King's Research Portal

*DOI:*
10.1016/j.ypmed.2018.02.005

Link to publication record in King's Research Portal

*Citation for published version (APA):*
Vandoros, S., Avendano, M., & Kawachi, I. (2018). The short-term impact of economic uncertainty on motor vehicle collisions. *Preventive Medicine*. https://doi.org/10.1016/j.ypmed.2018.02.005

**Citing this paper**
Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

**General rights**
Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

•Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
•You may not further distribute the material or use it for any profit-making activity or commercial gain
•You may freely distribute the URL identifying the publication in the Research Portal

**Take down policy**
If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 30. Nov. 2020

**DOI: https://doi.org/10.1016/j.ypmed.2018.02.005**

**Publisher's PDF, also known as Version of record**

**Citation for published version (APA):**
Vandoros S, Avendano M, Kawachi I. The short-term impact of economic uncertainty on motor vehicle collisions. Prev Med. 2018. DOI: 10.1016/j.ypmed.2018.02.005

# The Short-Term Impact of Economic Uncertainty on Motor Vehicle Collisions

Sotiris Vandoros[a,b]*, Mauricio Avendano[a,b] and Ichiro Kawachi[a]

[a] Harvard T.H. Chan School of Public Health, Harvard University, 677 Huntington Avenue, Boston MA, USA
[b] King's College London, Strand, London WC2R 2LS, United Kingdom

* Correspondence to: Sotiris Vandoros, Harvard T.H. Chan School of Public Health, Harvard University, 677 Huntington Avenue, Boston MA 02115, USA. Email: vandoros@hsph.harvard.edu

Sotiris Vandoros: vandoros@hsph.harvard.edu
Mauricio Avendano: mavendan@hsph.harvard.edu
Ichiro Kawachi: ikawachi@hsph.harvard.edu

Word count: 3,250
Abstract word count: 186

# The Short-Term Impact of Economic Uncertainty on Motor Vehicle Collisions


## Abstract

Stress and anxiety lead to attention loss and sleep deprivation and may reduce driving performance, increasing the risk of motor vehicle collision. We used evidence from a natural experiment to examine whether daily changes in economic uncertainty, potentially leading to attention or sleep loss, are associated with collisions in Great Britain. Daily data from the economic policy uncertainty index, derived from analysis of daily UK newspapers, were linked to the daily number of motor vehicle collisions in Great Britain over the period 2005-2015, obtained from the Department for Transport. Exploiting daily variations in economic uncertainty, we used a GARCH approach to model daily rates of motor vehicle collisions as a function of economic uncertainty, controlling for month and day of the week, monthly unemployment rates and weekly unleaded petrol prices. A spike in the daily economic uncertainty index was associated with an immediate increase in the number of motor vehicle collisions. Results were robust to various sensitivity analyses. Overall, daily increases in economic uncertainty are associated with short-term spikes in motor vehicle collisions. Preventive and traffic control measures may need to increase during periods of economic uncertainty.



*Keywords*: Traffic collisions; psychological stress; distracted driving; automobile driving; economics

## 1. Introduction

Motor vehicle collisions have risen to the top ten causes of death and are the leading cause of death at ages 15-29 years globally, with 1.25 million fatalities occurring every year [1]. In Great Britain, there has been a downward trend in collisions over the last years, with the number of those involving injury decreasing by 30% from 2005 (198,735 collisions) to 2015 (140,056 collisions) (Figure 1). Similarly, the number of fatal collisions decreased by 45% over the same period, from 2,913 (3,201 fatalities) in 2005 to 1,616 (1,730 fatalities) in 2015 [2-3]. While much discussion focuses on road traffic control and safety standards, little is known about how the social and economic environment might influence the short-term risk of motor vehicle collisions.

There are humans behind the wheel (at least for the time being), and their mistakes, misjudgements or traffic violations can lead to collisions. Cognitive distraction, which refers to thoughts that absorb the driver's attention and compromise their ability to drive safely, are believed to be a major cause of collisions [4-5]. Factors linked to cognitive distraction and that can lead to collisions include stress and anxiety [5-8], anger and frustration [9-12] and sleep deprivation [5,13-17]. Such factors can be more common in the presence of economic problems [18-19]. Furthermore, stressful situations may lead to increased alcohol drinking [20-21], which constitutes a major collision risk factor [5,22-23].

Economic uncertainty has recently reached very high levels compared to the past. Since the Global Financial Crisis of 2008, economic policy uncertainty has averaged about twice the level observed over the last 23 years [24]. While several studies have shown that deaths from collision decline during economic downturns [25-30], few studies have examined whether daily fluctuations in economic uncertainty can be a source of stress and distraction that can lead to temporary increases in the risk of collision. Existing evidence, however, suggests a potential causal link. For example, a recent study showed that the number of motor vehicle collisions increased during the first and second day following the announcement of austerity measures in Greece, before returning to previous levels [31]. Thinking about money and income inequality can also reduce social cohesion [32] and prompt individuals to think more selfishly [33]. Consequently, drivers worried about finances in periods of economic uncertainty may demonstrate less regard for pedestrians and other vehicles on the road.

[INSERT FIGURE 1 ABOUT HERE]

This paper examines the impact of daily changes in economic uncertainty on the rates of collisions in Great Britain. Using a quasi-experimental design, we exploit daily changes in a novel measure of economic uncertainty, the daily UK Economic Policy Uncertainty Index [34]. While there is a general downward trend in collisions in the UK, we examine whether increased uncertainty can lead to any short-term deviations (spikes) from this general trend. To our knowledge, this is the first study documenting how changes in economic uncertainty influence the risk of collision.

## 2. Methods

*Data*

We used the daily number of motor vehicle collisions in Great Britain (England, Scotland, Wales), over the 2005-2015 period, obtained from 'Road Safety Data', which are published by the UK Department for Transport [2]. The data include collisions on public roads that involved injury and were reported to police (data exclude damage-only collisions). To capture economic uncertainty, we used the Economic Policy Uncertainty Index, as constructed and published by Economic Policy Uncertainty [34]. This daily index is compiled based on terms included in UK newspapers daily, based on digital archives of the Access World News NewsBank service covering over 650 UK newspapers, ranging from large national to small local newspapers across the UK. Such reports in the media capture or affect people's expectations on what lies ahead in terms of their finances, thus making them stressed (if the news is bad or involves uncertainty) or distracting them (regardless of whether the reports are positive or negative). For a detailed description of how the data are collected and the index compiled, see Baker et al (2016) [35] and Economic Policy Uncertainty [34]. Monthly unemployment rates for the same period were obtained from the Office for National Statistics [36], because of the evidence on the impact of unemployment and recessions on collisions [25-30]. Weekly unleaded petrol prices were provided by the Department for Business, Energy and Industrial Strategy [37]. We control for petrol prices because higher prices may affect total traffic volume by making people drive less due to higher costs. This can have two opposite effects on the collisions. On one hand, fewer cars on the road means fewer cars at risk of crashing; on the other hand, this might mean less congested streets and an opportunity to speed, thus increasing the chances of collision.

*Analytical approach*

We used econometric methods to estimate how daily changes in economic uncertainty relate to daily changes in collisions. An ordinary least squares (OLS) approach was initially selected to examine the relationship between economic uncertainty and collisions. However, autocorrelation can often pose problems with daily series of data. This was confirmed by the Durbin-Watson test [Durbin-Watson statistic = 0.95], and the correlogram of residuals presented in Figure A1 in the Online Appendix. In addition, an ARCH-LM test indicates the presence of ARCH effects [$F$= 353; $p$=0.000]. Adding lags to the OLS model may help address autocorrelation problems, but ARCH effects persisted [$F$=9.492; $p$=0.000]. In order to address autocorrelation and ARCH effects, we also followed a GARCH (Generalized Autoregressive Conditional Heteroscedasticity) approach (also including lags of the dependent variable), developed by Bollerslev [38], who extended the model of Engel [39]. The GARCH(1,1) is deemed the preferable (and most parsimonious) such model [38, 40]. Before employing the GARCH approach, we checked whether our series are stationary. Indeed, the Augmented Dickey-Fuller test indicates that the collisions series is stationary [*Z*=-31.088; *p*=0.000]. In order to determine the most appropriate number of lags of the dependent variable, we followed the Schwarz and the Akaike criteria. These are both minimised when considering a GARCH model with 7 lags [Akaike criterion = -1.4205; Schwarz criterion = -1.3545], suggesting that this model provides the best fit. We experimented adding further lags which are were, however, not statistically significant. The Durbin-Watson statistic is 1.9, which indicates that in our GARCH model there is no first order autocorrelation. The correlogram (Figure A2 in the online Appendix) also shows that we have solved the autocorrelation problems. Performing an Engel's ARCH-LM test on the new model shows ARCH effects have also been resolved[*F*= 0.532; *p*=0.811].

The OLS model specification is presented in Equation (1):

$$\ln MVC_t = \beta_0 + \beta_1 \ln uncert_t + \beta_2 \ln petrol_\varphi + \beta_3 unempl_\xi + \beta_4 DSTspring_t + \beta_5 DSTautumn_t + \sum_{k=6}^{12} \beta_k day + \sum_{m=13}^{25} \beta_m month + \sum_{q=26}^{37} \beta_q year + \varepsilon \quad (1)$$

Adding lags of the dependent variable to the OLS model gives us the following model (Equation (2)):

$$lnMVC_t = \beta_0 + \sum_{j=1}^{7} \beta_j MVC_{t-j} + \beta_8 \ln uncert_t + \beta_9 \ln petrol_a + \beta_{10} unempl_\delta + \beta_{11} DSTspring_t + \beta_{12} DSTautumn_t + \sum_{k=13}^{20} \beta_k day + \sum_{m=21}^{33} \beta_m month + \sum_{q=34}^{46} \beta_q year + u \quad (2)$$

Similarly, the GARCH(1,1) specification is as follows (Equation 3):

$$\ln MVC_t = \beta_0 + \sum_{g=1}^{7} \beta_j MVC_{t-g} + \beta_8 \ln uncert_t + \beta_9 \ln petrol_\zeta + \beta_{10} unempl_\theta + \beta_{11} DSTspring_t$$

$$+ \beta_{12} DSTautumn_t + \sum_{h=13}^{20} \beta_k day + \sum_{m=21}^{33} \beta_m month + \sum_{w=34}^{46} \beta_q year + v_t \quad (3)$$

The variance equation is presented is Equation (4):

$$\sigma_t^2 = \gamma + a\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (4)$$

The dependent variable ln*MVC* is the natural logarithm of the daily number of motor vehicle collisions in Great Britain (England, Scotland, Wales). The main explanatory variable, ln*uncertainy*, is the natural logarithm of the UK daily economic policy uncertainty index. In addition to unemployment rates and petrol prices, we control for daylight saving time shifts in spring (*DSTspring*) and autumn (*DSTautumn*). A dummy variable takes the value of one seven days following the time change, as some previous studies suggest that there may be a change in the number of collisions due to changes in sleep or different light conditions [41-42]. Day of the week dummies are included, as different driving patterns occur per day, e.g., on weekends there are fewer people commuting to work but more people going out. Month dummies are included due to the different weather conditions and commuting patterns that may apply on average, depending on the time of the year. Year dummies account for any changes in the overall number of collisions, as the number of collisions in Britain varies between years (Figure 1). Subscript $t$ denotes day. Subscripts $\varphi$ and $\xi$ in Equation 1 denote day and week, respectively. The same holds for subscripts $a$, $\delta$ and $\zeta$, $\theta$ in Equations 2 and 3. Equation 4 shows the conditional variance ($\sigma^2$) as a function of a constant term ($\gamma$), information on the previous period's volatility – captured by the lag of the square of the error term of Equation 3 ($\varepsilon^2_{t-1}$); and the previous period's variance ($\sigma^2_{t-1}$).

We also included models using the previous day's level of uncertainty (a one-day lag) as an explanatory variable, because one day's reported uncertainty might affect people not only the same day, but also the day after, as well as subsequent days [31]. For the same reason, we also used a moving average of daily uncertainty in alternative models to smooth out the average effects of uncertainty over a few days.

**3. Results**

The uncertainty index varied considerably over the study period, fluctuating from zero to 1,236 (Table 1). Collisions also varied considerably, ranging from 118 in the lowest day to 882 in the highest day. Figure 2 illustrates the large day-to-day fluctuations and spikes in uncertainty from 2005 to 2015.

[INSERT TABLE 1 ABOUT HERE]

[INSERT TABLE 2 ABOUT HERE]

[INSERT FIGURE 2 ABOUT HERE]

Results of the OLS model are presented in columns (1) and (2) in Table 2. Estimates indicate that an increase in uncertainty by 1% leads to a significant increase in the number of collisions by 0.01% [coefficient 0.01; 95% CI 0.005 – 0.015]. The unemployment rate has a negative sign [coeff. -0.019; 95% CI -0.041 – 0.003] suggesting that a one-point increase in unemployment is associated with a decrease in collisions by 1.9%. Petrol prices were not associated with collisions [coeff. -0.014; 95% CI -0.182 – 0.153]. We also find a negative effect of daylight saving time in spring [coeff. -0.044; 95% CI -0.078 - -0.010]. We explored potential lagged effect of economic uncertainty on collisions by re-estimating the model using the previous day's level of uncertainty (a one-day lag) as an explanatory variable. Results are reported in columns (3) and (4) in Table 2. Again, the coefficient of lagged uncertainty is positive [coeff. 0.006; 95% CI 0.003 – 0.010].

However, as discussed in the methods section, autocorrelation [dw-stat=0.9; correlogram presented in Figure A1 in the Online Appendix] and ARCH effects [$F$= 353; $p$=0.000] are present in the OLS model. Adding lags to the OLS model led to the same results (a positive impact of uncertainty on collisions). This specification may have helped address autocorrelation problems, but ARCH effects persisted [$F$=9.492; $p$=0.000]. We therefore employed a GARCH(1,1) model. The series is stationary (augmented Dickey-Fuller test $t$-stat = -5.34; $p$=0.000), allowing us to follow this approach. Seven lags of the dependent variable were included, as guided by the Akaike and Schwarz criteria [-1.4205 and -1.3545, respectively], and the fact that from the eighth lag onwards, the lags became statistically insignificant.

Results of the main GARCH(1,1) model are presented in columns 1 and 2 in Table 3. The coefficient of uncertainty is positive and statistically significant [coeff. 0.008; 95% CI 0.007-0.009], indicating a positive relationship between uncertainty and collisions, confirming the results of the OLS model. A 1% increase in uncertainty is associated with a 0.008% increase in collisions. All the lags of the dependent variable included in the model are positive and statistically significant, apart from lag 5. The previous day's uncertainty does not have a statistically significant effect on collisions in the specifications presented in columns 3 and 4 in Table 2, which might be a result of the inclusion of lags of the dependent variable.

The Durbin-Watson statistic is 1.9, which indicates that there is no first order autocorrelation. According to the correlogram (Figure A2 in the online Appendix), we have addressed all autocorrelation problems. Performing an Engel's ARCH-LM test on the new model shows that the GARCH approach has also resolved ARCH effects ($F$= 0.532; $p$=0.811).

[INSERT TABLE 3 ABOUT HERE]

Once again using a GARCH(1,1) model, we considered the effect of uncertainty on non-fatal and fatal collisions separately (Tables A1 and A2, respectively in the online Appendix), and find a positive relationship in both cases [Non-fatal collisions: coeff. 0.008; 95% CI 0.008-0.009. Fatal collisions: coeff. 0.043; 95% CI 0.012-0.074]. Results for non-fatal collisions are very close to those for all collisions, given that non-fatal collisions account for the vast majority of the total number of collisions (437.6 out of 443.3 on average per day).

*Sensitivity analyses*

In supplementary models, we smoothed out uncertainty, compiling a moving average of the last few days of uncertainty as a robustness check. Results of the GARCH(1,1) model are reported in Table A3 (Online Appendix). The coefficients of the moving average of previous days' uncertainty has a positive effect on the total number of collisions in all cases. When taking a 3-day average, the coefficient is 0.017 [95% CI: 0.007 – 0.026], and when taking a 6-day average the coefficient is 0.014 [95% CI: 0.003-0.025].

We also implemented models adjusting for population and traffic volume. Such data are not available at the daily level: Population estimates are provided annually, and traffic volume is reported quarterly. However, we did run two additional sets of regressions, dividing the number of collisions by the average daily traffic volume (as calculated based on quarterly volume); and the population (as reported annually). Once again, there is a strong positive effect of uncertainty on collisions using a GARCH model (results reported in Tables A4 and A5 in the online Appendix).

In sensitivity analyses, we also estimated additive models using the levels of collisions and uncertainty rather than logarithms, as the latter imply a multiplicative association. Results of these GARCH models are qualitatively similar to the main model and hold the same interpretation, demonstrating a positive and statistically significant effect of uncertainty on collisions (Table A6 in the Appendix).

**4. Discussion**

This study examined the impact of economic uncertainty on motor vehicle collisions, using evidence from a natural experiment in Britain. We found that a daily increase in economic uncertainty is associated with a short-term spike in the number of motor vehicle collisions. Our findings suggest that uncertainty may distract drivers or disrupt their sleep cycle, thus increasing the risk of collision. Consistent with previous studies [25-30], we also find that unemployment is negatively correlated with collisions, and that there is a decrease in collisions after a switch to daylight saving time. The latter may be a result of more light in the evening, when people are driving home after work, that may compensate for the hour of sleep lost. Findings relate to Britain, but may be relevant to other countries, given that some degree of economic uncertainty can occur at varying intensity daily in any country.

In, Britain there has been a general downward trend in collisions over the past decade (Figure 1). In addition, several studies suggest that an increase in unemployment rates is associated with a decline in road traffic deaths [25-30]. Our results do not contradict these previous findings, as we focus on daily deviations from this general trend, and we study uncertainty (rather than downturns), controlling for unemployment.

We show that an increase in uncertainty by 1 percent leads to an increase in collisions by 0.008-0.010 percent. This implies that a doubling of the uncertainty index leads to almost one additional collision per day; or that an increase by one standard deviation from the mean leads to 0.5-0.6 additional collisions per day. The magnitude may seem small, but it is important to consider that the uncertainty index fluctuates between zero and 1,236 over the study period, and it has a mean of 272 and a standard deviation of 159. This implies that uncertainty fluctuates considerably, leading to multi-fold increases in collisions, as illustrated in Figure 2. For example, an increase in the index by 500% in a short period of time is not unusual, which would lead to an additional 4 to 5 collisions per day.

While our study is among the first to link short-term fluctuations in economic uncertainty to motor vehicle collisions, our findings are consistent with previous evidence that stressful periods lead to increased collisions. For example, it has been shown that a significant number of collision-related deaths and injuries a year can be attributed to stress due to divorce [43], and that the risk of collision is higher six months before and six months after filing for divorce [44]. Other risk factors identified include attending a funeral or having a family fight in the previous 24 hours [5], and the hospitalisation of a partner [43].

There are several potential explanations for the increase in motor vehicle collisions associated with uncertainty. First, cognitive distraction due to economic uncertainty may render drivers less capable of considering safety when navigating through the road environment [4]. Recent evidence from Australia suggests that most collisions can be attributed to drivers' inattention, with distraction (including task related or unrelated thoughts or just thinking in general) being one of the major contributors [5]. The authors suggest that most forms of inattention or distraction are preventable. Stress and anxiety, which are major risk factors for dangerous driving [5-8], may also explain this effect. In addition, previous research suggests that drivers who feel anger and frustration, emotions often triggered by economic uncertainty, are more likely to be involved in a collision [9-12]. Furthermore, stressful situations may lead to increased alcohol drinking [20-21], a major collision risk factor for collisions [5,22-23]. Another explanation involves sleep deprivation, which may increase during periods of uncertainty and has been shown to negatively impact on decision making [13] and increase risk of collision [5,14-15]. For example, it has been shown that driving while being awake for 17-19 hours is equivalent to driving with a blood alcohol concentration of 0.05% [17]. Sleep deprivation might also lead to drivers getting up late and consequently rushing to get to their destination on time, thus increasing the likelihood of a collision.

Our models using a moving average of uncertainty suggest that the effect of economic uncertainty might fade away over time but still last for several days. There are plausible explanations for this lasting effect. First, uncertainty may impact individual's concentration for more than a day. Second, as observed in Figure 2, the uncertainty index often comes in 'clouds', which means that uncertainty in one day is likely to be accompanied by uncertainty on neighbouring days, allowing these neighbouring days to have a similar effect.

*Study limitations*

Some limitations should be considered in our study. First, the daily aggregate nature of the data does not allow us to control for individual characteristics such as age, gender, weather conditions and the role of alcohol. In addition, only collisions involving injury or death are included in the data provided by the Department for Transport, meaning that we cannot investigate collisions involving no injury. There was a small number of fatal collisions daily in Britain (5.7 as opposed to 437.6 which involve injury but not death), and we were therefore underpowered to examine impact on fatal collisions in detail. Therefore, results on fatal collisions should be interpreted with caution. Finally, we only had data on economic uncertainty at the national level, and we therefore cannot rule out that other factors that varied at the national level and for which we do not control for could have biased our results. However, we believe it is unlikely that other confounding factors would have varied along daily fluctuations in economic uncertainty as measured through newspapers.

## 5. Conclusion

Our findings suggest that economic uncertainty is an important risk factor for motor vehicle collisions, one of the top-10 reasons of death globally. Collisions represent a high burden to both the National Health Service but also pose a social, emotional and mental health burden due to injury, disability, need for carers and loss of loved ones. Existing prevention campaigns encourage people not to drive when they drink or when they feel tired or sleepy. Similarly, authorities could reach out to people and inform them about the dangers of driving when distracted or stressed, while increased traffic control on days with higher economic uncertainty may help reduce motor vehicle collisions.

**Acknowledgements**: We are grateful to the Editor of the Journal and two anonymous referees for useful comments and suggestions. We would also like to thank Pedro Santos Raposo, Dimitris Korobilis and Athanasios Petralias for feedback on previous versions of the paper. Mauricio Avendano is supported by grants 633666 (Lifepath) and 667661 (MINDMAP) from the European Commission Horizon 2020 Programme. All outstanding errors are our own.

**Conflict of interest**: The authors declare that they have no conflict of interest

## References


[1] WHO 2015. Global Status Report on World Safety. World Health Organisation, Geneva.

[2] Road Safety Data. 2016. UK Department for Transport. Available at: https://data.gov.uk/dataset/road-accidents-safety-data

[3] "Reported Road Casualties Great Britain: 2015 Annual Report". (2016) Department for Transport. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/556385/rrcgb2015-00.pdf

[4] Young, K., & Regan, M., 2007. Driver distraction: A review of the literature. In: I.J. Faulks, M. Regan, M. Stevenson, J. Brown, A. Porter & J.D. Irwin (Eds.). *Distracted Driving*. Sydney, NSW: Australasian College of Road Safety. Pages 379-405.

[5] Beanland, V., Fitzharris, M., Young, K.L. and Lenné, M.G., 2013. Driver inattention and driver distraction in serious casualty crashes: Data from the Australian National Crash In-depth Study. *Accident Anal Prev*, *54*, pp.99-107.

[6] Cartwright, S., Cooper, C.L. and Barron, A., 1996. The company car driver, occupational stress as a predictor of motor vehicle accident involvement. *Hum Relat*, *49*(2), pp.195-208.

[7] Dula, C.S., Adams, C.L., Miesner, M.T. and Leonard, R.L., 2010. Examining relationships between anxiety and dangerous driving. *Accident Anal Prev*, *42*(6), pp.2050-2056.

[8] Shahar, A., 2009. Self-reported driving behaviors as a function of trait anxiety. *Accident Anal Prev*, *41*(2), pp.241-245.

[9] Nabi, H., Consoli, S.M., Chastang, J.F., Chiron, M., Lafont, S. and Lagarde, E., 2005. Type A behavior pattern, risky driving behaviors, and serious road traffic accidents: a prospective study of the GAZEL cohort. *Am J Epidemiol*, *161*(9), pp.864-870.

[10] Dahlen, E.R., Martin, R.C., Ragan, K. and Kuhlman, M.M., 2005. Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. *Accident Anal Prev*, *37*(2), pp.341-348.

[11] Deffenbacher, J.L., Lynch, R.S., Oetting, E.R. and Yingling, D.A., 2001. Driving anger: Correlates and a test of state-trait theory. *Pers Indiv Differ*, *31*(8), pp.1321-1331.

[12] Underwood, G., Chapman, P., Wright, S. and Crundall, D., 1999. Anger while driving. *Transport Res F-Traf*, *2*(1), pp.55-68.

[13] Harrison, Y. and Horne, J.A., 2000. The impact of sleep deprivation on decision making: a review. *J Ex Psychol-Appl*, *6*(3), p.236.

[14] Smolensky, M.H., Di Milia, L., Ohayon, M.M. and Philip, P., 2011. Sleep disorders, medical conditions, and road accident risk. *Accident Anal Prev*, *43*(2), pp.533-548.

[15] Horne, J.A. and Reyner, L.A., 1995. Sleep related vehicle accidents. *BMJ*, *310*(6979), pp.565-567.

[16] Gold, D.R., Rogacz, S., Bock, N., Tosteson, T.D., Baum, T.M., Speizer, F.E. and Czeisler, C.A., 1992. Rotating shift work, sleep, and accidents related to sleepiness in hospital nurses. *Am J Public Health*, *82*(7), pp.1011-1014.

[17] Williamson, A.M. and Feyer, A.M., 2000. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occup Environ Med*, *57*(10), pp.649-655.

[18] Hyyppä MT, Kronholm E, Alanen E. Quality of sleep during economic recession in Finland: a longitudinal cohort study. *Soc Sci Med*. 1997 Sep 1;45(5):731-8.

[19] Burgard SA, Kalousova L, Seefeldt KS. Perceived job insecurity and health: the Michigan Recession and Recovery Study. *J Occup Environ Med*. 2012 Sep 1;54(9):1101-6.

[20] Park, C.L., Armeli, S. and Tennen, H., 2004. The daily stress and coping process and alcohol use among college students. *J Stud Alcohol*, *65*(1), pp.126-135.

[21] Frone, M.R., 1999. Work stress and alcohol use. *Alcohol Res Health*, *23*(4), pp.284-291.

[22] Philip, P., Vervialle, F., Le Breton, P., Taillard, J. and Horne, J.A., 2001. Fatigue, alcohol, and serious road crashes in France: factorial study of national data. *BMJ*, *322*(7290), pp.829-830.

[23] Richter, E., Meltzer, U., Bloch, B., Tyger, G. and Ben-Dov, R., 1986. Alcohol levels in drivers and pedestrians killed in road accidents in Israel. *Int J Epidemiol*, *15*(2), pp.272-273.

[24] Economic Policy Uncertainty Index: Methodology / summary of results. Available at: http://www.policyuncertainty.com/methodology.html Accessed 8 April 2017.
[25] Stuckler D, Meissner C, Fishback P, Basu S, McKee M. Banking crises and mortality during the Great Depression: evidence from US urban populations, 1929–1937. *J Epidemiol Commun H*. 2012 May 1;66(5):410-9.
[26] Stuckler, D., Basu, S., Suhrcke, M., Coutts, A. and McKee, M., 2009. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. *Lancet*, *374*(9686), pp.315-323.
[27] Ruhm CJ. Are recessions good for your health?. *Q J Econ*. 2000 May 1;115(2):617-50.
[28] Stuckler, D., Basu, S., Suhrcke, M., Coutts, A. and McKee, M., 2011. Effects of the 2008 recession on health: a first look at European data. *Lancet*, *378*(9786), pp.124-125.
[29] Ruhm, C.J., 2015. Recessions, healthy no more?. *J Health Econ*, *42*, pp.17-28.
[30] Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., Mackenbach, J.P. and McKee, M., 2013. Financial crisis, austerity, and health in Europe. *Lancet*, *381*(9874), pp.1323-1331.
[31] Vandoros, S., Kavetsos, G. and Dolan, P., 2014. Greasy roads: the impact of bad financial news on road traffic accidents. *Risk Anal*, *34*(3), pp.556-566.
[32] Kawachi, I., Kennedy, B.P., Lochner, K. and Prothrow-Stith, D., 1997. Social Capital, Income Inequality, and Mortality. *Am J Public Health*, *87*(9), pp.1491-1498.
[33] Vohs, K.D., Mead, N.L. and Goode, M.R., 2006. The psychological consequences of money. *Science*, *314*(5802), pp.1154-1156.
[34] UK daily Economic Policy Uncertainty Index. Economic Policy Uncertainty, 2017. Available at: http://www.policyuncertainty.com/uk_daily.html
[35] Baker S.R., Bloom, N. and Davis, S.J. 2016. Measuring Economic Policy Uncertainty. Available at http://www.policyuncertainty.com/media/EPU_BBD_Mar2016.pdf
[36] Unemployment. 2017. Office for National Statistics. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment
[37] Weekly Road Fuel Prices. 2017. Department for Business, Energy and Industrial Strategy. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/595121/CSV_File__3_.csv/preview
[38] Bollerslev, T., 1986. Generalized autoregressive conditional heteroskedasticity. *J Econometrics*, *31*(3), pp.307-327.
[39] Engle, R.F., 1982. Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica*, pp.987-1007.
[40] Hansen, P.R. and Lunde, A., 2005. A forecast comparison of volatility models: does anything beat a GARCH (1, 1)?. *J Appl Econometrics*, *20*(7), pp.873-889.
[41] Sood, N. and Ghosh, A., 2007. The short and long run effects of daylight saving time on fatal automobile crashes. *BE J Econ Anal Poli*, *7*(1), pp.1-22.
[42] Coren, S., 1996. Daylight savings time and traffic accidents. *New Engl J Med*, *334*(14), pp.924-925.
[43] Lagarde, E., Chastang, J.F., Gueguen, A., Coeuret-Pellicer, M., Chiron, M. and Lafont, S., 2004. Emotional stress and traffic accidents: the impact of separation and divorce. *Epidemiology*, *15*(6), pp.762-766.
[44] McMurray, L., 1970. Emotional stress and driving performance: The effect of divorce. *Behavioral Research in Highway Safety*. 1(2): 110-114.

## TABLES

Table 1 – Summary Statistics

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Uncertainty index | 272.177 | 158.96 | 0 | 1236.11 |
| All collisions | 443.279 | 98.80 | 118 | 822 |
| Non-fatal collisions | 437.554 | 97.83 | 112 | 812 |
| Fatal collisions | 5.725 | 2.97 | 0 | 20 |
| Unleaded price (in pence) | 112.557 | 18.09 | 78.93 | 142.17 |
| Unemployment rate | 6.552 | 1.25 | 4.70 | 8.5 |
| DST spring (dummy) | 0.019 | 0.14 | 0 | 1 |
| DST autumn (dummy) | 0.019 | 0.14 | 0 | 1 |

Great Britain, 2005-2015

Table 2 - Regression results, OLS model: All collisions

| Dependent variable: Natural logarithm of total number of road traffic collisions | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | Same day's uncertainty | | Previous day's uncertainty | |
| ln(*uncertainty)* | 0.010*** | 0.010*** | | |
| | [0.005 - 0.015] | [0.005 - 0.016] | | |
| 1-day lag of ln(*uncertainy*) | | | 0.006*** | 0.006*** |
| | | | [0.003 - 0.010] | [0.003 - 0.010] |
| Ln (*petrol prices)* | | -0.014 | | -0.02 |
| | | [-0.182 - 0.153] | | [-0.196 - 0.155] |
| unemployment rate | | -0.019* | | -0.019 |
| | | [-0.041 - 0.003] | | [-0.041 - 0.004] |
| Daylight-Saving-Time spring | | -0.044** | | -0.044** |
| | | [-0.078 - -0.010] | | [-0.077 - -0.010] |
| Daylight-Saving-Time autumn | | -0.001 | | -0.001 |
| | | [-0.022 - 0.020] | | [-0.022 - 0.020] |
| Day of week dummies | yes | yes | yes | yes |
| Month dummies | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes |
| Constant | 6.166*** | 6.322*** | 6.185*** | 6.366*** |
| | [6.129 - 6.203] | [5.608 - 7.035] | [6.153 - 6.217] | [5.623 - 7.108] |
| Observations | 4,017 | 4,017 | 4,016 | 4,016 |
| R-squared | 0.605 | 0.606 | 0.597 | 0.598 |
| F statistic | 244.8 | 216.2 | 246.3 | 217.5 |

Great Britain, 2005-2015
Robust 95% confidence intervals in brackets
*** p<0.01, ** p<0.05, * p<0.1

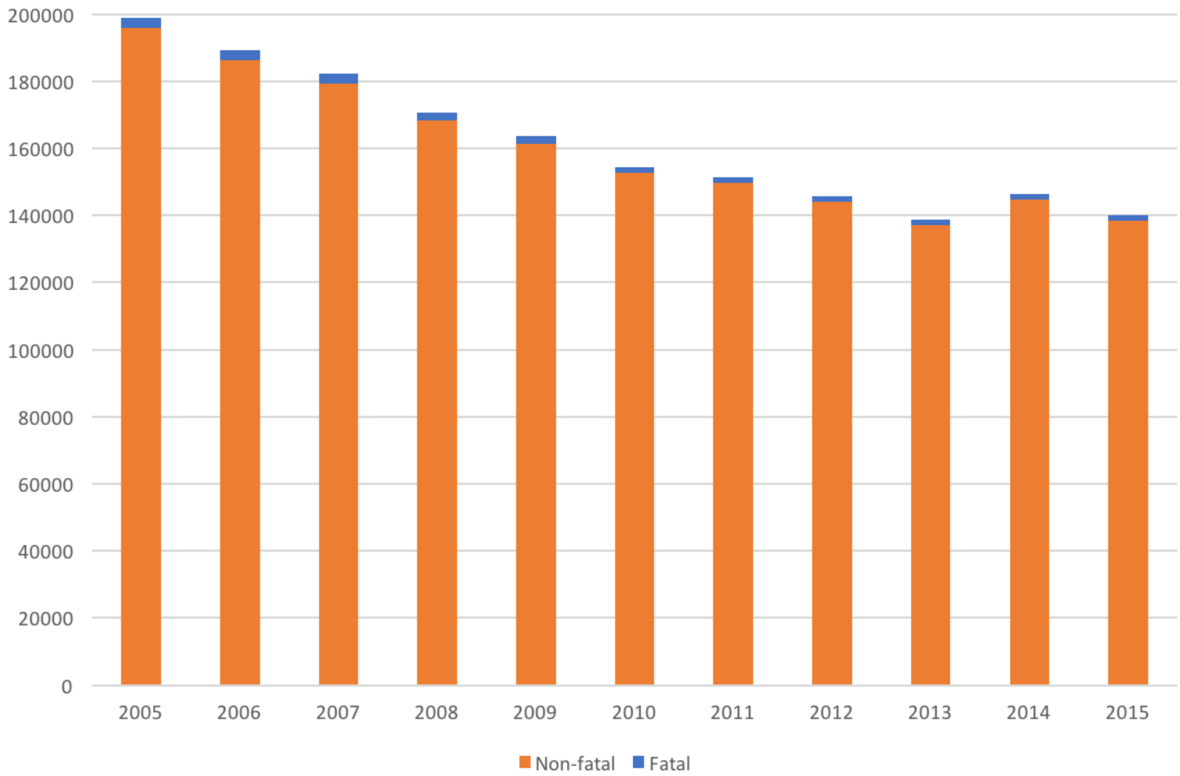
Table 3 – Regression results, GARCH(1,1) model: All collisions

| Dependent variable: ln(*count*) Natural logarithm of total number of road traffic collisions | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Same day's uncertainty | | Previous day's uncertainty | |
| 1-day lag of ln(count) | 0.329*** | 0.327*** | 0.316*** | 0.314*** |
| | [0.297 - 0.362] | [0.294 - 0.360] | [0.282 - 0.350] | [0.280 - 0.348] |
| 2-day lag of ln(count) | 0.076*** | 0.075*** | 0.071*** | 0.070*** |
| | [0.039 - 0.113] | [0.038 - 0.112] | [0.032 - 0.109] | [0.031 - 0.108] |
| 3-day lag of ln(count) | 0.091*** | 0.091*** | 0.085*** | 0.085*** |
| | [0.057 - 0.126] | [0.057 - 0.126] | [0.048 - 0.121] | [0.048 - 0.121] |
| 4-day lag of ln(count) | 0.047*** | 0.048*** | 0.042** | 0.043** |
| | [0.012 - 0.082] | [0.013 - 0.083] | [0.006 - 0.078] | [0.008 - 0.079] |
| 5-day lag of ln(count) | -0.010 | -0.009 | -0.009 | -0.009 |
| | [-0.046 - 0.027] | [-0.046 - 0.027] | [-0.047 - 0.029] | [-0.047 - 0.029] |
| 6-day lag of ln(count) | 0.044** | 0.044** | 0.041** | 0.041** |
| | [0.009 - 0.079] | [0.008 - 0.079] | [0.005 - 0.077] | [0.005 - 0.077] |
| 7-day lag of ln(count) | 0.079*** | 0.080*** | 0.079*** | 0.080*** |
| | [0.045 - 0.112] | [0.046 - 0.114] | [0.045 - 0.114] | [0.046 - 0.115] |
| ln(*uncertainty)* | 0.008*** | 0.008*** | 0.001 | 0.001 |
| | [0.007 - 0.009] | [0.007 - 0.009] | [-0.001 - 0.002] | [-0.001 - 0.002] |
| Ln (*petrol prices)* | | 0.019 | | 0.009 |
| | | [-0.056 - 0.094] | | [-0.058 - 0.075] |
| unemployment rate | | -0.005 | | -0.004 |
| | | [-0.019 - 0.008] | | [-0.017 - 0.009] |
| Daylight-Saving-Time spring | | -0.036*** | | -0.034*** |
| | | [-0.059 - -0.012] | | [-0.057 - -0.011] |
| Daylight-Saving-Time autumn | | 0.012 | | 0.013 |
| | | [-0.019 - 0.042] | | [-0.017 - 0.042] |
| Day of week dummies | yes | yes | yes | yes |
| Month dummies | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes |
| Constant | 1.897*** | 1.862*** | 1.998*** | 2.004*** |
| | [1.621 - 2.173] | [1.383 - 2.341] | [1.704 - 2.291] | [1.545 - 2.462] |
| Observations | 4,010 | 4,010 | 4,010 | 4,010 |
| chi2 | 12099 | 12138 | 13233 | 13274 |
| | *Variance Equation* | | | |
| resid(-1)^2 | 0.068*** | 0.069*** | 0.077*** | 0.078*** |
| | [0.055 - 0.081] | [0.056 - 0.082] | [0.064 - 0.091] | [0.064 - 0.092] |
| GARCH(-1) | 0.905*** | 0.905*** | 0.904*** | 0.904*** |
| | [0.888 - 0.923] | [0.887 - 0.923] | [0.889 - 0.920] | [0.888 - 0.919] |
| Constant | 0.000*** | 0.000*** | 0.000*** | 0.000*** |
| | [0.000 - 0.001] | [0.000 - 0.001] | [0.000 - 0.000] | [0.000 - 0.000] |

Great Britain, 2005-2015. ci in brackets. *** p<0.01, ** p<0.05, * p<0.1

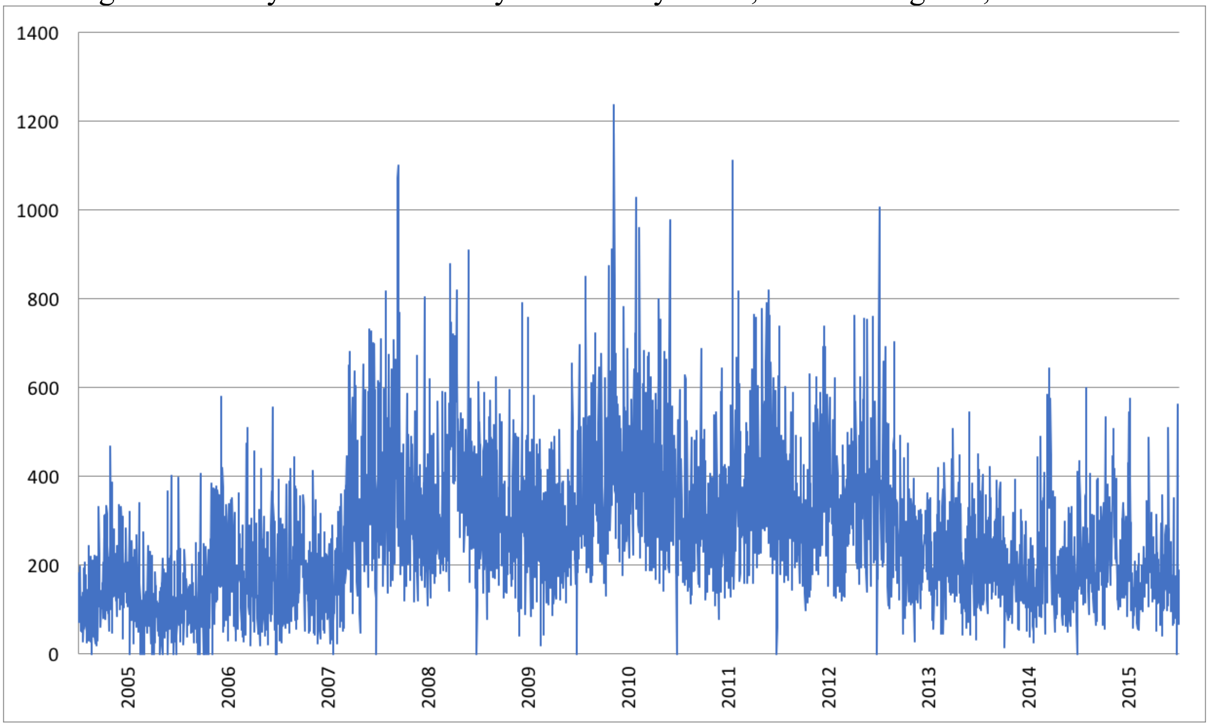
**FIGURES**

Figure 1 – Annual number of collisions (total, non-fatal and fatal), Great Britain, 2005-2015




*Source*: The authors, from Road Safety Data, Department for Transport, 2017

Figure 2 – Daily Economic Policy Uncertainty Index, United Kingdom, 2005-2015




*Source*: The authors, from data provided from “Measuring Economic Policy Uncertainty”, 2016, by Scott R. Baker, Nicholas Bloom and Steven J. Davis at www.PolicyUncertainty.com.