Automobile Safety Inspections and Enforcing Norms: Case Study of Japan Using Panel Data

yamamura, eiji

20 April 2006

Automobile Safety Inspections and Enforcing Norms: Case Study of Japan Using Panel Data

Eiji Yamamura*

Department of Economics, Seinan Gakuin University, 6-2-92 Sawaraku Nishijin Fukuoka 815-0075, Japan

Abstract

This paper explores, using panel data of Japan, whether automobile inspections help to reduce accidents. Two innovations introduced by this paper are the control of endogeneity by the 2sls fixed effects model and the taking into account of norm enforcement in order to control the omitted variable bias. We found through this estimation that automobile inspections and the enforcing of social norms play a critical role in reducing fatalities but not non-fatal accidents.

Running title: Safety Inspections and Norms

* To whom correspondence and reprints requests should be addressed at the Department of Economics, Seinan Gakuin University, 6-2-92 Sawaraku Fukuoka 814-8511, Fukuoka. Japan. E-mail address: yamaei@seinan-gu.ac.jp.

Automobile Safety Inspections and Enforcing Norms: Case Study of Japan Using Panel Data.

I. INTRODUCTION

Numerous empirical analyses have been compiled regarding regulations for automobile safety and their effectiveness. For instance, the study of the impact of automobile inspections on the reduction of automobile accidents and fatality rates has drawn the attention of many researchers. Peltzman (1975) argued that drivers drive more dangerously to offset some or all of the mandated safety. Garbacs and Kelly (1987), Garbacs (1990), and Merrel *et al.* (1999) found that safety inspections failed to reduce accidents, thereby supporting Peltzman's offsetting behavior hypothesis. Contrary to these studies, Loeb and Gilad (1984) and Loeb (1985, 1987, 1988, and 1990) found inspections to be effective in reducing vehicle fatalities.

Nonetheless, most of these studies, with the exception of Merrel *et al.*(1999), have not allowed for state-specific effects and are therefore vulnerable to omitted variable bias[1]. Additionally, it is likely that prefectures in which fatalities increase will more severely mandate their drivers to get inspections. The existing studies also made no efforts to control for the potential existence of endogeneity between safety inspections and automobile accidents. Hence, in

[1] Loeb and Gilad (1984), Loeb (1990), and Garbacz and Kelly (1987) use state-specific time series data. Loeb (1985, 1987, and 1988) uses cross-sectional data. Although Grabacz (1990) uses both time series and cross-sectional data, panel data was not used.

order to control for unobserved state-specific fixed effects as well as endogeneity, in this study we estimate the fixed effects 2sls model by using the panel data from 46 prefectures in Japan for the years 1988-2000 (Baltagi, 2005)[2]. Thus, one of the innovations introduced in this paper is the control of the endogeneity of inspection.

If an alcoholic, drunk driver drives along a road and kills a child, he knows that his neighbors will look down on him and that his employer will discover that he is an alcoholic. In the long run, the entire community will come to ostracize this driver (Posner and Rasmusen, 1999). Such a sanction is considered to be the cost of committing a crime (Funk, 2005). The higher the cost, the stronger the social norm "not to commit a crime" becomes. Therefore, the strength of the relative social norms plays a critical role in deterring drivers from driving dangerously. We believe that social norms are the key determinant the attitude of driver. This is why in this study we pay particular attention to the role of social norms in the regulation of drivers' manners and thus include the proxy variables of social disorganization.

Even if a community is tightly-knit and social norms are strong, if an accident is not serious, then the cost of committing the crime is likely to be low. Consequently, we postulate the hypothesis that the cost of committing a crime depends upon the extent of the accident. In this study we examine this hypothesis by estimating the determinants of fatalities and nonfatal accidents separately and comparing the results.

---

[2] Japan consists of 47 prefectures. We could not obtain the per capita consumption data of all types of alcoholic drinks for Okinawa Prefecture, however, and thus only the data for the other 46 prefectures was used.

II. MODEL

Figure 1 (a) and (b) report the number of non-fatal and fatal accidents, respectively. We see from Figure 1 (a) and (b) that non-fatal accidents rise consistently, which is in contrast to fatalities, which gradually decline after 1990. Figure 2 depicts the time trends of the real revenue of the Japanese automobile inspection industry. Figure 2 shows that there has been an immediate increase in revenue in recent years. Our conjecture from these observations is that safety inspections increase non-fatal accidents but decrease fatal ones.

Following the argument in the previous section, the estimated function takes the following form:

$$FATAL \text{ (or } ACCI \text{) } = \alpha_1 INSP_{it} + \alpha_2 BOOZE_{it} + \alpha_3 DENS_{it} + \alpha_4 DISORG1_{it}$$
$$+ \alpha_5 DISORG2_{it} + \alpha_6 YOUG_{it} + \alpha_7 POLICE_{it} + \alpha_8 LIGHT_{it} + \alpha_9 INCOM_{it}$$
$$+ \varepsilon_i + \nu_t + \omega_{it},$$

where *FATAL* and *ACCI* represent any of the two dependent variables in prefecture i and year t.. α represents the regression parameter.

ε_i , ν_t and ω_{it} represent the unobservable specific effects of the individual effects of i 's prefecture (a fixed effect prefecture vector) in t th year (a fixed effect time vector) and error term respectively. The structure of the data set used in this study is a panel; ε_i holds the time invariant feature. We control it by means of fixed effects estimation. A macro economic condition will be captured in ν_t and we incorporate each year's dummy variables to restrain the time specific effects.

Table 1 includes variable definitions, means, and standard deviations. Each variable is discussed as follows. Dependent variables are both fatalities and non-fatal accidents[3]. Independent variables are defined similar to those used by Loeb (1990) and Garbacs and Kelly (1987); real revenue of the car inspection industry, alcohol consumption, real per capita income, and the population of 20-24 year olds[4]. If the coefficients of *INSP* are positive, then the results support the offsetting behavior hypothesis. We use instrumental variables to break the endogeneity of the real revenue of car inspections[5].

Several control variables complete the model. The population density represents the difficulty of driving. The speed of driving partly depends upon the circumstances of the road, i.e.,, the road being so crowded that drivers cannot drive at high speeds. Further, low-speed driving is not likely to incur serious accidents. Nonetheless, it seems to be more difficult for drivers to avoid minor collisions in denser areas even when driving carefully. The number of policemen is taken as the value for formal enforcement for deterring dangerous driving. The number of traffic lights is taken as a means of decreasing accidents as traffic lights help to coordinate the traffic system.

The cost of committing a crime depends on the social norms, which are shaped by local interactions (Funk, 2005). Individuals are apt to drive dangerously due to the decrease in the expected cost of committing a crime if the

---

[3] Most previous research has considered only fatalities, except for Merrell *et al.* (1999).

[4] We take the real revenue of the car inspection industry as a proxy variable for the degree of car inspection. Note that some key variables, such as the price of medical care or automobile repair, cannot be obtained. Our fixed effects model, however, attenuates the omitted variable bias.

[5] Instrumental variables are the number of pedestrian crossings and its square.

community is disorganized and social norms are weak. According to Putnam (2000), social disorganization is regarded as the engine of bad behavior. Such disorganization undermines the social norms and marks urban areas where population turnover is high, one's neighbors are anonymous, and local organization is rare. *DISORG1* is the number of immigrants from other prefectures and *DISORG2* represents the number of residence changes within a prefecture. We consider these variables to be the proxy for social disorganization in order to capture the extent of population turnover and the decrease in the cost of committing a crime.

III. RESULTS

Table 2 presents the results of the estimations, in which the key results are those for *INSP* and its coefficients in the fatal accidents model of column (1), which shows positive but not statistically significant results. Nonetheless, the coefficient sign of the 2sls model in column (2) dramatically changes to negative and is statistically significant at the 1% level. Let us turn now to the non-fatal accident model in both columns (3) and (4), in which the coefficients are positive and statistically significant, which suggests the presence of offsetting effects. In summary, these results imply that automobile inspections are effective in reducing vehicle fatalities but not non-fatal accidents.

BOOZE is positive in every case but only statistically significant in the fatal accident model. *DENS* is negative in the fatal model but positive in the non-fatal model, and it is statistically significant in columns (1), (3), and (4). These results are consistent with our hypothesis.

Results for the fatal models in column (1) suggest that both *DISORG 1* and *DISORG 2* are positive but that only *DISORG 1* is statistically significant, at 5%. In column (2), using the 2sls model, *DISORG 1* and *DISORG 2* are positive and their values are larger than those in column (1), while being statistically significant at the 1% level. These results imply that the more disorganized the community, where social norms are fragile and the cost of committing a crime is lower, the more fatal accidents increase. The non-fatal equation finds the coefficient for *DISORG 1* and *DISORG 2* to be positive though not statistically significant. Thus the cost of committing the crime of a non-fatal accident is considered to be lower, and therefore the disorganization effects are weaker.

IV. CONCLUSION

One of innovations of this paper lies in its controlling of the endogeneity of inspection. The results of the estimation using the 2sls fixed effects model presented here suggest that automobile inspections are effective at reducing fatalities but not effective at reducing non-fatal accidents. Another innovation is the incorporation of the factor of social disorganization and the enforcement of norms into the estimation model. The more disorganized the community, the less robust the enforcing norm becomes. Due to the fragility of the enforcement of norms, the cost of committing a crime stemming from social sanctions from neighbors decreases. Hence, disorganized communities will induce drivers to drive more dangerously and thereby incur more mortal crashes.

In conclusion, we found evidence supporting the hypothesis that automobile inspections and the enforcement of norms play critical roles in

reducing fatalities through social sanctions.

REFERENCES

Asahi Shinbunsha. (2004) *Minryoku: TODOFUKEN-BETSU MINRYOKU SOKUTEI SHIRYOSHU* (CD-ROM edition), Asahi-Shinbunsha, Tokyo.

Baltagi, B. (2005) *Econometric Analysis of Panel Data*, John Wiley and Sons.

Funk, P. (2005) Government action, social norms, and criminal behavior, *Journal of Institutional and Theoretical Economics*, **161**, 522-35.

Garbacz, C. (1990). How effective is automobile safety regulation? *Applied Economics*, **22**, 1705-14.

Garbacz, C. and Kelly, G. (1987). Automobile safety inspection: new econometric and benefit/cost estimates, *Applied Economics*, **19**, 763-77.

Loeb, P. D. (1985). The efficacy and cost-effectiveness of motor vehicle inspection using cross sectional data: an econometric analysis, *Southern Economic Journal*, **52**, 279-87.

Loeb, P. D.(1987). The determinants of automobile fatalities with special consideration to policy variables, *Journal of Transport Economics and Policy*, **21**, 279-87.

Loeb, P. D. (1988). The determinants of motor vehicle accidents: a specification error analysis, *Logistics and Transportation Review*, **24**, 33-48.

Loeb, P. D. (1990). Automobile safety inspection: further econometric evidence, *Applied Economics*, **22**, 1697-1704.

Loeb, P. D. and Gilad, B. (1984). The efficacy and cost-effectiveness of vehicle inspection: a state specific analysis using time series data,

Journal of Transport Economics and Policy, **18**, 145-164.

Merrell, D., Poitras, M., and Sutter, D. (1999) The effectiveness of vehicle safety inspections: an analysis using panel, *Southern Economic Journal*, **65**, 571-83.

Peltzman, S. (1975). The effects of automobile safety regulation, *Journal of Political Economy*, **83**, 677-726.

Posner, R. A. and Rasmusen, E. (1999) Creating and enforcing norms, with special reference to sanction, *International Review of Law and Economics*, **19**, 369-82.

Putnam, R. (2000) *Bowling Alone: The Collapse and Revival of American Community*, A Touchstone Book.