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Working Paper

Thou shalt not bear false witness against your customers: Cultural norms and the Volkswagen scandal

IWH Discussion Papers, No. 21/2019

Provided in Cooperation with:

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Suggested Citation: Hasan, Iftekhar; Noth, Felix; Tonzer, Lena (2019) : Thou shalt not bear false witness against your customers: Cultural norms and the Volkswagen scandal, IWH Discussion Papers, No. 21/2019, Leibniz-Institut für Wirtschaftsforschung Halle (IWH), Halle (Saale), <https://nbn-resolving.de/urn:nbn:de:gbv:3:2-113431>

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<https://hdl.handle.net/10419/205151>

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Halle Institute for Economic Research
Member of the Leibniz Association

Discussion Papers

No. 21

October 2019



Thou Shalt not Bear False Witness Against Your Customers: Cultural Norms and the Volkswagen Scandal

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ISSN 2194-2188

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IWH Discussion Papers are indexed in RePEc-EconPapers and in ECONIS.

Thou Shalt not Bear False Witness Against Your Customers: Cultural Norms and the Volkswagen Scandal*

Abstract

This paper investigates whether cultural norms shaped by religion drive consumer decisions after a corporate scandal. We exploit the unexpected notice of violation by the US Environmental Protection Agency in September 2015, accusing the car producer Volkswagen (VW) to have used software to manipulate car emission values during test phases. Using a difference-in-difference model, we show that new registrations of VW (diesel) cars decline significantly in German counties with a high share of Protestants following the VW scandal. Our results suggest that the enforcement culture rooted in Protestantism affects consumer decisions and penalises corporate fraud.

Keywords: religion, corporate scandal, consumer choice, climate change

JEL classification: D12, O30, Q50, Z12

* We thank Anat Admati, Stefano Colonnello, Reint E. Gropp, Steffen Müller, Oliver Holtemöller, Michael Koetter, Alexander Popov, and Luigi Zingales for valuable comments and suggestions. We are grateful to the Kraftfahrt-Bundesamt (Federal Motor Transport Authority) for providing data. A revised version of this paper has been published as *Hasan, Iftekhar; Noth, Felix; Tonzer, Lena: Cultural Norms and Corporate Fraud: Evidence from the Volkswagen Scandal. IWH Discussion Paper 24/2020. Halle (Saale) 2020.*

1 Introduction

Cultural norms are an essential driver in individuals' economic decision-making. In their seminal paper, Guiso et al. (2006) show that culture defined as *“those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation”* affects economic outcomes. At the same time, corporate scandals undermine established trust in a company and are found to change market participants' behavior towards fraudulent firms (Giannetti and Wang, 2016; Knittel and Stango, 2014; Krueger, 2015; Williams and Barrett, 2000). In this paper, we combine these two strands of literature and ask whether cultural norms shaped by religion affect how consumers react to a corporate environmental scandal. From a corporate governance perspective, the question is particularly important in situations, in which regulatory interventions lag and alternative mechanisms are needed to penalize fraud.

We exploit the occurrence of an unexpected event with the potential to change consumer behavior. On 18 September 2015, the US Environmental Protection Agency (EPA) issued a Notice of Violation of the Clean Air Act. This way, the EPA notified the car producer Volkswagen (VW) about the violation of exhaust standards through the implementation of a defeat device software for cars with a diesel engine. Figure 1 shows the Google trends index for the search items *VW* and *Diesel*. The spike in autumn 2015 indicates that the revealed information was unexpected, as reflected by the increased use of those search items. Furthermore, Figure 2(a) documents that the VW scandal in 2015 was sizable in terms of registrations of new cars from the VW brand in Germany.

Figure 1 and Figure 2 about here

This quasi-natural experiment serves as an ideal setting to evaluate whether consumers respond differently to the scandal, depending on cultural norms. The analysis benefits from a granular panel data set covering monthly information on newly registered cars at the county level over the period 2013-17 and differentiating by car producer and engine type (diesel, non-diesel). Our proxy for cultural norms is the dispersion of local Protestantism. It can be an essential factor in driving consumer choice because it might affect to which extent consumers exert discipline to the firm for fraudulent behavior. Our study thus provides novel evidence of how culture can act as a corporate governance mechanism by inducing consumers to penalize corporate fraud.

The question is of relevance having in mind that, first, greenhouse gas emissions and the consequences for climate change are serious environmental threats. However, current discussions about CO₂ taxes and emission certificates reveal that regulation is lagging. Second, car producers dominating the market have tended to neglect the potential of clean technologies. Still, their products have relevant market shares, they are major employers, and contribute significantly to countries' gross domestic product.¹ Third, the corporate entity that initiated the diesel scandal, the car producer Volkswagen (VW) employed around 600,000 people in 2015 and consequent effects are thus likely to be economically sizable.

¹“German car producers underestimated the potential of the all-electric vehicle and thought it was just a fad that would pass. [...] And at the same time they've been pushing diesel engines with defeat devices.” Quote by Juergen Resch, head of Environmental Action Germany, <http://www.latimes.com/business/autos/la-fi-hy-0419-tesla-germany-20160419-story.html>.

We show that after the VW scandal in 2015, new registrations of VW cars decline significantly more in Protestant regions compared to non-Protestant regions (see also Figure 2(b)). Our results suggest that different cultural norms embedded in Protestant counties such as stricter enforcement rather than a “forgiveness culture” spill over to consumer decisions. While we do not find significant effects for new diesel cars in general, a significant difference again arises for VW cars with a diesel engine. Hence, consumers are not only likely to punish the corporate entity subject to the scandal but also a specific product type depending on their sensitivity to the scandal. Importantly, our findings demonstrate that Protestantism seems to establish a normative system that determines the economic response of a sizable subset of the population. Embedded cultural norms can thus be an effective instrument to “mobilize the masses” and exert market discipline. Our results further reveal that the penalizing effect of Protestantism is more pronounced in counties in which Protestantism is long-rooted and which are less conservative. Also, we find no evidence that environmental preferences play a significant role in the reaction of Protestants.

We contribute to three main strands of literature. First, closely related to our research are papers that assess the effects of the VW (diesel) scandal. Negative news about car emissions due to firms using defeat device software to manipulate emission values can hurt those firms due to reputation effects. Bachmann et al. (2017) show that US sales and stock returns of not only VW but also other German car producers decline following the scandal revealing “group reputation externalities” (Barth et al., 2019). Strittmatter and Lechner (2017), who analyze the supply of *used* VW diesel cars, provide further

evidence that consumers respond to the scandal. Other research confirms that firms face reduced stock market valuation and adverse demand-side effects after corporate scandals (Karpoff et al., 2005; Knittel and Stango, 2014). Giannetti and Wang (2016) show that household stock market participation declines following corporate scandals.² Further, there is research that studies adverse effects on human health due to excessive emissions of VW cars in the United States or Europe (Alexander and Schwandt, 2019; Barrett et al., 2015; Holland et al., 2016; Oldenkamp et al., 2016; Schlenker and Walker, 2015).

Second, our paper contributes to the literature on culture and economic outcomes. The culture we live in shapes social norms and beliefs and thus impacts on economic decision-making (Guiso et al., 2004, 2006, 2009; Tabellini, 2010). A critical aspect of culture is religion. Various studies show that religion determines not only a country's growth path (Barro and McCleary, 2003) but also work and social ethic (Arruñada, 2010; Becker and Woessmann, 2009; Cantoni, 2015; Guiso et al., 2003), and political preferences or institutional features such as investor protection (Basten and Betz, 2013; Stulz and Williamson, 2003). We contribute to the literature by asking whether a stronger enrooted Protestantism affects consumer decisions when it comes to corporate fraud. Corporate fraud in this paper has a strong environmental aspect. The sensitivity of market participants to environmental questions is, for example, discussed by Chava (2014). He shows that firms face a higher cost of capital if there are doubts about their environmental

²The relation between corporate social responsibility and firm outcomes is, e.g., assessed by Dyck et al. (2019); Krueger (2015); Mohr and Webb (2005); Williams and Barrett (2000).

profile (see also Sharfman and Fernando (2008)). However, there is limited evidence to what degree culture shapes this response.³ Our results show that culture is a strong driver behind changes in consumer demand interacting, however, to a limited extent with environmental aspects.

Finally, our contribution to studies by Acemoglu et al. (2012), Acemoglu et al. (2016) and Aghion et al. (2016) is that we make use of an exogenous shock to consumer sentiment about clean technologies. This shock may force managers to redirect resources away from conservative technologies in the car industry in the long run. Reduced sales of environmentally dirty cars can result in declines in cash flows. Further, this decline can increase incentives to invest in research to foster the development of more sustainable products like electric cars.⁴ The emission scandal could then represent a “game changer” allowing clean technologies to overtake dirty technologies. There is also the risk that an environmental scandal at one firm has competitive effects (Hadlock and Sonti, 2012; Roehm and Tybout, 2006) by, e.g., inducing consumers to switch firm but not product type. Our results show that – at least in the shorter run – negative demand-side effects seem to be centered around Volkswagen but not diesel cars as such.

³The relation between religion, wealth and consumer behavior in other contexts is assessed by, e.g., Buser (2015); Laeven et al. (2019); Ramasamy et al. (2010); Sood and Nasu (1995); Vitell et al. (2005).

⁴For example, Daimler recently announced the construction of one of the biggest battery factories.<http://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-lays-foundation-for-one-of-the-biggest-and-most-modern-battery-factories-in-the-world.xhtml?oid=17464074>

2 Predictions

In this study, we aim at establishing a link between cultural norms and consumer demand after a corporate scandal. One elementary aspect that is attached to the notion of culture is religion, which in the form of Protestantism is the focus of our study.⁵ From the literature it is well-known that religion shapes our value system and impacts on economic outcomes (Barro and McCleary, 2003; Becker and Pascali, 2019; Campante and Yanagizawa-Drott, 2015; Bryan et al., 2018; Guiso et al., 2003). We ask whether a deeper local dispersion of Protestantism affects consumer response to a corporate scandal.

An important aspect of Protestantism raised in the seminal work by Weber (1930) is that Protestants have a strong “work ethic”,⁶ which led to the rise of capitalism in Northern Europe. The main mechanism put forward is that Protestants are inclined to hard work, encouraged to generate wealth, but discouraged to consume. They have hence incentives to save and invest in productive activities, thus fostering economic growth.

Related to Max Weber’s hypothesis about religion and work ethic is the idea that Protestants have a distinct preference and value system. For example, Basten and Betz (2013) put forward that Protestants place more emphasis on self-reliance and less so on governmental redistribution. Arruñada (2010) finds support for a specific “social ethic” of Protestants. He argues that the Catholic “forgiveness culture” is characterized by the individual’s

⁵Studies that consider religion as a fundamental part of culture contain – but are not limited to – Arruñada (2010); Guiso et al. (2006, 2009); Stulz and Williamson (2003).

⁶Empirical evidence on the “work ethic” hypothesis is mixed (e.g., Becker and Woessmann, 2009; Cantoni, 2015; Guiso et al., 2003; Schaltegger and Torgler, 2010; Spenkuch, 2017; van Hoorn and Maseland, 2013).

confession of sins to a priest and the salvation by works. However, there is no such immediate forgiveness of sins available for Protestants who are instead more inclined to monitor each other. The authors argue that Protestantism fostered the “empowerment of the laity” as the church lost its favorable role in intermediating between believers and God.

Consequently, the adherence to and the enforcement of rules, as well as mutual control, replace private confession of sins with potential implications for individuals’ decision-making. Evidence that the enforcement culture that comes with Protestantism indeed impacts on decisions of households is provided by Hasan et al. (2019) who find that household over-indebtedness is higher for German regions with a high share of Protestants. In line with this literature, we assume that Protestants due to a less active forgiveness culture, a higher degree of monitoring of others’ well-behavior or misconduct, and a stronger emphasis on the enforcement of rules react to the VW scandal by exerting market discipline over the corporation for fraudulent behavior.

***Hypothesis:** Protestantism affects the sensitivity of consumer demand for a corporation’s (fraudulent) products after an environmental scandal.*

Furthermore, we test whether the enforcement culture rooted in Protestantism interacts with environmental attitudes. Protestants might punish not only the corporation but also the environmentally harmful product. The reason for this is the Protestants’ attitude towards current life and work. Accumulating wealth due to hard work but without excessive consumption was encouraged by Protestant reformers such that the pursuance of worldly activities (compared to monastic asceticism) gains in value (Arruñada, 2010;

Becker and Woessmann, 2009). Having success on earth is interpreted as a sign of salvation and being among the elect, which cannot be reached by following doctrines or good deeds as it previously applied to Catholics. Hence, Protestants might care about diligent and sustainable work at present and punish environmentally harmful behavior of others more. Also, Benjamin et al. (2016) show in an experimental setting that Protestants are more likely to contribute to a public good (which clean air constitutes). In a more general setting, Hong and Kacperczyk (2009) show that social norms affect demand for and pricing of “sin” stocks, i.e., stocks of companies producing alcohol, tobacco, or games.

One could argue that religion has lost its importance in recent years and might thus be a poor proxy for cultural norms. However, the ample literature on religion and economic outcomes suggests that religion shapes value systems still today – even besides declining church attendance and growing atheistic beliefs. Importantly, “implicit socialization” can act as a medium to transmit value systems across generations even if the underlying institutions lose in importance (Basten and Betz, 2013). Also, Guiso et al. (2009) acknowledge that religion still plays a vital role in the teaching agenda at schools, which impacts religiously raised individuals’ beliefs even if they are no longer religious as adults (Guiso et al., 2003). In the empirical analysis, we extend the model and include a “deep parameter” of religious beliefs next to the current share of Protestants in a region to test if religion exerts such long-lasting effects.

3 VW scandal

On 18 September 2015, the US agency EPA issued a Notice of Violation of the Clean Air Act to Volkswagen⁷ accusing Volkswagen to have installed software to circumvent US emission standards. The installation of the software in 2.0-liter diesel cars of the years 2009-2015 results in 40 times more emissions than allowed (Barrett et al., 2015).⁸ Such a software-based defeat device recognizes when the car is in a test box and recalibrates the engine to reduce emissions compared to the on-road performance. Once the defeat device software became public knowledge, VW's market value declined sharply (Figure OA1 in the Online Appendix). Furthermore, Volkswagen had to recall almost 500,000 cars in the United States immediately.

How has the cheating device been detected? In May 2014, the non-profit organization "International Council on Clean Transportation" (ICCT) detected with the help of West Virginia University's Center for Alternative Fuels Engines and Emissions that on-road emissions for a 2012 Jetta (and a 2013 Passat) have been 13-35 (5-20) times higher than test values (Schiermeier, 2015). These institutions informed the EPA, and VW recalled the tested car models claiming that the discrepancy has been due to a software error. In May 2015, the California Air Resources Board (CARB) again tested emission values and reconfirmed the discrepancy in emission values. Following requests by US authorities, the car manufacturer admitted in early September 2015 to have manipulated the software to reduce emission val-

⁷Volkswagen comprises in this context Volkswagen AG, Audi AG, and Volkswagen Group of America, Inc

⁸See also the EPA online sources: <https://www.epa.gov/vw/learn-about-volkswagen-violations#timeline>, <https://www.epa.gov/vw/announcements-volkswagen-violations>

ues during test phases. Finally, on 18 September 2015, the scandal became public in the course of the issuance of the EPA’s Notice of Violation.

Over the next few days and months, negative news accumulated. Quickly after the release of the notice, it became public that not only US cars were affected. The CEO Martin Winterkorn resigned in September 2015, just some days before the German public prosecutors started investigations. A first lawsuit was filed in Germany on October 2015, in which an owner of a VW diesel car requested compensation. VW reacted by recalling cars to update the software, which soon became mandatory for respective car owners in Germany. Consequently, for the year 2015, VW released information about operational losses of around 4 billion euros. In 2016, the US government officially accused VW of manipulation of emission values, and, on June 2016, VW agreed upon civil settlement payments of around 15 billion dollars. A more detailed timeline of key events surrounding the scandal can be found in Table 1 (see also Bachmann et al., 2017; Breitingner, 2018).

Table 1 about here

Why did Volkswagen implement the software-based defeat device? Car producers face the trade-off between developing cars that perform well on-road, are price competitive, and fulfill emission standards in different countries. As concerns VW, starting in 2009, the company aimed at gaining market shares in the United States by pushing a “clean-diesel” campaign for cars with a TDI clean diesel engine.⁹ Diesel cars – compared to cars with a

⁹VW even won “Green Car of the Year” awards (returned by the carmaker after the scandal). It advertised these TDI clean diesel engine cars at the Super Bowl (“The Force” was classified as the best add 2011 by Adweek) and throughout the media. Consequently, VW sold around 600,000 cars with a TDI clean diesel in the United States at the time of the scandal (Alexander and Schwandt, 2019).

gasoline engine – have the advantage that they emit fewer greenhouse gases such as CO₂ (Klier, 2016). However, the nitrogen oxide (NO_x) emissions of Diesel cars are much higher. One “clean-diesel” car could emit as much NO_x as 150 gasoline cars (Alexander and Schwandt, 2019; Breitingner, 2018).

The current state of knowledge is that VW engineers found no cost-efficient solution to adapt engines to meet emission standards. This failure eventually led to the development and implementation of a defeat device software, which adapted the vehicle’s behavior during test phases to reduce NO_x emissions. Hence, on-road emissions of diesel cars were much higher than regulatory standards would have allowed. A study by ICCT (2014) compares the pattern of regulatory standards and real-term NO_x emissions revealing, that also for European standards, vehicles fail to do well (Chossière et al., 2018). Helmers et al. (2019) show that even in terms of CO₂ emissions, the diesel boom in Europe did not bring a climate benefit. This result is crucial as European regulation set particular incentives to reduce CO₂ emissions of vehicles making diesel cars much more popular compared to the United States (Miravete et al., 2015).

For the US company DuPont, Shapira and Zingales (2017) document that environmentally harmful behavior was value maximizing from the perspective of the corporation. They argue that polluting the environment was an ex-ante optimal decision by the company in the light of low detection probabilities. Investigating whether a similar rationale applies to Volkswagen would, without doubt, be an interesting avenue for future research. However, there is still much speculation about who mandated the active use of the software and who knew about its implementation at which stage. In

this paper, rather than studying the ex-ante drivers of fraudulent behavior of a company, we assess in how far ex-post consumer reaction impacts on the environmentally harmful product and the respective manufacturer.

After the “Dieselgate” became public, also other car producers have found themselves subject to investigations. Evaluations by the German Federal Ministry of Transport and Digital Infrastructure in 2016 have revealed problematic NOx emission values for German car producers such as BMW or Daimler (requiring a recall of around 630,000 cars in Germany), but also for vehicles produced by foreign firms such as Nissan and Renault. Ultimately, public awareness regarding environmentally harmful emissions causing health problems increased substantially. Environmental agencies, e.g., the Environmental Action Germany (Deutsche Umwelthilfe), asked for bans of diesel cars in cities with high values of fine dust. The first ban began in June 2018 for particular streets in the city of Hamburg. Further bans in large German cities are still discussed and scheduled for 2019. In October 2018, the governing coalition agreed upon a “program for clean air”¹⁰ foreseeing, for example, the electrification of urban traffic. Hence, the topic has entered the political agenda as well.

4 Data

The data on new car registrations per German region come from the German Federal Motor Transport Authority (Kraftfahrt-Bundesamt) and comprise 4,662,040 observations for 153 car producers in 405 counties for every month

¹⁰<https://www.bmvi.de/SharedDocs/DE/Artikel/DG/sofortprogramm-saubere-luft-2017-2020.html?nn=12830>

between 2013 and 2017. The local authority registers new cars at the place of residence. Hence, new car registrations are a useful proxy for sales of new cars in a county. In a first step, we collapse the sample on the county-month level and match it with data on religion on the county level. The data on religion come from the German Statistical Office and has already been used in Hasan et al. (2019). Our procedure leaves us with 401 counties with 24,032 observations. In a second step, we augment the sample with additional control variables at the regional level. After deleting all missing values, the final data set that we use for our analysis has 391 counties with 23,244 observations on a county-month level. Table 2 contains a list of all variables and Table 2 provides summary statistics.

Table 2 and Table 2 about here

Figure 3(a) and Figure 3(b) provide a first overview of the main variables, namely the distribution of new VW car registrations and the share of Protestants across German counties. Figure 3(a) depicts the distribution of the share of new registrations of VW cars in total registrations of new cars for each German county before September 2015. Yellow-colored regions are counties with a share of less than 30%. Regions colored in lighter orange and orange have average shares of about 30-45% and 45-50%, respectively. The counties with the highest VW shares are in red. Here the share of new registrations of VW cars is larger than 50% on average. Not surprisingly, we find counties with the highest shares in Lower Saxony clustered around Wolfsburg, the headquarter of VW. The regions with the lowest shares are mostly in southern Germany, which constitutes the counties where the main competitors, like BMW and Mercedes-Benz, have their headquarters.

Figure 3 about here

Figure 3(b) shows whether a German county has a Protestant majority, i.e., more than 50% of the population are registered Protestants (red-colored counties). In counties colored in yellow, the share of Protestants is less than 50%. We find counties with a Protestant majority mostly in north Germany. Surprisingly, no county in eastern Germany – the center of the Protestant revolution – has a Protestant majority.

5 Identification

For the identification, we exploit that the VW scandal happened unexpectedly to the broader public, in particular, potential buyers of new cars.¹¹ As previously explained, on 18 September 2015, it became public that VW had used software to manipulate emission values of diesel cars in the United States. Some US authorities had suspected this already some months before. However, Figure 1 plots the Google search index for the items “VW” and “Diesel” and reveals that the awareness of the German public for these topics suddenly jumped after the issuance of the EPA’s notice. Also, stock market prices for Volkswagen and Audi declined suddenly (Figure OA1 in the Online Appendix). The latter finding suggests that also potentially more informed shareholders (compared to local buyers of VW cars) have been surprised by the news.

Consequently, we make use of this unexpected event and use the following

¹¹Alexander and Schwandt (2019) exploit the VW scandal as a natural experiment as concerns the diffusion of “clean-diesel” cars before the scandal and ambient air pollution. Their analysis draws on car registration data at the US county level.

difference-in-difference setup for our analysis:

$$Y_{i,s,m,t} = \alpha_i + \alpha_{m,t} + \alpha_{s,t} + \beta (\text{VW Scandal}_{m,t} \times \text{Protestant}_i) \quad (1)$$

$$+ \sum_k \gamma_k C_{i,t-1} + \epsilon_{i,s,m,t}$$

Equation 1 explains different shares of registrations of new cars per German county i , in a federal state s , in month m , and in a particular year t during the period from 2013 to 2017. $\text{VW Scandal}_{m,t}$ is a dummy variable that is one after September 2015, the month in which the EPA issued the Notice of Violation, and zero before. Protestant_i is a dummy variable that is one if 50% or more of the population in a county is registered with the Protestant church in 2011 and zero otherwise. The coefficient of interest β thus captures whether consumer demand for, e.g., the share of new VW (diesel) cars, responds significantly different after the VW scandal in Protestant-dominated regions compared to other counties. We use county (α_i), year-month ($\alpha_{m,t}$), and federal state-year ($\alpha_{s,t}$) fixed effects.¹² We further saturate our regression model with regional control variables C , which we lag by one year. We cluster the standard errors on the county level.

¹²Note that the presence of the many fixed effects does not allow to estimate the effects of the components of the difference-in-difference effect. We later provide robustness by showing baseline results without any fixed effects.

6 The effect of Protestantism on new car registrations

6.1 Main results

We present our baseline results in Table 3. In the first column, we use the share of new registrations of VW cars in total registrations of new cars in a particular county per month as the dependent variable. We find that the difference-in-difference effect is negative and significant at the 5% level. Our result suggests that new registrations of VW cars in Protestant counties drop significantly after September 2015 in comparison to non-Protestant counties. In economic terms, this decrease amounts to 0.8 percentage points. Judged against the overall mean of new VW car registrations of about 0.37, this drop is around 2%. Hence, our results are in line with our hypothesis. They suggest that regional differences in cultural norms stemming from deeper rooted Protestantism seem to affect how a fraudulent company like Volkswagen fares after the scandal broke out. In that respect, our results are similar to studies by, amongst others, Arruñada (2010), Basten and Betz (2013), and Hasan et al. (2019).

Table 3 about here

To find out whether the decline in the share of new registrations of VW cars stems from either consumer punishment of the company or the fraudulent product, we refine the definition of the dependent variable. In the second column, we change the dependent variable to the share of new registrations of cars with a diesel engine in total new registrations in a

county. We find a negative but insignificant coefficient, which indicates that Protestant regions do not differ in terms of diesel car registrations after the scandal. The result reveals that during our sample period, which was mainly characterized by bad news about VW, no spillover effects to other manufacturers of diesel cars took place.

In Column (3), we zoom in even further and use the share of new VW car registrations with a diesel engine as the dependent variable. The results show a negative and significant coefficient: New registrations of VW cars with a diesel engine drop significantly in Protestant regions relative to non-Protestant regions by about 3% (0.006/0.19) after September 2015. In the fourth column, we check the development of the share of registrations of new VW cars with an engine other than diesel. We find a negative but insignificant coefficient indicating that purchases of this type of car from Volkswagen do not change in Protestant regions after the VW scandal broke out.

In all four regression, we can explain a large share of about 70 to 80% of the variation in the share of new car registrations. This result potentially stems from the many fixed effects we insert into the model since most of the time-varying regional control variables turn out to be insignificant.

Table 3 reveals that the share of new registrations of VW cars in Column (1) decreases because the share of new registrations of VW diesel cars declines after the scandal in Protestant counties. Table 4 in which we use the natural logarithm of new car registrations for the different car types instead corroborates this finding. It shows that total new car registrations (Column (1)) are not different between Protestant and Non-Protestant counties after

the scandal. This result demonstrates that the overall demand for new cars is not significantly different between Protestant and non-Protestant counties after the Volkswagen scandal.

However, Column (4) of Table 4 reveals that as before, the number of new VW cars with a diesel engine significantly declines in Protestant counties by 3.9% after 2015. Again, our results thereby support our hypothesis but show that consumer reaction is nuanced. Protestants seem to be more likely not to forgive the fraudulent company and reduce demand. This reduction mainly applies to the fraudulent product of the respective company. Column (2) of Table 4 shows, that it does neither have negative spillovers to the whole range of products of the company responsible for the scandal nor the product, i.e., cars with a diesel engine, also produced by other car manufacturers (see Column (2) of Table 3 or Column (3) of Table 4).

Table 4 about here

At the industry level, we find little evidence for spillovers. Compared to Giannetti and Wang (2016), who find that a scandal erodes trust and reduces stock market participation of households across firms, or Knittel and Stango (2014) showing that the Tiger Woods scandal had an adverse market signal, we do not find such reduced demand dynamics for both fraudulent and non-fraudulent producers. Obviously, our analysis stops in 2017 and negative news with respect to diesel cars (e.g., bans in cities) accumulated later on such that in the longer run, these spillovers might nevertheless happen. While we do not find evidence for negative spillovers, it could, on the contrary, also be that consumers substitute away from Volkswagen and switch to other car manufacturers. However, the last column of Table 4

provides evidence that competitors of Volkswagen did not benefit: demand for new, non-VW cars did not increase significantly in Protestant counties after the scandal.

More generally, our results add to recent literature as in Rajan (2019) that highlights the importance of communities and their diverse roles in shaping people’s identities and attitudes. We provide evidence that a stronger imprint of Protestant values into communities can work as a disciplining device for corporate wrongdoing. From a corporate governance perspective, the detection of fraud can become costly once regulators intervene. For example, the grounding of airplanes of Boeing by regulators has already resulted in costs of around 8 billion USD. We show that even without regulatory intervention, there can be other mechanisms, in our case, consumers’ reactions, that punish corporate fraud. Hence and in contrast to Karpoff et al. (2005), our results suggest that consumer actions triggered by Protestant values have the potential to work as reputational penalties that moderate the excesses of markets (Polanyi et al., 1957) and can complement mostly lagged, legal and regulatory penalties.

6.2 Robustness

Before assessing what the driving factors behind our main results are, we first provide a battery of robustness checks for our baseline results from the previous section. We provide relevant tables in the Online Appendix.

Fixed effects and standard errors Table OA1 shows results for the baseline regression without any fixed effects and control variables. Overall, we can explain around 4 to 8% of the variation only with the difference-

in-difference components. The difference-in-difference effect loses some significance for new VW car registrations but remains unchanged for all other regressions. Importantly, the regressions show that VW car registrations (in particular non-diesel) were, on average higher, whereas registrations of new diesel cars were, on average lower in Protestant regions before September 2015. It is important to note that we take care of this level difference with the fixed effects in the main regressions. Furthermore, we find a significant general decrease of new car registrations for VW, diesel, and VW diesel in non-Protestant regions over the VW Scandal. This result shows that the differential effects that we find for the Protestant regions are not contrary to the general trend but just stronger.

Table OA2 revisits our results from the first column of Table 3 but uses four different ways to cluster the standard errors. In our main regression, we cluster the standard errors on 391 counties, which produces a standard error of 0.004 for new VW car registrations. In Table OA2, we check alternative clustering on the state level (Column (1)), per month (Column (2)) and two-way clustering on the county and month (Column (3)) and state and month (Column (4)) level. Overall, we find that our results remain significant in all regressions. We, therefore, stay with our choice of using the county level for clustering in the remaining paper since those standard errors turn out to be more conservative than on the state level and the two-way-clustering on 391 counties and 60 months produces similar standard errors. Note further that our results remain intact when we use calendar month clusters (January, February,...) instead. However, we refrain from using them because the then 12 (year-month) clusters probably introduce more bias (Cameron and

Miller, 2015). Further, Abadie et al. (2017) point out that clustering at too aggregate levels might be harmful.

VW core brand and difference-in-difference scrutiny The first column of Table OA3 shows the regression results when we use only the registrations of new cars from Volkswagen’s core brand. Note that the share of VW car registrations, as reported in our main results (and throughout the paper), also includes registrations from other brands like Audi, Porsche, SEAT, and Skoda. We feel that this is the better proxy since those brands are directly associated with Volkswagen in Germany, and the defeat software was initially developed within the Audi brand. However, results in the first column of Table OA3 provide evidence that our baseline results stay intact when we restrict the analysis to the core brand of Volkswagen.

Additionally, the remaining columns of Table OA3 show standard robustness checks for a difference-in-difference setup. In Column (2), we collapse the pre and post dimension to account for potential autocorrelation problems as suggested by Bertrand et al. (2004), and the results show that this is not affecting our results.

Column (3) and Column (4) contain results for our baseline specification when we use matched samples based on the regional characteristics. In Column (3), we use the level of regional characteristics to match on a 1:1 basis non-Protestant counties to the group of Protestant counties. In Column (4), we match on first differences of regional characteristics. In both cases, the interaction effects remain negative and significant at the 5% level and again corroborate our main effect.

Furthermore, Table OA4 and Figure 2(b) corroborate the presence of parallel trends. In Table OA4, we check pre-September 2015 differences between Protestant and non-Protestant regions of all variables in first differences. The normalized differences reported in the last column indicate that no variable shows a significantly different development in the run-up to the VW scandal between the two sets of regions. Furthermore, Figure 2(b) shows the time trends in new VW car registrations for the two groups of regions before and after September 2015 and again no significantly different development between both groups before the VW scandal can be detected.

Placebo results and Protestant threshold Figure OA2 in the Online Appendix further exploits our baseline results on the time dimension. Figure OA2(a) shows the difference-in-difference effects from our baseline regression with new VW car registrations as the dependent variable for varying length of the post-scandal period. The x-axis shows the month until we extend the post-event window. We find that the negative differential effect for Protestant regions becomes significant from October 2015 onwards and remains significant basically until the end of our sample period. Figure OA2(b) checks whether our results are driven by the actual VW scandal of 2015 or maybe just spurious and would arise in any other year. Therefore, Figure OA2(b) plots the difference-in-difference estimates and 95% confidence intervals for regressions in which we define 15 placebo events starting from September 2011 to December 2012. In each of these placebo regressions, we find an insignificant differential effect, which indicates that the actual VW scandal from 2015 is driving our main results.

Moreover, Figure OA3(a) in the Online Appendix shows results when we do a placebo analysis on the cross-section. In this exercise, we test our main results by randomly assigning a Protestant majority to each county. Based on the unconditional probability of being a Protestant region, we randomly allocate 1,000 times the status of Protestant across the sample of counties and re-estimate our baseline regression with new VW car registrations as the dependent variable. Figure OA3(a) provides the difference-in-difference coefficients together with the 95% confidence intervals. If the distribution of Protestant regions produces spurious results, we will find significant difference-in-difference effects in these placebo regressions. However, our results only show significant estimates in 51 out of 1,000 simulations, which is very close to the 5% threshold that one would expect in random sampling. This placebo exercise mutes concerns about confounding effects.

Finally, Figure OA3(b) in the Online Appendix checks our baseline results for varying threshold values to separate Protestant from Non-Protestant counties. We run 31 regressions starting with a threshold of about 35, which means that we define Protestant when a county hosts a share of Protestant equal to or larger than 35% (every other county gets a zero) going to 65, which means a share of equal to or larger than 65%. The x-axis depicts the respective threshold for which we plot the difference-in-difference effect (black circle) as well as the 95% confidence bands. We also plot the share of Protestant counties for each threshold (gray squares) on the second y-axis. We find that the difference-in-difference effects are significant at the 5% level up from a share of 48% to around 57% Protestant population. The evidence shows, first, that our baseline result does not hinge on the 50% level and,

second, that larger thresholds leave stronger Protestant counties also in the control group, which makes finding a significant effect less likely. Further, the share of Protestant counties decreases quickly with higher thresholds which also speaks against finding significant results when we would choose very high thresholds.

Regional robustness Table OA5 in the Online Appendix further checks our baseline results by accounting for some specific regional factors. First, the headquarter of Volkswagen is located in Wolfsburg, which is in the state of Lower Saxony. Because Volkswagen is a huge employer and has for sure effects well beyond selling cars¹³, it stands to reason that proximity to Wolfsburg is a factor that drives our results. Therefore we use a dummy variable (Lower Saxony) that identifies counties in Lower Saxony and show triple-interaction results in Column (1). We find the negative difference-in-difference for Protestant \times VW Scandal effect to stay significant and the triple interaction effects to be positive but not significant. The result indicates that all Protestant counties outside Lower Saxony saw significant fewer VW car registrations after 2015 but that this effect is the same for Protestant counties in Lower Saxony, which mitigates concerns that proximity to the headquarter of Volkswagen is a problem for our analysis. Furthermore, the interaction effect for VW Scandal \times Lower Saxony is insignificant, which indicates that registrations of new VW cars do not change for the non-Protestant counties in Lower Saxony.

Very similar to our regression in Column (1), we check in Column (2)

¹³For example, Volkswagen is the main partner of VfL Wolfsburg, a Bundesliga (major league) soccer club.

of Table OA5 whether effects are different for counties with and without a Volkswagen factory. We find that the main effect for Protestant \times VW Scandal is still negative and significant but that this negative effect on VW car registrations is significantly pronounced for counties that have a VW factory. Since the effects for both groups are significant, we take this as evidence that our results do not hinge on counties with and without a VW factory. However, we find that registrations of new VW cars are unaffected for non-Protestant counties with a VW factory as indicated by the interaction effect for VW Scandal \times VW factory.

The third column of Table OA5 further checks whether counties where car leasing companies register their cars play a role in our results. This is important since car leasing companies can have a considerable impact on new registrations if they renew or extend their fleet. The major car leasing car companies in Germany are Sixt, which registers cars in Munich, Hertz (Dueren), Europcar (Hamburg), and Avis (Wiesbaden, Euskirchen, and Ludwigsburg (Porsche only)). In Column (3), we find that our results remain unchanged when we exclude these counties from our regression.¹⁴

In the last column of Table OA5, we check whether our results hinge on some particular regions in Germany. We, therefore, introduce an additional dummy variable (Rural) that identifies rural counties. We find that the effect of Protestantism on total VW car registrations is driven by counties that are not classified as rural. Put differently; the results show that the significant adverse reactions towards Volkswagen are foremost to be found in more urban regions. One explanation might be that, in contrast to more

¹⁴Note that we are not able to estimate a triple difference-in-difference effect here since none of these counties is classified as Protestant.

rural areas, substitutes for cars like train connections, car-sharing, or using the bicycle are more readily available in urban regions and probably facilitate the decision of a Protestant against Volkswagen. Note, however, that the triple interaction effect with Rural is not significant but positive, indicating that the effects for rural regions are – if anything – less pronounced but not different from a statistical point of view.

7 Channels

Cultural norms embedded in Protestantism seem to affect consumer choice after an environmental scandal attached to one company. This section explores the importance of a persistently Protestant environment as well as the role of competing factors, which enable us to deepen the understanding behind our main result.

7.1 Long-run effects of Protestantism

In this subsection, we check whether the effects of Protestantism on new car registrations of Volkswagen are stronger in case cultural norms and habits of Protestantism are deeper ingrained into the population of a county. We do this in two ways. First, in line with Spenkuch (2017) and similar to Hasan et al. (2019), we make use of information on the religion of the territorial lord of a county in 1624. This approach exploits the fact that in 1624, all inhabitants of a county had to adopt the religion of the territorial lord (or had to leave the county). We regard this as a good proxy to measure the long-term effects of Protestantism on a county. To do so, we create the dummy variable Protestant^{1624} , which identifies whether a county was Protestant

already in 1624. Second, following the idea by Cantoni (2012) who uses the distance to Wittenberg, the heart of the Protestant revolution, we employ the distance in kilometers to famous Protestant churches (Protestant cathedral^{distance}) similar to Hasan et al. (2019).¹⁵ More specifically, we use the dummy variable Protestant cathedral, which is one if the distance to a famous Protestant church is below the median and zero otherwise.

Table 5 about here

Columns (1) to (4) of Table 5 provide the results for the two modifying factors of Protestantism in a county. We show results only for the two dependent variables total new registrations of VW cars and new registrations of VW diesel cars. The reason is that these variables turn out to be the two measures that show significant reactions of Protestant counties after the Volkswagen scandal. Thus, they provide evidence of an enforcement culture in Protestantism that enables market discipline. The triple interaction regression in Column (1) shows, first, that counties that have a majority of Protestants nowadays but had none in 1624 do not react significantly to the Volkswagen scandal in terms of new VW car registrations. Second, comparing Protestant counties of today that were and were not Protestant in 1624 shows that the effects are not different. Third, the total marginal effect of Protestant counties that were Protestant already in 1624¹⁶ shows that those 72 counties saw a significant drop in new VW car registrations after 2015. This result corroborates our main results because it shows that

¹⁵For more details about the Protestant churches, see the Online Appendix of Hasan et al. (2019).

¹⁶We call it Triple^{Total MFX} in the lower panel of Table 5. It is the sum of the difference-in-difference effect (Protestant \times VW Scandal) and the coefficient of the triple interaction effect.

the total effect on VW car registrations is foremost present for counties that had been Protestant for a long time. Column (2) shows very similar results for new VW car registrations with a diesel engine. Again, the effect only comes out significant for those counties in which Protestantism has already rooted since 1624. In contrast to Column (1), now even the triple interaction coefficient is significant, which makes our result even stronger.

The results in Columns (3) and (4) are in line with the previous results. They show both that new VW car registrations do not decrease significantly for Protestant counties that are far away from famous Protestant churches. Again, we find a significant drop in both types of new VW car registrations only for those 41 Protestant counties that are relatively close to famous churches. This result again points to a more profound effect of Protestantism that led inhabitants of these counties to react to the Volkswagen scandal by registering a fewer amount of new VW cars.

The results from Table 5 thus support the idea of long-lasting effects of culture and religion on people and communities as, for example, put forward by Guiso et al. (2006) or Rajan (2019).

7.2 Competing regional factors, politics, and environmental attitudes

In this subsection, we provide horse races between our difference-in-difference effects. We, therefore consider, also other major regional factors that might influence new VW car registrations after 2015. We provide the results in Table 6. Again, we only focus on total new VW car registrations and those VW car registrations with a diesel engine in each set of regressions.

Table 6 about here

In the first two columns, we separate between counties with a population above (below) the median average age across all counties. The coefficients from both regressions turn out to be negative but not significant. This result indicates that the distribution of both groups of counties, those with an older or a younger population, intersect to no small extent. However, we find that the total marginal effects for the triple interactions are negative and significant for both types of VW new car registrations. Thereby, our results show that, foremost, those Protestant regions with an older population are responsible for the negative effect on new VW car registrations. Hence, our results are in line with Malmendier and Nagel (2011, 2016), and Giannetti and Wang (2016) who find that lifetime experience (foremost of negative past events) is an essential factor in household decision making. An alternative explanation for this result can be that risk aversion tends to increase with age. Older individuals might be less inclined to invest in a new VW (diesel) car with potentially lower reselling value (Dohmen et al., 2011).

In Columns (3) and (4), we add another interaction term with Female, which is a dummy variable that identifies regions with an above-median share of the female population. The impact of females and Protestantism may coincide since, for example, Becker and Woessmann (2008) show that Protestantism helped to close the gender gap of education in the early 19th century in Germany. Thereby, counties with a larger Protestant population may still be associated with a more educated and voiced female population. We find – similar to the first two columns – that both the difference-in-difference coefficient and the triple interaction term are negative but not

significant. However, again, the total marginal effects for the triple interactions turn out to be significant and negative for total VW new car registrations and those with a diesel engine. The results show that Protestant regions with a larger share of the female population react more strongly to the Volkswagen scandal. Since females are usually associated with a lower propensity to commit corporate fraud (e.g., Cumming et al., 2015), our results seem plausible in showing that a broader female share of the population fuel the penalizing effects of Protestantism on Volkswagen.

The next columns check the influence of politics on our results. To do this, we run two sets of regressions using total new VW car registrations and those with a diesel engine as dependent variables. We further use the interaction of Protestant \times VW Scandal with a dummy variable that identifies the voting results of the CDU and the Green party in Germany in the latest county election before 2015. From this election outcome, we construct a dummy variable that is one if the party outcome in a particular county is above its median score across all German counties (and zero otherwise).

In Columns (5) and (6) of Table 6, we check the additional effect of election outcomes for the CDU, the leading conservative party in Germany. We find that the negative difference-in-difference effect is significant and even stronger in economic terms than for our baseline results. This result means that less conservative Protestant counties react stronger by having much fewer new VW car registrations after the Volkswagen scandal. This effect remains for total registration as for those with a diesel engine. Column (5) also shows that Protestant counties with an above-median presence of the CDU do not differ from the other counties. However, the total marginal

effect of Protestant and CDU counties is not significant. That means that Protestant counties with a larger share of the leading conservative party in Germany do not react after the Volkswagen scandal in terms of new VW car registrations.

The result is slightly different for Column (6), with new diesel car registrations as the dependent variable. Here we show that Protestant CDU counties do not react either. However, this time, the sharp and significant decline in new VW car registrations with a diesel engine for the less conservative counties differs significantly from the other counties. Our results may suggest that Protestantism paired with a less conservative political surrounding leads to stronger enforcement of market discipline on Volkswagen. Further, conservatives are usually more skeptical towards climate change (e.g., Zia and Todd, 2010; McCright and Dunlap, 2011), which might explain why Protestants in more conservative counties see less need to turn down Volkswagen cars. Opposing effects can also be since the share of Protestant party members in the CDU tends to be below 50%¹⁷ such that conservative values in strong parties overrule enforcement culture in a Protestant region.

Note that in unreported results where we test for other significant parties in Germany, we find that the Protestant \times VW Scandal effect is only significant for counties that are less conservative. Thereby, this corroborates our previous results that the combination of Protestantism and less conservatism leads to a significant reduction in new car registration of Volkswagen after the scandal.

We repeat the exercise from Columns (5) and (6) in the last two columns

¹⁷See, for example, <https://fowid.de/meldung/partemitglieder-und-konfessionen>.

for the Green party (Grüne). This party is mainly concerned with environmental issues, and we can test whether enforcement culture rooted in Protestantism interacts with environmental attitudes in a county. We find that Protestant counties that are characterized by a high voting outcome of the Green party saw a significant decrease in new VW car registrations after the scandal. However, the triple interaction effect is indicating that this effect is not significantly different from the other Protestant counties. However, the effect is twice the size for the “green” Protestant counties than for the other Protestant counties. Hence, similar to results by Kahn (2007), consumer choice as concerns transportation significantly depends on the priority environmentalism receives in a county.

At the level of the firm, our result is surprising in that consumers in Protestant counties refrain from VW but mostly by reducing demand for VW diesel cars. One reason can be that despite the detection of the defeat device software, politicians have over a long period instead protected VW as well as the car industry which could have positive effects on consumer sentiment.¹⁸ A related and more important question is in how far Protestantism represents an enforcement culture or picks up environmental attitudes. We thus add in Columns (9) and (10) of 6 an interaction term between Protestant×VW Scandal and the change in fine dust values from 2011 to 2015. We further use the demeaned variant of the variable, and therefore the double interaction between Protestant counties and the scandal represents the effect for counties without a change in fine dust. We

¹⁸Only in 2019, both a company (Deutsche See) and several German states such as Baden-Wuerttemberg announced to file a lawsuit against VW given the loss in the value of staff cars.

would expect that in counties with a stronger increase in fine dust values, people are more sensitive to environmental questions, especially after the VW scandal. However, results reveal that the decline in new car registrations can still be explained by Protestantism and is not picked up by the additional interaction term.

Table 7 about here

Columns (7)-(9) document that the effect of Protestantism on new VW car registration seems to be unrelated to environmental attitudes. To further strengthen this point, we provide evidence from the survey questions from the German Socio-Economic Panel (SOEP) between 2011 and 2016. We pick four questions related to individuals' preferences towards environmental issues and present mean values in Table 7. We separate between Protestant and Catholic individuals as well as individuals who are not members of a religious group as well as members of other religious groups in Germany. We find that Protestants are not more likely to be members of environmental non-profit organizations than Catholics.¹⁹ However, individuals that belong to one of the two dominant Christian religions are more active in those organizations than individuals from the remaining two groups. The other results show the same tendency for general worries about the environment. However, Protestants seem to care a bit less than Catholics about the climate in general. In terms of worries concerning nuclear power, an essential topic in Germany after the Fukushima disaster in 2011, there is again no difference between the two dominant Christian religions. However, we find that related

¹⁹Note, that stars indicate a significant difference between Protestants and the other groups.

to all answers, the non-religious group and individuals from other religions like Islam seem to care less about environmental aspects. Overall, there are no significant differences between Protestants and Catholics, the dominant religious group in our control group, when it comes to environmental issues. Thereby, the circumstantial evidence from Table 7 suggests again that environmental issues play only a minor role in the Protestant reaction towards the VW scandal.

8 Conclusion

In this paper, we provide evidence that an essential aspect of culture, namely religion, can be a relevant factor when it comes to penalizing corporate fraud. For our analysis, we use the VW emission scandal from 2015 as a natural experiment as well as a granular dataset on new car registrations at the county level. Our focus is on the consumer response as a reaction to the scandal.

We robustly find that counties in Germany which host a majority of members of the Protestant Church decrease the demand for Volkswagen cars significantly after the scandal.

Our results corroborate the general finding of an enforcement culture in Protestantism. They further highlight that an enforcement culture can be a useful tool to execute market discipline since penalties implemented by regulators typically lag. We further find that the penalizing effects on Volkswagen stemming from Protestant counties are stronger when Protestantism is long-rooted in the counties and when the Protestant culture pairs with less conservative political environments. We find no significant evidence

that environmental issues play a dominant role for Protestants to react to the scandal. Critical policy advice from our results is that politicians should foster local cultures that are, like Protestantism, better equipped to respond to excesses of markets and capitalism.

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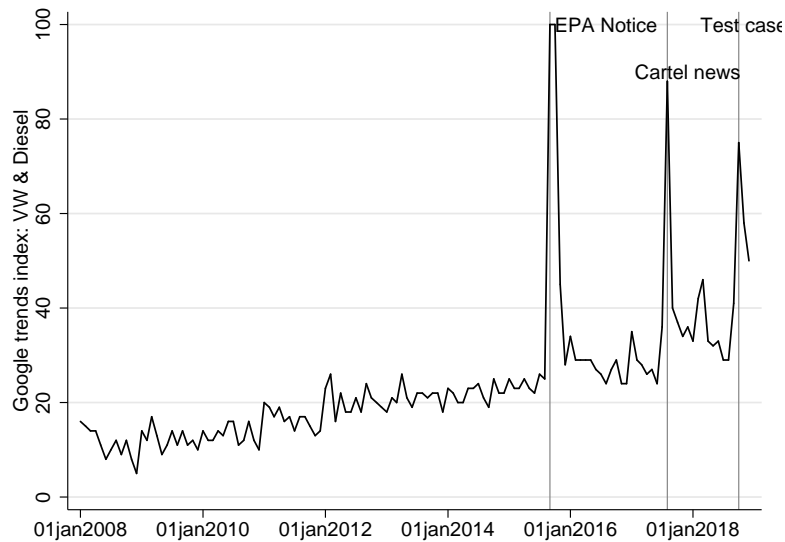
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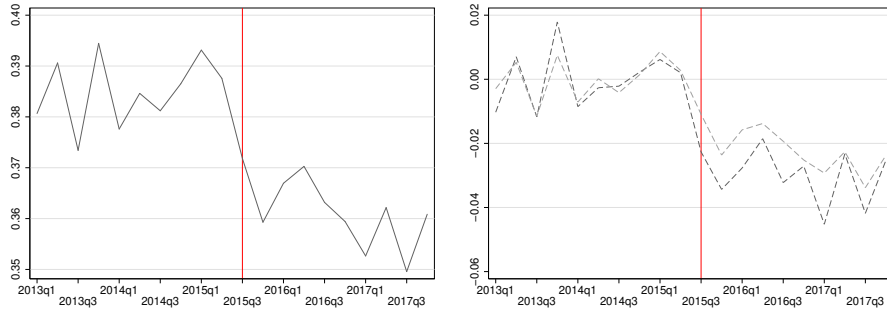
Figures and Tables

Figure 1: Google trends: Search index “VW & Diesel”



The figure shows the Google trends index for the search items “VW” and “Diesel” for Germany and the period 01/01/2008-31/12/2018. 100 indicates that these search items have been most popular on that day over the considered period; all other values are relative to this spike (e.g., 50 indicates that the search items have been half as popular); 0 indicates that not enough values are available. The vertical lines relate to the EPA’s Notice of Violation on 18/09/2015, the news released on 21/07/2017 about the possible cartel formation by VW, Audi, Porsche and Daimler, and the start of a test case in Braunschweig on 10/09/2018, in which VW diesel car owners request compensation.

Figure 2: New VW car registrations by regions over time

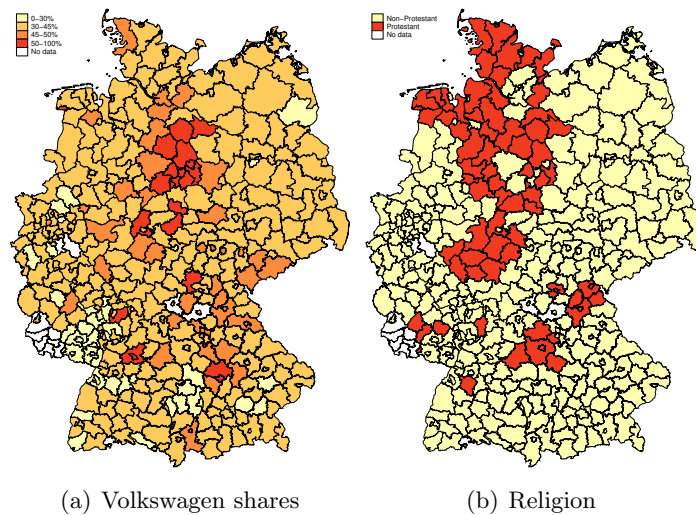


(a) New Volkswagen car registrations

(b) New Volkswagen car registrations by Protestant regions

The left graph shows the average share of new registrations of VW cars per German county. The right graph provides the same information for counties with a share of the Protestant population above(black-dashed)/below(gray-dashed) 50%.

Figure 3: Volkswagen and Protestant shares in Germany



The left map shows the average share of new registrations of VW cars per German county before September 2015. Yellow indicates regions with a share of less than 30%. Lighter orange and orange regions indicate shares of about 30-45% and 45-50%, respectively. If a region is in red, this means that the share of new VW cars is larger than 50% on average. The right graph shows whether a German region has no majority (more than 50% of the population) of the Protestant (yellow) or whether the majority is Protestant (red).

Table 1: Time line VW Scandal

15/05/2014	• ICCT detects discrepancy between emission values in the lab and on-road.
06/05/2015	• CARB conducts new tests and again finds discrepancy.
03/09/2015	• VW admits the usage of a software-based defeat device.
18/09/2015	• EPA issues Notice of Violation of Green Air Act.
18/09/2015	• VW recalls almost 500,000 cars in the United States.
20/09/2015	• VW admits officially the implementation of defeat device software
23/09/2015	• Investigations start in the US, CEO Martin Winterkorn resigns.
25/09/2015	• Matthias Mueller takes the position as CEO at VW.
28/09/2015	• German public prosecutors start investigations.
07/10/2015	• Lawsuit against VW filed by German diesel car owner.
15/10/2015	• German transport authority (KBA) requests recall of 2.4 million VW cars.
28/10/2015	• VW releases information on losses running into billions of euros.
23/11/2015	• Audi admits as well usage of software-based defeat device.
01/01/2016	• US ministry of justice files a lawsuit against VW.
10/03/2016	• US CEO of VW, Michael Horn, resigns.
22/04/2016	• Further tests in Germany reveal high emissions for other car producers.
22/04/2016	• VW releases information on operational loss of 4.1 billion euros in 2015.
28/06/2016	• VW agrees on civil settlement payments in US of 14.7 billion dollars.
25/10/2016	• Civil settlement is authorized by US court.
18/11/2016	• VW decides to cut around 30,000 jobs.
03/01/2017	• German consumer advisers file a test case requesting withdrawal of diesel car.
11/01/2017	• VW confesses guilty of fraud to US justice and pays 4.3 billion dollars.
27/01/2017	• German public prosecution extends investigations against M. Winterkorn.
10/05/2017	• German public prosecution investigates possible stock price manipulation.
01/06/2017	• German minister of transport confirms that Audi cheated as well.
10/07/2017	• Porsche is now also investigated by public prosecutors.
18/07/2017	• Public prosecution also suspects manipulation by Daimler.
21/07/2017	• Audi, Porsche, VW and Daimler suspected to have formed a cartel.
06/12/2017	• VW manager Oliver Schmidt sentenced in US to 7 years of prison.
27/01/2018	• Shocking news on animal lab experiments and fuel emissions.
30/01/2018	• VW promises to rule out animal experiments in the future.
23/02/2018	• Also car producer BMW used software to manipulate emission values.
20/03/2018	• Car manufacturer BMW officially inspected by public prosecution.
12/04/2018	• VW CEO Matthias Mueller is replaced by Herbert Diess.
18/04/2018	• Property of Porsche searched by police and public prosecution.
03/05/2018	• US courts accuse M. Winterkorn for violation of environmental laws.
06/06/2018	• Daimler suspected to have manipulated emission values as well.
11/06/2018	• Start of investigations against Audi CEO Rupert Stadler.
11/06/2018	• Daimler has to recall more than 200,000 cars in Germany.
13/06/2018	• VW sentenced by German court to pay penalty of 1 billion euros.
10/09/2018	• Start of test case in which German car owners request compensation.
22/02/2019	• German federal court decides that manipulation software is a material defect.

This table lists the important events that relate to the Volkswagen scandal until February 2019. The information stems mainly from Breitinger (2018).

Table 2: Variable description

Variable name	Description	Source
Dependent variables:		
Total registrations	Total registrations of new cars per county and month. Note that we use the natural logarithm of this variable in the regressions.	Kraftfahrt-Bundesamt
Diesel share	New registrations of cars with a diesel engine as a share of total new car registrations per county and month.	Kraftfahrt-Bundesamt
VW share	New registrations of Volkswagen cars as a share of total new car registrations per county and month. We consider all new car registrations from the Volkswagen brand directly but also from the VW subsidiaries Audi, Porsche, SEAT, and Skoda.	Kraftfahrt-Bundesamt
VW (only) share	New registrations of Volkswagen cars as a share of total new car registrations per county and month. We consider only new car registrations from the Volkswagen brand and not from the VW subsidiaries Audi, Porsche, SEAT, and Skoda.	Kraftfahrt-Bundesamt
VW-Diesel share	New registrations of Volkswagen cars with a diesel engine as a share of total new car registrations per county and month.	Kraftfahrt-Bundesamt
VW-non-Diesel share	New registrations of Volkswagen cars with an engine other than diesel as a share of total new car registrations per county and month.	Kraftfahrt-Bundesamt
Treatment variables:		
Protestant share	The share of Protestants per county as of 2011.	Statistisches Bundesamt
Protestant	A dummy variable that is one if the share of Protestants in a county is larger than 50% (and zero otherwise).	
Control variables:		
Car density	Cars per one million inhabitants per county and year.	Statistisches Bundesamt
Graduate share	The share of pupils who graduate from high school (German Gymnasium) per county and year.	Statistisches Bundesamt
Corporate insolvencies	Total number of yearly corporate insolvencies per one million inhabitants on the county level.	Statistisches Bundesamt
New business	Total number of yearly new business per one million inhabitants on the county level.	Statistisches Bundesamt
Traffic accidents	Total number of yearly traffic accidents per cars on the county level.	Statistisches Bundesamt
Garden-Park waste	Yearly waste from gardens and parks in tons on the county level.	Statistisches Bundesamt

Further regional indicators:

Protestant cathedral ^{distance}	The distance in kilometers from the middle of the region to the next important Protestant cathedral.	Hasan et al. (2019).
Protestant cathedral	A dummy variable that is one if the distance between region and next important Protestant cathedral is below the median and zero otherwise.	
Protestant ¹⁶²⁴	A dummy variable that is one if the region was led by a Protestant ruler in 1624 and zero otherwise.	Hasan et al. (2019).
VW factory	This dummy variable is one if the county has a VW factory. Those counties are: Aurich (Emden), Osnabrueck, Hannover, Wolfenbuettel (Salzgitter), Wolfsburg, Kassel, Zwickau, Chemnitz, and Dresden	https://www.volkswagenag.com/de/group/portrait-and-production-plants.html .
Lower Saxony	A dummy that is one if the county belongs to Lower Saxony.	
Car rental region	A dummy that is one if a car rental company uses the license plate number of this county for registering its cars. Those are: Sixt (Munich), Hertz (Dueren), Europcar (Hamburg), Avis (Wiesbaden, Euskirchen and Ludwigsburg (Porsche only)).	https://www.mietwagen-klassen.de/mietwagen-kennzeichen/ .
Rural	A dummy that is one if the region is classified as a rural region.	Statistisches Bundesamt
Female share	The share of the female population in a county.	Statistisches Bundesamt
Female	A dummy that is one if the share of the female population in the region is above the median for all counties.	Statistisches Bundesamt
Average age	The average age of the population in a county.	Statistisches Bundesamt
Age	A dummy that is one if the average age of the population in the county is above the median for all counties.	Statistisches Bundesamt
CDU share	The share of votes for the CDU in a county from the last regional election before 2015.	Koetter and Popov (2018).
CDU	A dummy that is one if the share of votes for the CDU in a county from the last regional election before 2015 is above the median vote shares for the CDU for all German counties.	
Green share	The share of votes for the Green party (Grüne) in a county from the last regional election before 2015.	Koetter and Popov (2018).
Green	A dummy that is one if the share of votes for the Green party (Grüne) in a county from the last regional election before 2015 is above the median vote shares for the Green party for all German counties.	
FD	Concentrations (micrograms per cubic meter) of mineral dust and sea-salt filtered fine particulate matter of 2.5 micrometers or smaller (PM2.5) per county in Germany. FD is measured as the percentage change between 2011 and 2015.	Socioeconomic data and application center (Van Donkelaar et al., 2016; van Donkelaar et al., 2018)
Member of an environmental non-profit organization	A dummy variable that is one if an individual from the SOEP panel agrees to the question.	SOEP question plh0266
Worries about the environment	A dummy that is one if an individual is worried (answer is recorded as a 1 or 2) about the environment.	SOEP question plh0036
Worries about the climate	A dummy that is one if an individual is worried (answer is recorded as a 1 or 2) about the climate.	SOEP question plh0037
Worries about the safety of nuclear power plants	A dummy that is one if an individual is worried (answer is recorded as a 1 or 2) about the safety of nuclear power plants.	SOEP question plh0044

Table 2: Descriptive statistics

	Mean	SD	1st	99th
Dependent variables:				
Total registrations	663.57	1286.97	93.00	6241.00
Diesel share	0.42	0.09	0.23	0.66
VW share	0.37	0.11	0.12	0.75
VW (only) share	0.19	0.08	0.04	0.43
VW-Diesel share	0.18	0.06	0.05	0.40
VW-non-Diesel share	0.19	0.07	0.05	0.43
Non-VW share	0.63	0.11	0.25	0.88
Treatment variables:				
Protestant share	0.32	0.18	0.08	0.71
Protestant	0.19	0.39	0.00	1.00
Control variables:				
Car density	0.56	0.07	0.39	0.68
Graduate share	0.32	0.09	0.13	0.56
Corporate insolvencies	0.69	0.36	0.20	1.92
New business	0.77	0.21	0.41	1.36
Traffic accidents	0.73	0.19	0.44	1.28
Garden Park waste	0.07	0.06	0.00	0.25
Further regional indicators:				
Protestant ¹⁶²⁴	0.60	0.49	0.00	1.00
Protestant cathedral ^{distance}	31.39	26.39	0.00	114.96
Protestant cathedral	0.50	0.50	0.00	1.00
VW factory	0.02	0.15	0.00	1.00
Lower Saxony	0.04	0.19	0.00	1.00
Car rental region	0.02	0.12	0.00	1.00
Rural	0.25	0.43	0.00	1.00
Age average	41.50	1.69	38.27	45.76
Age	0.50	0.50	0.00	1.00
Female share	0.51	0.01	0.50	0.53
Female	0.50	0.50	0.00	1.00
CDU share	0.36	0.08	0.20	0.58
Green share	0.10	0.05	0.00	0.26
CDU	0.50	0.50	0.00	1.00
Green	0.50	0.50	0.00	1.00
FD	0.03	0.07	-0.12	0.13

This table shows descriptive statistics for all variables we use in our analysis. The sample comprises 23,244 observations for 391 counties every month between January 2013 and December 2017. See Table 2 for a detailed description of every variable.

Table 3: How do Protestants react?

Dependent variable:	New car registrations: share of			
	VW	Diesel	VW-Diesel	VW-non-Diesel
	(1)	(2)	(3)	(4)
Protestant×VW Scandal	-0.008** (0.004)	-0.001 (0.004)	-0.006** (0.003)	-0.001 (0.003)
Car density	0.194 (0.150)	-0.006 (0.166)	-0.024 (0.155)	0.218 (0.159)
Graduate share	-0.019 (0.033)	-0.011 (0.032)	-0.006 (0.022)	-0.013 (0.025)
Corporate insolvencies	0.000 (0.004)	-0.002 (0.004)	0.005* (0.002)	-0.005 (0.003)
New business	-0.003 (0.008)	-0.012 (0.011)	-0.006 (0.008)	0.003 (0.007)
Traffic accidents	0.025 (0.018)	-0.028* (0.016)	-0.007 (0.012)	0.033** (0.013)
Garden-Park waste	-0.070 (0.058)	-0.026 (0.046)	-0.072* (0.038)	0.002 (0.041)
County FE	Yes	Yes	Yes	Yes
Month×Year FE	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes
Observations	23,244	23,244	23,244	23,244
Counties	391	391	391	391
Adjusted R2	0.82	0.77	0.75	0.75

This table shows regression results for Equation (1). In each column, we use a different dependent variable. In the first column, we use the share of new VW car registrations. In Column (2), we use the share of new car registrations with a diesel engine. In Column (3), we use the share of new VW car registrations with a diesel engine. In Column (4), we use the share of new VW car registrations with an engine other than diesel. Share refers to all new car registrations per region in a particular month. The main independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). See Table 2 for a detailed explanation of every other control variable that we use and Table 2 for more summary statistics. We cluster standard errors at the county level. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table 4: Absolute number of car registrations

Dependent variable:	New car registrations: Natural logarithm of					
	Total	VW	Diesel	VW Diesel	VW-non-Diesel	Non-VW
	(1)	(2)	(3)	(4)	(5)	(6)
Protestant×VW Scandal	0.000 (0.013)	-0.009 (0.013)	-0.011 (0.013)	-0.039** (0.016)	0.007 (0.015)	0.016 (0.016)
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Month×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,244	23,244	23,244	23,244	23,244	23,244
Counties	391	391	391	391	391	391
Adjusted R2	0.98	0.96	0.97	0.95	0.94	0.97

This table shows regression results for Equation (1). In each column, we use a different dependent variable. In the first column, we use the natural logarithm of all new car registrations. In Column (2), we use the natural logarithm of new VW car registrations. In Column (3), we use the natural logarithm of new car registrations with a diesel engine. In Column (4), we use the natural logarithm of the new VW car registrations with a diesel engine. In Column (5), we use the natural logarithm of new VW car registrations with an engine other than diesel. In Column (6), we use the natural logarithm of new non-VW car registrations. The main independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). See Table 2 for a detailed explanation of every other control variable that we use and Table 2 for more summary statistics. We cluster standard errors at the county level. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table 5: Long-run effects of Protestantism

Dependent variable:	New car registrations: share of			
	VW	VW Diesel	VW	VW Diesel
	(1)	(2)	(3)	(4)
Protestant×VW Scandal	-0.007 (0.005)	0.001 (0.004)	-0.001 (0.005)	-0.001 (0.004)
Protestant×VW Scandal×Protestant ¹⁶²⁴	-0.001 (0.006)	-0.008* (0.004)		
VW Scandal×Protestant ¹⁶²⁴	0.002 (0.003)	0.002 (0.002)		
Protestant×VW Scandal×Protestant cathedral			-0.012* (0.007)	-0.010** (0.005)
VW Scandal×Protestant cathedral			0.001 (0.003)	-0.001 (0.002)
County FE	Yes	Yes	Yes	Yes
Month×Year FE	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Observations	23,244	23,244	23,244	23,244
Counties	391	391	391	391
Adjusted R2	0.82	0.75	0.82	0.75
Triple ^{Total MFX}	-0.009**	-0.007**	-0.013***	-0.010***
Counties in Triple	72	72	41	41

This table shows regression results for Equation (1) for two sets of regressions. In each set, we use the share of new VW car registrations and the share of new VW car registrations with a diesel engine as dependent variables. Share refers to all new car registrations per region in a particular month. The main independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). In each set, we augment our regression model with an additional factor that we fully interact with the difference-in-difference effect and its components. In Columns (1) and (2), we use Protestant¹⁶²⁴, which is a dummy identifying counties with a Protestant ruler in 1624. In Columns (3) and (4), we use Protestant cathedral, which is a dummy variable that shows whether a county is close to a famous Protestant church. We include all other control variables in each regression but do not show estimates here. See Table 2 for a detailed explanation of every other control variable that we use and Table 2 for more summary statistics. We cluster standard errors at the county level. Triple^{Total MFX} provides the total marginal effect of the group of counties that are identified by the triple interaction. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table 6: Competing regional factors and politics

Dependent variable:	New car registrations: share of									
	VW	VW Diesel	VW	VW Diesel	VW	VW Diesel	VW	VW Diesel	VW	VW Diesel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Protestant × VW Scandal	-0.006 (0.006)	-0.005 (0.004)	-0.005 (0.004)	-0.003 (0.003)	-0.012** (0.005)	-0.009** (0.004)	-0.005 (0.007)	-0.004 (0.004)	-0.008** (0.004)	-0.007** (0.003)
Protestant × VW Scandal × Age	-0.005 (0.008)	-0.003 (0.005)								
VW Scandal × Age	0.005 (0.003)	0.003 (0.002)								
Protestant × VW Scandal × Female			-0.005 (0.007)	-0.007 (0.004)						
VW Scandal × Female			-0.000 (0.003)	-0.000 (0.002)						
Protestant × VW Scandal × CDU					0.012 (0.007)	0.008* (0.005)				
VW Scandal × CDU					-0.001 (0.003)	0.001 (0.002)				
Protestant × VW Scandal × Green							-0.004 (0.008)	-0.003 (0.006)	-0.004* (0.002)	
VW Scandal × Green										
Protestant × VW Scandal × FD									-0.044 (0.051)	-0.000 (0.035)
VW Scandal × FD									0.013 (0.028)	-0.027 (0.019)
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,244	23,244	23,244	23,244	23,244	23,244	23,244	23,244	23,244	23,244
Counties	391	391	391	391	391	391	391	391	391	391
Adjusted R2	0.82	0.75	0.82	0.75	0.82	0.75	0.82	0.75	0.82	0.75
Triple ^{Total} MFX	-0.010**	-0.008*	-0.010*	-0.009**	-0.001	-0.001	-0.009*	-0.007*	-0.008	-0.008
Counties in Triple	40	40	40	40	28	28	54	54		

This table shows regression results for Equation (1) for four sets of regressions that we present in two panels. In each set, we use the share of new VW car registrations and the share of new VW car registrations with a diesel engine as dependent variables. Share refers to all new car registrations per region in a particular month. The main independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). In every set, we augment our regression model with an additional factor that we fully interact with the difference-in-difference effect and its components. These factors comprise: Age (if the counties average age is above the median overall counties); Female (if the counties share of female population is above the median overall counties); CDU and Green (dummy variable that is one if the party outcome in a particular county is above its median score across all German counties); FD measures the change in concentration (demeaned) in fine dust between 2011 and 2015 for each county. We include all other control variables in each regression but do not show estimates here. See Table 2 for a detailed explanation of every other control variable that we use and Table 2 for more summary statistics. We cluster standard errors at the county level. Triple^{Total} MFX provides the total marginal effect of the group of counties that are identified by the triple interaction. ***, **, * and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table 7: Enviromental preferences of religious groups

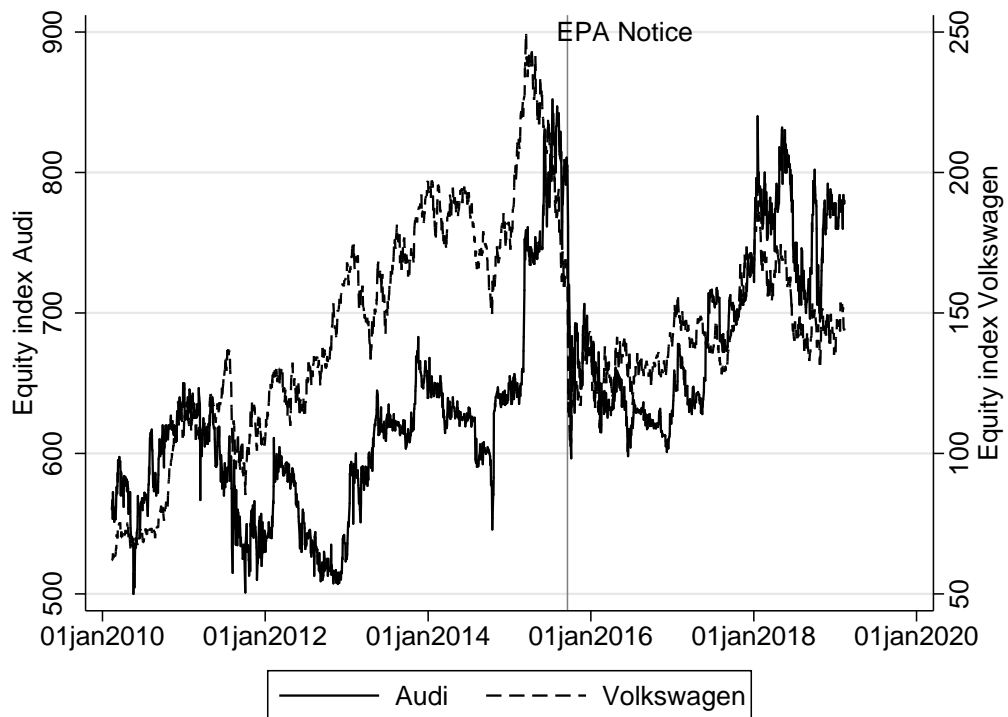
	Protestants	Catholics	Non-religious	Others
Member of an environmental non-profit organization	0.0299	0.0292	0.0224***	0.0068***
Care about environment	0.9513	0.9536	0.9326***	0.8779***
Care about climate	0.9363	0.9435*	0.9115***	0.8590***
Worried about the safeness of nuclear power plants	0.1296	0.1340	0.0969***	0.0612***
Individuals	10,071	8,758	11,102	2,923

This table shows mean values for answers from the German Socio-Economic Panel (SOEP) between 2011 and 2016. See Table 2 for a detailed description of every variable. ***, ** and * indicate significant differences in means between Protestants and the other religious groups at the 1%, 5%, and 10% levels, respectively.

Online Appendix

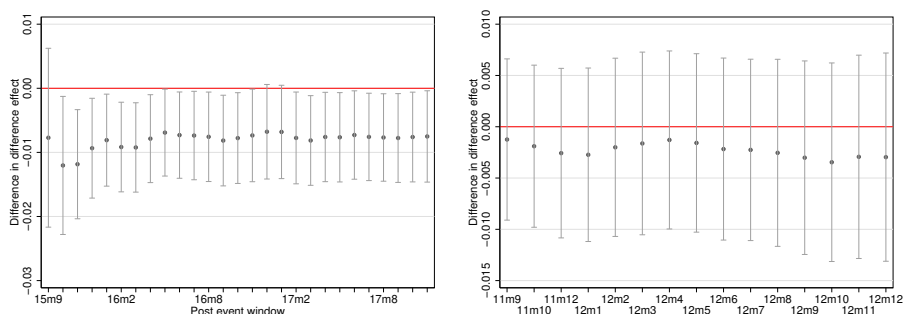
This Appendix is for Online Publication and provides further details on the data and results of the article.

Figure OA1: Market performance of car producers



The figure shows the equity price indices of Audi (solid line, left axis) and Volkswagen (dotted line, right axis) around the scandal. The vertical line relates to the EPA's Notice of Violation on 18/09/2015. We took the data from Datastream.

Figure OA2: Robustness for new VW car registrations on the time dimension

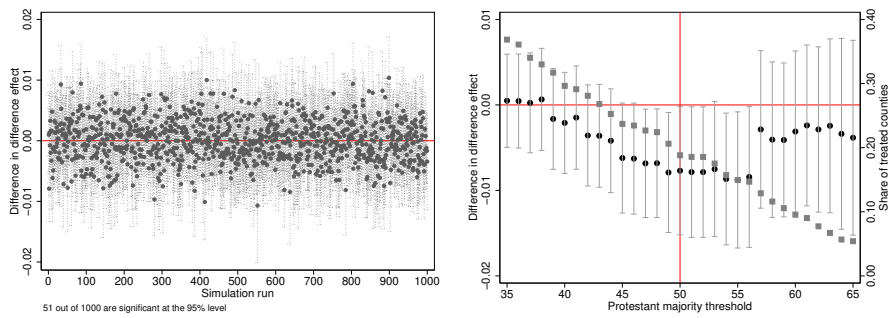


(a) Varying post event windows

(b) Placebo events

The left graph shows the difference-in-difference effect from Equation (1) from the main text for varying lengths of the post-scandal period. On the x-axis, we show the month until we extend the post-event window while holding the pre-event period constant. The black dots indicate the difference-in-difference coefficients with 95% confidence intervals as vertical lines. The right graph shows the difference-in-difference coefficients and 95% confidence bands for Equation (1) from the main text for 15 (pre-scandal) placebo events between September 2011 and December 2012.

Figure OA3: Random distribution of Protestant and different Protestant thresholds



(a) Random sampling of Protestant

(b) Different Protestant threshold

The left graph shows regression coefficients and 95% confidence bands from 1,000 regressions of Equation (1) from the main text in which we randomly assign the Protestant status to the counties. The right graph shows regression coefficients and 95% confidence bands from regressions of Equation (1) from the main text in which we use varying thresholds to define the Protestant dummy. We start on the left by separating Protestant from non-Protestant counties at the 35% percentile going to the 65% percentile on the very right (in our baseline regression, we use the median split, i.e., the 50% percentile). On the second y-axis, we plot (gray squares) the share of Protestant counties for every threshold.

Table OA1: Baseline w/o fixed effects

Dependent variable:	New car registrations: share of			
	VW	Diesel	VW Diesel	VW-non-Diesel
	(1)	(2)	(3)	(4)
Protestant	0.043*** (0.012)	-0.024*** (0.007)	0.005 (0.005)	0.038*** (0.009)
VW Scandal	-0.022*** (0.001)	-0.045*** (0.002)	-0.023*** (0.001)	0.001 (0.001)
Protestant×VW Scandal	-0.007* (0.004)	-0.004 (0.003)	-0.009*** (0.002)	0.002 (0.003)
Constant	0.376*** (0.005)	0.444*** (0.004)	0.190*** (0.003)	0.186*** (0.003)
Observations	23,244	23,244	23,244	23,244
Counties	391	391	391	391
Adjusted R2	0.03	0.08	0.04	0.05

This table shows regression results for Equation (1) from the main text without any fixed effects or control variables. In each column, we use a different dependent variable: In the first column we use the share of new VW car registrations; in Column (2) we use the share of new car registrations with a diesel engine; in Column (3) we use the share of new VW car registrations with a diesel engine; in Column (4) we use the share of new VW car registrations with an engine other than diesel. Share refers to all new car registrations per region in a particular month. The primary independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). See Table 2 from the main text for a detailed explanation of every variable that we use and Table 2 from the main text for more summary statistics. We cluster standard errors at the county level. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table OA2: Standard error robustness

Dependent variable:	New car registrations: share of VW			
	(1)	(2)	(3)	(4)
Protestant×VW Scandal	-0.008** (0.003)	-0.008*** (0.002)	-0.008** (0.004)	-0.008** (0.003)
County FE	Yes	Yes	Yes	Yes
Month×Year FE	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes
SE	State	Month	County & Month	State & Month
Regional controls	Yes	Yes	Yes	Yes
Observations	23,244	23,244	23,244	23,244
Counties	391	391	391	391
Adjusted R2	0.82	0.82	0.82	0.82

This table shows regression results for Equation (1) from the main text. In each column, we use the share of new VW car registrations as the dependent variable. Share refers to all new car registrations per region in a particular month. In each column, we use different ways to cluster the standard errors. In Column (1), we cluster on the state level. In Column (2), we cluster on a monthly level. In Column (3), we cluster two-ways on the county and monthly level. In Column (4), we cluster two-ways on the state and monthly level. The primary independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). See Table 2 from the main text for a detailed explanation of every other control variable that we use and Table 2 from the main text for more summary statistics. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table OA3: DiD scrutiny

Dependent variable:	New car registrations: share of VW			
	VW (only)	Collapsed periods	Matching (levels)	Matching (first differences)
	(1)	(2)	(3)	(4)
Protestant×VW Scandal	-0.006** (0.003)	-0.010** (0.004)	-0.011** (0.005)	-0.010** (0.005)
County FE	Yes	Yes	Yes	Yes
Month×Year FE	Yes	No	Yes	Yes
Month and Year FE	Yes	No	subsumed	subsumed
State×Year FE	Yes	No	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Observations	23,244	782	8,616	7,272
Counties	391	391	146	122
Adjusted R2	0.81	0.96	0.81	0.82

This table shows regression results for Equation (1) from the main text. In the first column, we use the share of new VW car registrations from Volkswagen’s core brand only. In each other column, we use the share of new VW car registrations as the dependent variable. Shares refers to all new car registrations per region in a particular month. In Columns (2) to (5), we use standard scrutiny tests for difference-in-difference regressions: in Column (2), we collapse the pre and post period according to Bertrand et al. (2004). In Column (3) and (4), we match on a 1:1 basis a control group to the Protestant counties based on pre-scandal levels (Column (3)) and first differences (Column (4)) of the control variables. The primary independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). See Table 2 from the main text for a detailed explanation of every other control variable that we use and Table 2 from the main text for more summary statistics. We cluster standard errors at the county level. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

Table OA4: Pre-scandal dynamics

	Protestant		Non-Protestant		ND
	Mean	SD	Mean	SD	
D.VW share	-0.001	0.065	-0.001	0.061	-0.00
D.VW (only) share	-0.002	0.057	-0.002	0.048	-0.00
D.Diesel share	-0.001	0.059	-0.001	0.056	-0.00
D.VW Diesel share	-0.001	0.047	-0.001	0.043	-0.00
D.VW non-Diesel share	-0.000	0.052	-0.000	0.045	0.00
D.Car density	0.418	1.708	0.280	1.478	0.06
D.Graduate share	0.037	0.814	0.002	0.849	0.03
D.Corporate insolvencies	-0.346	6.081	-0.266	5.001	-0.01
D.New business	-0.115	1.325	-0.206	2.128	0.04
D.Traffic accidents	0.004	1.089	-0.067	1.407	0.04
D.Garden-Park waste	0.007	0.235	0.006	0.220	0.00

This table shows average first differences of the main dependent and independent variables that we use in Equation (1) from the main text. We calculate the first difference for the period before September 2015 (the month of the VW scandal) and show mean and standard deviations for the group of Protestant and Non-Protestant counties. The last column shows normalized differences, according to Imbens and Wooldridge (2009). Absolute values of the normalized difference above 0.25 would indicate significant pre-scandal differences.

Table OA5: Regional robustness

Dependent variable:	New car registrations: share of VW			
	Lower Saxony (1)	VW Factory (2)	W/o car rental regions (3)	Rural regions (4)
Protestant×VW Scandal	-0.009** (0.004)	-0.007* (0.004)	-0.008** (0.004)	-0.010** (0.005)
Protestant×VW Scandal×Lower Saxony	0.010 (0.012)			
VW Scandal×Lower Saxony	-0.004 (0.012)			
Protestant×VW Scandal×VW factory		-0.026* (0.014)		
VW Scandal×VW factory		0.002 (0.007)		
Protestant×VW Scandal×Rural				0.007 (0.007)
VW Scandal×Rural				-0.002 (0.003)
County FE	Yes	Yes	Yes	Yes
Month×Year FE	Yes	Yes	Yes	Yes
State×Year FE	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Observations	23,244	23,244	22,884	23,244
Counties	391	391	385	391
Adjusted R2	0.82	0.82	0.82	0.82
No. of counties in Triple	11	3	.	27

This table shows regression results for Equation (1) from the main text. In each column, we use the share of new VW car registrations. Share refers to all new car registrations per region in a particular month. The primary independent variable is the interaction between Protestant (a dummy that is one if more than 50% of the population belongs to the Protestant Church) and VW Scandal (a dummy that is one for all periods after September 2015). In Column (1), we interact the difference-in-difference components with a dummy that identifies counties in Lower Saxony. In Column (2), we interact the difference-in-difference components with a dummy that identifies counties with a Volkswagen factory. In Column (3), we drop all counties where one of the major car rental companies in Germany register their cars. In Column (4), we further identify rural counties and interact the dummy variable Rural with the difference-in-difference components. See Table 2 from the main text for a detailed explanation of every other control variable that we use and Table 2 from the main text for more summary statistics. We cluster standard errors at the county level. ***, ** and * indicate significant coefficients at the 1%, 5%, and 10% levels, respectively.

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ISSN 2194-2188