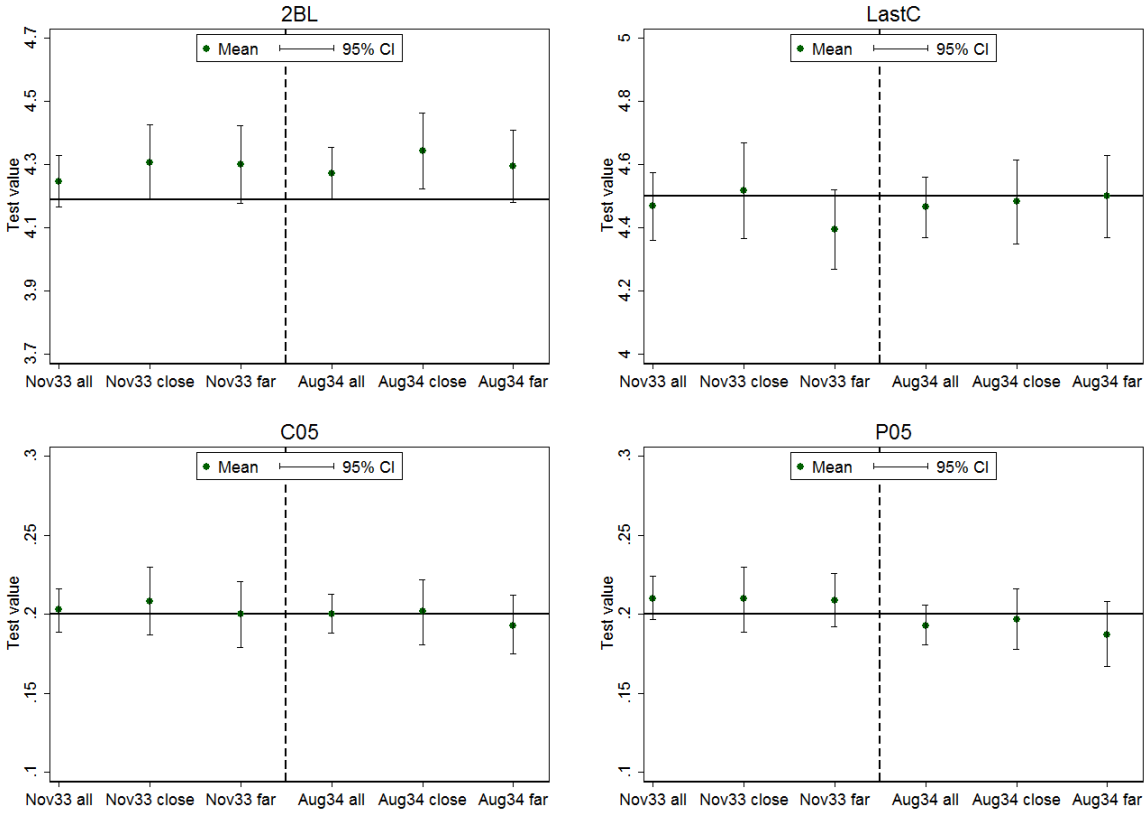

Figure 8: Election Forensics

Note: One the x-axis, for each election (Nov'33 and Aug'34), "all" = all cities in the sample, "close"=close to highways under construction (below median-distance), "far"=above-median distance. The figure implements four tests of election fraud proposed by Hicken and Mebane (2015). For each test, the horizontal line shows the expected value under no fraud. The tests are the following: 2BL – Benford's Law, based on the second digit of each location's reported pro-Nazi votes (lower digits have a higher frequency according to Benford's Law; the expected average of 2nd digits is 4.19); LastC – analyzes the last digit of the pro-Nazi vote count (this is expected to be normally distributed, with a mean of 4.5); C05 – analyzes the proportion of the pro-Nazi vote count ending in either 0 or 5 (under a uniform distribution, this proportion should be 0.2); P05 – analyzes whether the rounded percentage of pro-Nazi votes has last digit 0 or 5 (these digits are more likely to appear if public officials want to signal that they have committed election fraud. Under a uniform distribution, the corresponding proportion should be 0.2). All statistics are based on reported town/city-level votes in favor of the NSDAP (November 1933) and of "yes" votes in the referendum in August 1934. The 95% confidence intervals are estimated using nonparametric bootstrapping. Table A.2 in the appendix reports the coefficients.

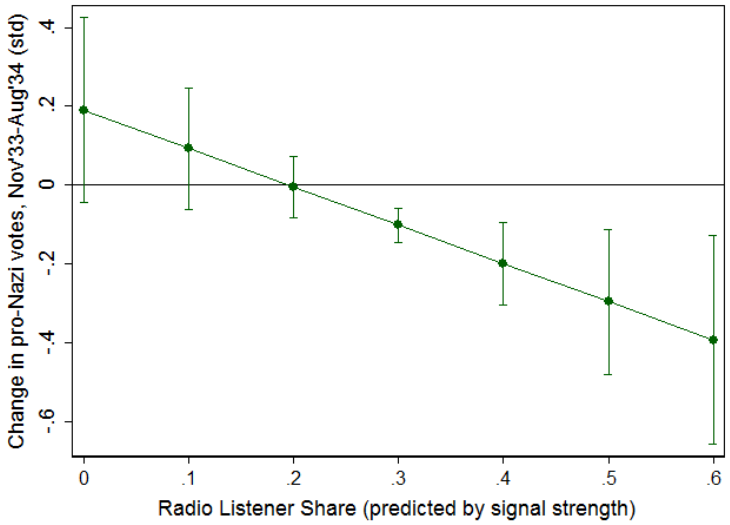

Figure 9: Effect of distance to highways on Nazi vote gain, by radio listener share

Note: The figure visualizes the estimate from Table 8, column 4, showing that the effect of distance to highways on pro-Nazi votes is particularly pronounced in areas with high radio listenership (as predicted by radio signal strength).

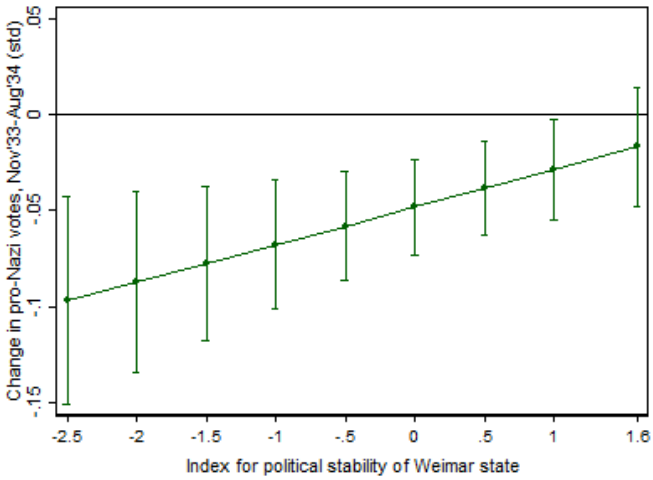

Figure 10: Effect of distance to highways, by political stability of Weimar state

Note: The figure visualizes the estimate from Table 9, column 4, showing that the effect of distance to highways on pro-Nazi votes was strongest in Weimar states with low political stability. The range of the x-axis corresponds to the 1st-99th percentile of the political stability measure from Satyanath, Voigtländer and Voth (2017).

TABLES

Table 1: Number of Towns and Cities in the Sample, Conditional on Highway Construction

		Highway under construction in 1934 (< 20 km)		
		Yes	No	Total
Part of National Highway plan? (<20 km)	Yes	1,097	918	2,015
	No	0	1,261	1,261
	Total	1,097	2,179	3,276

Note: A map with the location of highways is shown in Figure 2.

Table 2: Cities Characteristics, By Highway Plans and Construction

	Full	Highway planned		
Variable	sample	All	built	not built
Baseline controls				
Population size 1933	12,294	15,906	21,687	8,992
Unemployment rate 1933	0.152	0.164	0.182	0.142
Additional controls				
Blue collar share 1933	0.336	0.347	0.364	0.328
Share Industrial Employment	0.297	0.315	0.340	0.285
Share Catholic	0.364	0.339	0.283	0.404
Share Jewish	0.005	0.005	0.004	0.005
Initial Nazi support				
NSDAP vote share in March 1933	0.425	0.412	0.415	0.410
Number of cities	3,276	2,015	1,097	918

Note: Under “Highway planned”, “All” comprise all cities within 20 km of planned, approved, or built highways in 1934, according to the highway network in Figure 2; “not built” are those segments that were planned but not yet under construction by August 1934.

Table 3: Distance to Highways and Change in Nazi Support

Dependent variable: change in standardized pro-Nazi votes, Nov 1933- Aug 1934

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS Results						
log(distance HW)	-0.0962***	-0.0591***	-0.0775***	-0.0380***		
	(0.0132)	(0.0121)	(0.0135)	(0.0125)		
HW within 20km					0.127***	0.124***
					(0.0274)	(0.0263)
Vote change 1-100km#	*-2.9%*	*-2.7%*	*-2.3%*	*-1.1%*	*0.8%*	*0.8%*
Pro-NSDAP votes in Nov 1933		-0.360***	-0.427***	-0.442***	-0.359***	-0.428***
		(0.0157)	(0.0167)	(0.0158)	(0.0158)	(0.0168)
ln(population) in 1933		-0.0525***	-0.0358***	-0.0450***	-0.0537***	-0.0360***
		(0.0146)	(0.0131)	(0.0135)	(0.0146)	(0.0131)
unemployment rate in 1933		0.547**	-0.0590	-0.135	0.615***	0.0325
		(0.225)	(0.213)	(0.221)	(0.221)	(0.213)
Additional Controls				✓		
District FE			✓	✓		✓
Observations	3,245	3,230	3,230	3,212	3,230	3,230
Adjusted R^2	0.014	0.185	0.469	0.554	0.185	0.467
Panel B: Accounting for spatial correlation, same controls as above§						
log(distance HW)	-0.0767***	-0.0546***	-0.07886***	-0.0269**	0.1470***	0.1268***
	(0.1077)	(0.0130)	(0.0129)	(0.0120)	(0.0309)	(0.0279)
Vote change 1-100km#	*-2.3%*	*-1.6%*	*-2.4%*	*-0.8%*	*0.9%*	*0.8%*
Panel C: Change in % (non-standardized) pro-Nazi votes, Nov 1933- Aug 1934. Persuasion Rates						
log(distance HW)	-0.500***	-0.421***	-0.552***	-0.271***		
	(0.0830)	(0.0864)	(0.0959)	(0.0893)		
HW within 20km					0.904***	0.885***
					(0.195)	(0.187)
Vote change 1-100km#	*-2.3%*	*-1.9%*	*-2.5%*	*-1.2%*	*0.9%*	*0.9%*
Persuasion Rate‡	*15.8%*	*13.3%*	*17.4%*	*8.5%*	*6.2%*	*6.1%*

Notes: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934; "HW within 20km" is a dummy that takes on value one if "Distance HW" is below 20 km, and zero otherwise. "Additional controls" include the share of blue collar workers and the share of industrial employment in 1933, as well as the share of Catholics and of Jews in 1925. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.

#In columns 1-4: change in pro-Nazi votes (in percent) when going from one to 100km distance to nearest highway segment under construction. In columns 5-6: Gain in Nazi support in cities within 20km of highways, relative to all other cities farther than 20km.

‡Persuasion rates are computed following Della Vigna and Gentzkow (2010), assuming that exposure to highways was zero beyond 100km (cols 1-4) / beyond 20km (cols 5-6).

§Panel B accounts for spatial correlation. The model is estimated by maximum likelihood, using each city's geographic location to derive the weighting matrix. All cities with distance less than 3 degrees (~200km-330km) are considered spatially contiguous and are assigned a nonzero spatial weight. All controls are the same as in the OLS regression above. However, district fixed effects are now for 35 electoral districts (*Wahlkreise*) in Weimar Germany, since the 77 *Regierungsbezirke* are too restrictive for the estimation procedure to converge. The spatial regressive coefficient λ is precisely estimated to be zero in all specifications. If $\lambda=0$, the spatial error model reduces to OLS. For $\lambda\neq0$, OLS is unbiased and consistent, but inefficient.

Table 4: Panel Estimation

Dependent variable: Standardized votes for the Nazi Party

	(1)	(2)	(3)	(4)	(5)	(6)
Elections included:	March 1933, Nov 1933, Aug 1934				1924-1934	
log(distance HW) × Aug 1934	-0.0790***	-0.0647***	-0.0645***	-0.0497**	-0.0671***	-0.0876***
	(0.0204)	(0.0210)	(0.0204)	(0.0225)	(0.0230)	(0.0236)
log(distance HW) × Nov 1933	0.0174	0.00259	0.00255	0.0159	0.0291	0.0281
	(0.0238)	(0.0247)	(0.0248)	(0.0240)	(0.0258)	(0.0247)
log(distance HW) × March 1933					0.0117	-0.0221
					(0.0201)	(0.0209)
log(distance HW) × Sep 1930					0.00410	-0.00194
					(0.0197)	(0.0186)
log(distance HW) × May 1928					-0.0190	
					(0.0176)	
Lagged Nazi Party votes			0.0367**	0.0508***		0.113***
			(0.0154)	(0.0156)		(0.0141)
City FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Baseline controls × Year		✓	✓	✓		✓
Additional Controls × Year				✓		✓
District FE × Year				✓		✓
Observations	9,775	9,712	9,681	9,654	19,457	16,095
Adjusted R^2	0.459	0.462	0.464	0.672	0.351	0.564

Notes: Robust standard errors in parentheses, clustered at the city level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934. "Baseline controls" include log population and unemployment rate in 1933. "Additional controls" include the share of blue collar workers and the share of industrial employment in 1933, as well as the share of Catholics and of Jews in 1925. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany. The election in May 1924 uses the (standardized) vote share for the DVFP, which presented a joint list with Nazi candidates while the NSDAP was banned (see footnote 34).

Table 5: Planned vs. Built Highways
Dependent variable: Change in standardized pro-Nazi votes, Nov'33-March'34

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All cities	Only cities with distance<x km from any HW[#]				
		x<20km	x<20km	x<20km	x<20km	x<5km
log(distance HW under construction)	-0.0974***	-0.109***	-0.0503***			
	(0.0187)	(0.0201)	(0.0163)			
log(distance to any HW)[#]	0.0103	0.00232	0.0110			
	(0.0165)	(0.0201)	(0.0127)			
HW under construct. within 20km				0.226***	0.0578*	
				(0.0381)	(0.0306)	
HW under construct. within 5km						0.120**
						(0.0533)
All controls			✓		✓	✓
District FE			✓		✓	✓
Observations	2,797	1,799	1,788	2,002	1,979	711
Adjusted R^2	0.012	0.018	0.567	0.018	0.564	0.568

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "All controls" include log city population, the unemployment rate in 1933, the (standardized) share of pro-Nazi votes in the November 1933 election, the share of blue collar workers and the share of industrial employment in 1933, as well as the share of Catholics and of Jews in 1925. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.
[#] Distance to any highway is the distance to the nearest planned, approved, or built highway segment.

Table 6: Instrumental Variable Regressions with Least Cost Paths

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Reduced Form		Placebo	First Stage		Second Stage	
Dependent Var:	Change in votes for the Nazi Party:			log(distance to highway)		Change in votes for the Nazi Party:	
	Nov'33-March'34		Mar-Nov'33			Nov'33-March'34	
log(distance to Least Cost Path)	-0.0400***	-0.0218**	0.0000359	0.375***	0.304***		
	(0.0101)	(0.00891)	(0.000604)	(0.0158)	(0.0159)		
log(distance HW)						-0.107***	-0.0719**
						(0.0267)	(0.0293)
Weak-IV robust p-value						[0.0009]	[0.0025]
Baseline controls	✓	✓	✓	✓	✓	✓	✓
Additional controls		✓	✓		✓		✓
District FE		✓	✓		✓		✓
First Stage F-Statistic				565.0	364.8		
Instrument partial R^2				0.222	0.168		
Observations	3,204	3,186	3,183	3,204	3,186	3,204	3,184
Adjusted R^2	0.185	0.555	0.913	0.305	0.511		

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934. "Baseline controls" include log city population and the unemployment rate in 1933, as well as the (standardized) share of pro-Nazi votes in the November 1933 election (in col 3, in the March 1933 election). "Additional controls" include the share of blue collar workers and the share of industrial employment in 1933, as well as the share of Catholics and of Jews in 1925. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.

Table 7: Possible Mechanisms? Unemployment and Car Ownership
Dependent variable: Change in votes for the Nazi Party, Nov'33-Aug'34

	(1)	(2)	(3)	(4)
	Unemployment rate relative to median		Vehicle ownership relative to median	
	below	above	below	above
log(distance HW)	-0.0769***	-0.0408***	-0.0323*	-0.0366***
	(0.0200)	(0.0152)	(0.0193)	(0.0128)
Test that coeff are equal:	col (1) = col (2)		col (3) = col (4)	
	p-value: 0.151		p-value: 0.853	
Baseline Controls	✓	✓	✓	✓
Observations	1,626	1,608	1,618	1,472
Adjusted R^2	0.177	0.198	0.129	0.412

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Baseline controls" include log city population and the unemployment rate in 1933, as well as the (standardized) share of pro-Nazi votes in the November 1933 election.

Table 8: Radio Reception and Highway Building
Dep. var.: Change in (standardized) votes for the Nazi Party, Nov'33-Aug'34

	(1)	(2)	(3)	(4)
	Radio reception‡		all	Cities <20km
Cities in sample:	low	high	cities	from any HW§
log(distance HW)	-0.0249	-0.0935***	0.161	0.189
	(0.0201)	(0.0175)	(0.0989)	(0.120)
Test that coeff are equal:	col (1) = col (2) p-value: 0.010			
Radio Listeners (predicted)#			4.220***	5.110***
			(1.178)	(1.282)
log distance HW × Radio Listeners			-0.791**	-0.972**
			(0.354)	(0.419)
Baseline controls	✓	✓	✓	✓
Observations	1,680	1,550	2,256	1,435
Adjusted R^2	0.204	0.171	0.234	0.215

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934. "Baseline controls" include log city population and the unemployment rate in 1933, as well as the (standardized) share of pro-Nazi votes in the November 1933 election. In columns 3 and 4, we also include a dummy that equals one for locations within 20km of a large city (more than 500,000 inhabitants).

Nonlinear prediction of radio listeners, as described in Appendix A.6.

‡ Corresponds to radio signal strength below vs. above median.

§ Distance to any highway is the distance to the nearest planned, approved, or built highway segment.

Table 9: Political Stability of Weimar States and Highway Building
Dep. var.: Change in (standardized) votes for the Nazi Party, Nov'33-Aug'34

	(1)	(2)	(3)	(4)	(5)
Notes:	Political Stability‡		Prussia	All cities	
	high	low	only	Stability1#	Stability2#
log(distance	-0.0276	-0.111***	-0.0334*	-0.0482***	-0.0610***
HW)	(0.0259)	(0.0197)	(0.0178)	(0.0116)	(0.0152)
Test that coeff are equal:	col (1) = col (2) p-value: 0.0100				
Weimar State Stability#				-0.0993**	-0.105**
				(0.0431)	(0.0451)
log distance HW × State Stability				0.0196**	0.0207**
				(0.00767)	(0.00924)
Baseline controls	✓	✓	✓	✓	✓
Observations	683	692	1,705	3,080	3,078
Adjusted R^2	0.272	0.443	0.146	0.243	0.243

Notes: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, in cols 4 and 5, clustered at the Weimar state level. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934. "Baseline controls" include log city population and the unemployment rate in 1933, as well as the (standardized) share of pro-Nazi votes in the November 1933 election. Regressions also include dummies for the three states that were already governed by the NSDAP before January 1933: Mecklenburg-Schwerin, Oldenburg, and Thuringia.

#Stability1 is the measure for Weimar States' political stability between Nov 1918 and June 1932 from Satyanath, Voigtländer and Voth (2017). Stability2 extends this measure to January 1933.

‡ Weimar State's political stability above median (high stability) vs. below median (low stability), based on the Stability1 measure. Prussia is excluded in cols 1 and 2 (see footnote 42).

Table 10: Using Highway under Construction and those Approved for Construction
Dependent variable: Change in standardized pro-Nazi votes, Nov'33-March'34

Sample includes:	(1)	(2)	(3)	(4)
	All cities		Cities located <20km from any HW[#]	
log(distance HW under construction)	-0.0260*		-0.0448***	
	(0.0134)		(0.0167)	
log(distance approved HW)	-0.0389**		-0.0391**	
	(0.0151)		(0.0173)	
log(distance HW approved or under construction)		-0.044***		-0.0617***
		(0.0114)		(0.0162)
log(distance to any HW)[#]			0.0171	0.0202
			(0.0132)	(0.0137)
All controls	✓	✓	✓	✓
District FE	✓	✓	✓	✓
Observations	3,220	3,186	1,799	1,788
Adjusted R^2	0.016	0.368	0.023	0.568

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All controls include log city population, the unemployment rate in 1933, the (standardized) share of pro-Nazi votes in the November 1933 election, the share of blue collar workers and the share of industrial employment in 1933, as well as the share of Catholics and of Jews in 1925. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.
[#] Distance to any highway is the distance to the nearest planned, approved, or built highway segment.

Table 11: Entropy Balancing
Dependent variable: Change in standardized pro-Nazi votes, Nov'33-March'34

Sample includes:	(1)	(2)	(3)
	All cities		Cities located <20km from any HW[#]
HW within 20km	0.116***	0.0837***	0.0875**
	(0.0316)	(0.0316)	(0.0393)
Baseline controls	✓	✓	✓
Additional controls		✓	✓
District FE		✓	✓
Observations	3,234	3,216	1,979
Adjusted R^2	0.005	0.242	0.257

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Regressions are estimated using entropy weighting, which creates balanced samples by reweighting the control group data (farther than 20 km from highway construction) to match the mean of covariates in the treatment group (less than 20 km from highway construction). See Hainmueller and Xu (2013) for details; Table A.6 in the appendix shows the means for covariates before and after rebalancing. "Baseline controls" include log city population and the unemployment rate in 1933, as well as the (standardized) share of pro-Nazi votes in the November 1933 election. "Additional controls" include all other variables listed in Table 2. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.
[#] Distance to any highway is the distance to the nearest planned, approved, or built highway segment.

Table 12: Sample Splits
Dependent variable: Change in votes for the Nazi Party, Nov'33-March'34

	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A: Sample split by vote shares in March 1933 election						
	NSDAP relative to median		Moderate parties relative to median		Communist Party relative to median	
	below	above	below	above	below	above
log(distance HW)	-0.141***	-0.0696***	-0.0599***	-0.155***	-0.144***	-0.0516***
	(0.0238)	(0.0220)	(0.0206)	(0.0264)	(0.0292)	(0.0182)
Test that coeff are equal:	col (1) = col (2)		col (3) = col (4)		col (5) = col (6)	
	p-value: 0.024		p-value: 0.004		p-value: 0.006	
Baseline controls	✓	✓	✓	✓	✓	✓
District FE	✓	✓	✓	✓	✓	✓
Observations	1,609	1,609	1,599	1,619	1,619	1,599
Adjusted R^2	0.393	0.133	0.153	0.370	0.343	0.197
PANEL B: Sample split by religion and population size						
	Share of Catholics relative to 50%		Share of Jews relative to median		City population relative to median	
	below	above	below	above	below	above
log(distance HW)	-0.0521***	-0.194***	-0.104***	-0.115***	-0.108***	-0.107***
	(0.0168)	(0.0338)	(0.0211)	(0.0240)	(0.0248)	(0.0210)
Test that coeff are equal:	col (1) = col (2)		col (3) = col (4)		col (5) = col (6)	
	p-value: 0.0001		p-value: 0.725		p-value: 0.970	
Baseline controls	✓	✓	✓	✓	✓	✓
District FE	✓	✓	✓	✓	✓	✓
Observations	2,103	1,131	1,598	1,618	1,592	1,642
Adjusted R^2	0.136	0.340	0.351	0.262	0.313	0.287

Note: Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. "Distance HW" is the distance of a city to the nearest highway segment that was under construction by August 1934. Baseline controls include log population and unemployment rate in 1933. District FE correspond to 77 *Regierungsbezirke* in Weimar Germany.