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Abay Asfaw, Regina Pana-Cryan, Roger Rosa. *The business cycle and the incidence of workplace injuries : evidence from the U.S.A.* Pages 1-8.

Introduction: The current study explored the association between the business cycle and the incidence of workplace injuries to identify cyclically sensitive industries and the relative contribution of physical capital and labor utilization within industries. **Method:** Bureau of Labor Statistics nonfatal injury rates from 1976 through 2007 were examined across five industry sectors with respect to several macroeconomic indicators. Within industries, injury associations with utilization of labor and physical capital over time were tested using time series regression methods. **Results:** Pro-cyclical associations between business cycle indicators and injury incidence were observed in mining, construction, and manufacturing but not in agriculture or trade. Physical capital utilization was the highest potential contributor to injuries in mining while labor utilization was the highest potential contributor in construction. In manufacturing each effect had a similar association with injuries. **Conclusion:** The incidence of workplace injury is associated with the business cycle. However, the degree of association and the mechanisms through which the business cycle affects the incidence of workplace injuries was not the same across industries. **Impact on Industry:** The results suggest that firms in the construction, manufacturing, and mining industries should take additional precautionary safety measures during cyclical upturns. Potential differences among industries in the mechanisms through which the business cycle affects injury incidence suggest different protective strategies for those industries. For example, in construction, additional efforts might be undertaken to ensure workers are adequately trained and not excessively fatigued, while safety procedures continue to be followed even during boom times. **Research Highlights:** ► Workplace injuries in mining, construction, and manufacturing sectors but not in agriculture or trade were sensitive to the business. ► The mechanism through which the business cycle affects the incidence of workplace injuries was not the same across different industries. ► Physical capital utilization was the highest potential contributor to injuries in mining while labor utilization was the highest potential contributor in construction. In manufacturing each effect had a similar association with injuries. This indicates the need for considering different prevention strategies in different industries.

- **Keywords:** The business cycle; Workplace injury; Industry; Labor utilization effect; Physical capital utilization effect; Time series

John M. Sullivan. *Trends and characteristics of animal-vehicle collisions in the United States.* Pages 9-16.

Introduction: Since 1990, fatal animal-vehicle collisions (AVCs) in the United States have more than doubled. This paper examines annual AVC trends in the United States over a 19-year period, seasonal and diurnal patterns of AVC risk, the geographic distribution of crash risk by state, and the association between posted speed limit and AVC crash risk in darkness. **Method:** AVCs were compiled from the Fatality Analysis Reporting System (FARS) and the General Estimates System (GES) for the years 1990-2008 to examine annual crash trends for fatal and nonfatal crashes. Seasonal trends for fatal AVCs were examined with the aggregated FARS dataset; seasonal trends for fatal and nonfatal AVCs were also examined by aggregating four years of Michigan crash data. State-by-state distributions of fatal AVCs were also described with the aggregated FARS dataset. Finally, the relationship between posted speed limit and the odds that a fatal or nonfatal AVC occurred in darkness were examined with logistic regressions using the aggregated FARS and Michigan datasets. **Results:** Between 1990 and 2008, fatal AVCs increased by 104% and by 1.3 crashes per trillion vehicle miles travelled per year. Although not all AVCs involve deer, daily and seasonal AVC crash trends follow the general activity pattern of deer populations, consistent with prior reports. The odds that a fatal AVC occurred in darkness were also found to increase by 2.3% for each mile-per-hour increase in speed; a similar, albeit smaller, effect was also observed in the aggregated Michigan dataset, among nonfatal crashes. **Conclusion:** AVCs represent a small but increasing share of crashes in the United States. Seasonal and daily variation in the pattern of AVCs seem to follow variation in deer exposure and ambient light level. Finally, the relative risk that a fatal and nonfatal AVC occurred in darkness is influenced by posted speed limit, suggesting that a driver's limited forward vision at night plays a role in AVCs, as it does in pedestrian collisions. **Impact on Industry:** The association between speed limit and crash risk in darkness suggests that AVC risk might be reduced with countermeasures that improve a driver's forward view of the road. **Research Highlights:** ► Animal-vehicle collisions are increasing in the United States. ► The odds that such collisions occur in darkness increases with posted speed limit. ► The effect is strongest for the most severe collisions.

- **Keywords:** Animal-vehicle collisions visibility; Lighting; Crash analysis; Collision avoidance; Logistic regression

George Yannis, Constantinos Antoniou, Eleonora Papadimitriou, Dimitris Katsochis. *When may road fatalities start to decrease?* Pages 17-25.

Introduction: The comparative analysis of macroscopic trends in road safety has been a popular research topic. The objective of this research is to propose a simple and, at the same time, reliable multiple regime model framework for international road safety comparisons, allowing for the identification of slope changes of personal risk curves and respective breakpoints. **Method:** The trends of road traffic fatalities in several EU countries have been examined through the temporal evolution of elementary socioeconomic indicators, namely motorized vehicle fleet and population, at the country level. **Results:** Piece-wise linear regression models have been fitted, using a methodology that allows the simultaneous estimation of all slopes and breakpoints. The number and location of breakpoints, as well as the slope of the connecting trends, vary among countries, thus indicating different road safety evolution patterns. **Impact on industry:** Macroscopic analysis of road accident trends may be proved beneficial for the identification of best examples and the implementation of appropriate programmes and measures, which will lead to important benefits for the society and the economy through the reduction of road fatalities and injuries. Best performing countries and the related programmes and measures adopted may concern several safety improvements at the processes of the road, the vehicle and the insurance industries. **Conclusions:** Lessons from the analysis of the past road safety patterns of developed countries provide some insight into the underlying process that relates motorization levels with personal risk and can prove to be beneficial for predicting the road safety evolution of developing countries that may have not yet reached the same breakpoints. Furthermore, the presented

framework may serve as a basis to build more elaborate models, including more reliable exposure indicators (such as vehicle-km driven). **Research Highlights:** ► A simple and reliable multiple regime model framework for international road safety comparisons is presented in this paper. ► The methodology allows the identification of slope changes of personal risk curves and respective break-points. ► Lessons from the analysis of the past road safety patterns can be proved beneficial for predicting the road safety evolution of developing countries.

- **Keywords:** Road safety; Macroscopic trends; Personal risk; Motorization rate

Emily Piercefield, Tracy Wendling, Pam Archer, Sue Mallonee. *Winter storm-related injuries in Oklahoma, January 2007. Pages 27-32.*

Introduction: A January 2007 ice storm occurred in Oklahoma, causing power outages and hazardous travel conditions. The objective of this investigation was to describe the nature of winter storm-related injuries among Oklahoma residents, to determine populations at risk, and to inform prevention-planning personnel. **Methods:** Winter storm-related injuries were a temporarily reportable condition; all acute-care hospitals and the state medical examiner logged storm-related injuries and deaths during January 12 – 30, 2007. Medical records were retrospectively abstracted. Risk of injury was described by demographic group, injury type, and mechanism. **Results:** Among 6,047 persons experiencing winter storm-related injuries, 74% were injured in falls, 13% in motor-vehicle collisions (MVCs), 8% while sledding, 1% by unintentional carbon monoxide poisoning, 1% in cleanup activities, and 3% by other mechanisms. Median age of injured persons was 39 years. Persons aged ≥ 40 years were 1.4 times more likely to experience falls as the cause of injury than those aged < 40 years, and falls were twice as likely as other mechanisms to cause fractures among persons aged ≥ 40 years. Injured persons aged < 40 years were 2.2 times more likely to experience MVC-related injuries, and 19 times more likely to experience sledding-related injuries than persons aged ≥ 40 years. **Conclusions:** Younger persons were more likely injured in MVCs and sledding incidents, whereas older persons were more likely to experience falls and fractures. **Impact on industry:** Prevention messages for winter storm-related injuries should target winter-driving safety tips to younger adults and precautions regarding falls to older adults. **Research Highlights:** ► Statewide surveillance was conducted for injuries related to an ice storm. ► The majority of winter storm-related injuries resulted from falls. ► Older persons were more likely to have been injured in falls and younger persons to suffer MVC-related injuries. ► Most MVCs, CO poisonings, and sledding injuries occurred early in the storm period. ► Target prevention messages to appropriate age groups and ahead of anticipated peak.

- **Keywords:** Environmental medicine; Injury surveillance; Wounds; Fractures; Falls; Traffic collisions

John M. Sullivan, Michael J. Flannagan. *Differences in geometry of pedestrian crashes in daylight and darkness. Pages 33-37.*

Introduction: Previous studies have shown that increased risk in darkness is particularly great for pedestrian crashes, suggesting that attempts to improve headlighting should focus on factors that likely influence those crashes. The current analysis was designed to provide information about how details of pedestrian crashes may differ between daylight and darkness. **Method:** All pedestrian crashes that occurred in daylight or dark conditions in Michigan during 2004 were analyzed in terms of the variables included in the State of Michigan crash database. Additional analysis of the narratives and diagrams in police accident reports was performed for a subset of 400 of those crashes—200 sampled from daylight and 200 sampled from darkness. **Results:** Several differences were found that appear to be related to the characteristic asymmetry of low-beam headlamps, which (in the United States) distributes more light on the passenger's side than the driver's side of

the vehicle. These results provide preliminary quantification of the how the photometric differences between the right and left sides of typical headlamps may affect pedestrian crash risk. **Impact on Industry:** The results suggest that efforts to provide supplemental forward vehicle lighting in turns may have safety benefits for pedestrians. **Research Highlights:** ► When crossing at intersections, pedestrian crash risk differs in darkness compared to daylight. ► This difference occurs primarily with left-turning vehicles. ► No difference in risk was found with right-turning vehicles.

- **Keywords:** Pedestrian collisions; Visibility; Conspicuity; Nighttime; Light Distribution; Approach path

R.R. Dinu, A. Veeraragavan. *Random parameter models for accident prediction on two-lane undivided highways in India. Pages 39-42.*

Introduction: Generalized linear modeling (GLM), with the assumption of Poisson or negative binomial error structure, has been widely employed in road accident modeling. A number of explanatory variables related to traffic, road geometry, and environment that contribute to accident occurrence have been identified and accident prediction models have been proposed. The accident prediction models reported in literature largely employ the fixed parameter modeling approach, where the magnitude of influence of an explanatory variable is considered to be fixed for any observation in the population. Similar models have been proposed for Indian highways too, which include additional variables representing traffic composition. The mixed traffic on Indian highways comes with a lot of variability within, ranging from difference in vehicle types to variability in driver behavior. This could result in variability in the effect of explanatory variables on accidents across locations. Random parameter models, which can capture some of such variability, are expected to be more appropriate for the Indian situation. **Method:** The present study is an attempt to employ random parameter modeling for accident prediction on two-lane undivided rural highways in India. Three years of accident history, from nearly 200 km of highway segments, is used to calibrate and validate the models. **Results:** The results of the analysis suggest that the model coefficients for traffic volume, proportion of cars, motorized two-wheelers and trucks in traffic, and driveway density and horizontal and vertical curvatures are randomly distributed across locations. **Conclusions:** The paper is concluded with a discussion on modeling results and the limitations of the present study. **Research highlights:** ► The present study employs random parameters modeling approach to model accident frequencies on Indian two-lane undivided rural highways, which is a novel attempt. The facts that there is large variability in safety performance of Indian highways across locations and that random parameter modeling can capture that variability to a great extent compared to conventional fixed parameter modeling make the present study relevant. ► The results of the study show that the model coefficients of many variables, related to traffic and road geometry and environment, are in fact random. The results are encouraging and suggest random parameter modeling approach as a potential candidate for development of accident prediction models for Indian highways. ► The models developed in the present study could be used for safety evaluation of Indian two-lane undivided rural highways. These models are expected to give a more realistic picture as they capture some of the variability in safety levels of highways, which is otherwise unaccounted for in conventional fixed parameter models.

- **Keywords:** Road accident modeling; Rural highway; Mixed traffic; Poisson regression; Random parameter models

Zoi Christoforou, Simon Cohen, Matthew G. Karlaftis. *Identifying crash type propensity using real-time traffic data on freeways. Pages 43-50.*

Introduction: We examine the effects of various traffic parameters on type of road crash. *Method:* Multivariate probit models are specified on 4-years of data from the A4-

A86 highway section in the Ile-de-France region, France. **Results:** Empirical findings indicate that crash type can almost exclusively be defined by the prevailing traffic conditions shortly before its occurrence. Rear-end crashes involving two vehicles were found to be more probable for relatively low values of both speed and density, rear-end crashes involving more than two vehicles appear to be more probable under congested conditions, while single-vehicle crashes appear to be largely geometry-dependent. **Impact on Industry:** Results could be integrated in a real-time traffic management application. **Research Highlights:** ► Crash outcome can be defined by the traffic conditions before its occurrence. ► Rear-ends involving two vehicles are more probable under low speed and density. ► Rear-ends involving more than two vehicles are more probable under congestion. ► Two-vehicle sideswipe accidents are more probable with increasing volume. ► Multi-vehicle sideswipes are associated with high speeds, daytime, and flat freeways.

- **Keywords:** Traffic accident; Crash type; Multivariate Probit; Freeway

Nurit Guttman, Anat Gesser-Edelsburg. "The Little Squealer" or "The Virtual Guardian Angel"? : young Drivers' and Their Parents' Perspective on Using a Driver Monitoring Technology and its Implications for Parent-Young Driver Communication. Pages 51-59.

Introduction: In-vehicle driving monitoring technologies have the potential to enable young drivers to learn from self-assessment. However, their use is largely dependent on parental involvement. **Method:** A total of 79 interviews were conducted with young drivers and parents regarding this technology and its use. Most had the experience of having an in-vehicle data recorder installed in the vehicle driven by the young drivers. Parents and the young drivers expressed both appreciation as well as reservations about its potential as a means to enhance the driving safety of young drivers. **Results:** A surprising finding was that some parents did not check the feedback and said they relied on the young driver to do so. Main concerns related to privacy, parent-young driver relationship, self-esteem and confidence, constructive use of the feedback data, and the limitations of the documentation that can be done by the technology. **Conclusions:** Providing parents and young drivers with a support system and tools to discuss and utilize the feedback are underscored. Challenges include addressing the invasion of young drivers' privacy and gender differences, and using the monitoring-capacity of the technology to enhance safe driving practices. Implications for programs to enhance communication and a dialogical approach between parents and young drivers are discussed. **Research Highlights:** ►Objections to in-vehicle tracking technology are invasion of privacy and trust ►An in-vehicle tracking technology advantage is it proves young drivers' competence ►Parents find in-vehicle tracking technology can enhance parental authority ►In-vehicle tracking technology data viewed as limited and can be circumvented ►Parents may not check the feedback from the in-vehicle tracking technology

- **Keywords:** Novice drivers; In-vehicle technologies; Road safety; Qualitative study; Road safety technologies; Parent-young driver relationship; Gender and driving

Brenda H. Vrkljan, Dana Anaby. What vehicle features are considered important when buying an automobile? : an examination of driver preferences by age and tender. Pages 61-65.

Introduction: Certain vehicle features can help drivers avoid collisions and/or protect occupants in the event of a crash, and therefore, might play an important role when deciding which vehicle to purchase. The objective of this study was to examine the importance attributed to key vehicle features (including safety) that drivers consider

when buying a car and its association with age and gender. **Methods:** A sample of 2,002 Canadian drivers aged 18 years and older completed a survey that asked them to rank the importance of eight vehicle features if they were to purchase a vehicle (storage, mileage, safety, price, comfort, performance, design, and reliability). ANOVA tests were performed to: (a) determine if there were differences in the level of importance between features and; (b) examine the effect of age and gender on the importance attributed to these features. **Results:** Of the features examined, safety and reliability were the most highly rated in terms of importance, whereas design and performance had the lowest rating. Differences in safety and performance across age groups were dependent on gender. This effect was most evident in the youngest and oldest age groups. **Conclusions:** Safety and reliability were considered the most important features. Age and gender play a significant role in explaining the importance of certain features. **Impact on Industry:** Targeted efforts for translating safety-related information to the youngest and oldest consumers should be emphasized due to their high collision, injury, and fatality rates.

- **Keywords:** Vehicle safety; Vehicle purchases; Older drivers; Younger drivers

Rebecca B. Naumann, Ann M. Dellinger, Marcie-jo Kresnow. *Driving self-restriction in high-risk conditions : how do older drivers compare to others?* Pages 67-71.

Introduction: Many older drivers self-restrict or avoid driving under high-risk conditions. Little is known about the onset of driving self-restrictions or how widespread self-restrictions are among drivers of all ages. **Methods:** The Second Injury Control and Risk Survey (ICARIS-2) was a nationwide cross-sectional, list-assisted random-digit-dial telephone survey from 2001 to 2003. National prevalence estimates and weighted percentages of those reporting driving self-restrictions were calculated. Multivariable logistic regression was used to explore associations between specific self-restrictions and age group, adjusting for other personal characteristics. **Results:** More than half of all drivers reported at least one driving self-restriction. The most commonly reported restriction was avoidance of driving in bad weather (47.5%), followed by at night (27.9%) and on highways or high-speed roads (19%). A greater percentage of young adult women (18-24 years) reported self-restricting in bad weather compared to women in other age groups, and the percentage of drivers self-restricting at night, in bad weather, and on highways or high-speed roads increased steeply after age 64. We found that women, those in low income groups, and those who had driven low annual mileage were more likely to self-restrict. **Conclusions:** In addition to assessing self-restrictions among older drivers, a new finding from our study is that self-restrictions are also quite prevalent among younger age groups. Driving self-restrictions may be better understood as a spectrum across ages in which drivers' reasons for restriction change. **Impact on industry:** Future research on the ability of driving self-restrictions to reduce actual crash risk and prevent injuries is needed. **Research Highlights:** ► About half of all drivers, an estimated 87 million persons, self-restricted their driving. ► The most commonly reported restriction was avoidance of driving in bad weather (47.5%). ► Driving self-restrictions were prevalent at not only older ages but also younger ages. ► Women, those in low income groups, and those who had driven low annual mileage were more likely to self-restrict. ► Driving self-restrictions may be better understood as a spectrum across ages in which drivers' reasons for restriction change.

- **Keywords:** Motor vehicle; Self-restriction; Older adult