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ORIGINAL PAPER

Paying Money for Freedom: Effects of Monetary Compensation on Sentencing for Criminal Traffic Offenses in China

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Abstract

Objectives The current study seeks to understand the role that monetary compensation plays on the joint occurrence of imprisonment and probation for criminal traffic offenses in China. We argue that monetary compensation influences sentencing decisions primarily by manipulating the probation terms in favor of the defendant. With monetary compensation directly increasing the chances of a more lenient punishment through extended probation as opposed to more severe penalties, we have found sentence lengths for criminal traffic offenses to be concentrated at 36 months, the maximum length eligible for probation.

Methods All available sentencing documents for criminal traffic offenses from 2014 to 2016 were retrieved from the China Judgments Online website. The final dataset contains 141,689 observations. Following a joint model approach using both sentence length and probation as outcomes, we utilized a Zero-Truncated-Generalized-Inflated-Poisson model to address the distributional characteristics of sentence length, such as discrete integers, non-zero values, and the concentration of data on certain points. To avoid detecting effects of little scientific importance due to our large sample size, all results were evaluated using bootstrapping techniques.

Results We found that the likelihood of probation increases when monetary compensation is provided, but that compensation does not make a significant difference on the sentence length for those defendants receiving less than 36 months imprisonment. When considering the concentration of sentence lengths at specific values, monetary compensation was positively associated only with the chance of inflation at the value of 36 months, and the probation itself became insignificant in predicting sentence length.

Conclusions The significant positive relationship between monetary compensation and lenient sentencing outcomes suggests that compensation plays a crucial role in the Chinese judicial process. Our study will not only help researchers to better understand the legal process in China, but it will also benefit the larger community as an example of utilizing new sources of data.

Keywords Monetary compensation · Sentencing outcomes · Inflation · Criminal traffic offenses · China

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Introduction

A common criticism of the Unites States legal system is that wealth has a disproportionate effect on sentencing outcomes, and that a person's socioeconomic disadvantage translates to more severe legal penalties (Lott 1987). It is widely believed that the wealthy have advantages when navigating each step in the justice system, such as with paying bail (Lu and Kelly 2008), selecting legal services (Hartley et al. 2010; Rattner et al. 2008), and receiving lenient sentencing (Bagaric 2014). Although criminal sentencing has attracted extensive research in both the United States (Ulmer 2012) and in European countries (Wermink et al. 2015; van Wingerden et al. 2016), little is known about how a defendant's wealth or socioeconomic factors contribute to the sentencing outcomes, which is largely due to a lack of data and appropriate means of measurement (Kutateladze et al. 2016; Reitler et al. 2013; Ulmer 2012).

The ways in which legal and extra-legal factors contribute to judges' sentencing decisions have been a focal point of previous sentencing literature. For instance, an offender's age (Little and Karp 2012; Steffensmeier et al. 1998), gender (Gelb 2010; Jeffries and Bond 2010; Van Wingerden et al. 2014), and race/ethnicity (Fishman et al. 2006; Johnson and Betsinger 2009; Mitchell 2005), have all been studied extensively in regards to their relation to criminal processing outcomes. Beyond the simple claim that age, gender, or race/ethnicity matters, there has been a growing consensus that the influences of those variables are mutually dependent in affecting the process of juridical decisions (Spohn 2000; Ulmer 2012). In particular, a large body of research argues that a major contributor to the higher conviction and sentencing rates of minorities is due to racial disparities in economic resources, which in turn forces many defendants to rely on a deficient defense system (Anderson and Heaton 2012; Roach 2014).

There have been demands for studies to disentangle the influence of race/ethnicity and socioeconomic factors (Doerner and Demuth 2010), however, due to a number of reasons, information on an offender's socioeconomic status has been very limited. While there are typical measures that researchers could utilize to garner a more nuanced picture of a defendant's SES, such as type of attorney (e.g., public defender or assigned counsel) (Kutateladze et al. 2014), and employment status (Wooldredge 2010), these variables can only be considered as a proxy for socioeconomic status. Moreover, these factors do not directly address the question of whether wealth affects sentencing outcomes. In contrast with Western jurisdictions, such as the U.S. and Great Britain, where monetary compensation awarded to victims is usually a part of the sentencing outcome (Ng and He 2014), countries such as China have legal systems that allow any compensation given from the defendant to the victim to be considered in a judge's ultimate sentencing decision (Supreme People's Court [SPC] 2014). While monetary compensation is not necessarily equivalent to a measure of wealth, it offers a perspective that is different from traditional measures and provides a great opportunity to investigate the effect of wealth on sentencing outcomes.

Although it has been discussed extensively by legislators and policy makers, with the exception of a few case studies, to the best of our knowledge, a systematic investigation of the effect of monetary compensation on sentencing outcomes is sparse. To fill this gap, the current study aims to explore the influence that monetary compensation provided by defendants to their victims has on the sentencing outcomes for criminal traffic offenses according to Article 133 *Traffic Accident Crime* of the Chinese Criminal Law.

The definition of a criminal traffic offense in China is similar to that of vehicular homicide or unintentional vehicular manslaughter in the United States. According to Article 133

of the Chinese Criminal Law, violations of traffic or transportation laws and regulations that lead to major accidents involving severe injuries, deaths, or great losses of public/private properties shall be sentenced to no more than 3 years of fixed-term imprisonment or criminal detention. Aggravating factors, such as fleeing the scene ("Hit and Run"), escalates the punishment to three to 7 years of fixed-term imprisonment; the length of incarceration further increases to no less than 7 years if fleeing the scene results in casualties.

The Chinese Criminal Law allows for the following three outcomes to be considered as forms of reduced punishment: (1) a downgrade of the category of punishment; (2) a shorter length of sentence; or (3) a granted probation. Since the written law defines the specific elements of criminal activities and the categories of seriousness and culpability, judges have little discretion in changing the category of the punishment without statutory circumstances and adequate justification endorsed by a higher level of authorities. Although it is theoretically possible to downgrade the category of punishment by offering monetary compensation in the case of a criminal traffic offense, in practice it is extremely difficult and an unlikely outcome. Therefore, we focus on the remaining two forms of punishment that could realistically be affected by monetary compensation: a reduction of sentence length, and the increased chance of probation. In addition, built on previous studies, we implemented a Zero-Truncated-Generalized-Inflated-Poisson model (ZTGIP) to address the unique characteristics of the sentence length distribution, the truncation of zero for example, and the inflation of certain values (Cai et al. 2018a).

The rest of this article is organized as follows: we begin by introducing the discretionary circumstances of sentencing in the Chinese judicial system and summarize previous findings. Next, we present a description of the data and methods used, followed by our results with a discussion. We conclude with a summary and suggestions for future studies. Technique details are appended in the appendices.

Background

Monetary Compensation and Sentencing in China

In the Chinese judicial system, monetary compensation refers to the real assets offered by the defendant to the victim before or during the trial process, which is a unique practice compared to that in the U.S. and European countries (Ng and He 2014). For example, in the U.S. criminal justice system, compensation, especially for traffic offenses, is often paid by insurance companies instead of offenders. Therefore, offenders do not have the obligation to compensate victims directly. However, due to the absence of a well-developed insurance system in China, the victims of criminal traffic offenses usually do not receive a suitable amount of monetary compensation from insurance companies (Ng and He 2017). Moreover, it is not uncommon that the offenders of traffic offenses are not covered by any insurance (Ng and He 2017). Thus, seeking compensation directly from the offenders becomes a practical option for the victims.

The relationship between monetary compensation and sentencing outcomes has received much attention in Chinese criminal justice studies that focus on the legitimacy and practical issues of monetary compensation as a discretionary circumstance in the sentencing process (Bai 2011; Li 2015; Liu and Palermo 2009; Jiang 2010; Ng and He 2017; Trevaskes 2013; Xiang 2013). Arguably, the monetary compensation is representative of an apology from the offender, which, if accepted, effectively establishes an agreement between the

defendant and victim (Ng and He 2017; Xiang 2013). The agreement alongside the compensation is usually considered a product of criminal reconciliation under the paradigm of restorative justice promoted by the current political policy (Li 2015; Ng and He 2017; Trevaskes 2013; Xiang 2013). Although prior studies have demonstrated that monetary compensation plays a crucial role in obtaining a lenient punishment in the present Chinese judicial system, particularly for cases that include the death penalty (Miao 2016; Trevaskes 2013; Weatherley and Pittam 2015), the practice is not always well-received. In one high profile case there was public outcry when a defendant was charged with Article 115, *crime of endangering public security*. The public was incensed after learning that the death penalty sentence with immediate execution was reduced to a suspended death sentence in the second trial after a substantial amount of compensation was paid by the offender (Huang et al. 2009).

Several judicial interpretations released by the SPC regulate that monetary compensation shall be considered as a discretionary circumstance. For instance, in Chinese Criminal Law, although monetary compensation was not officially documented as a discretionary circumstance until 2008, it was usually interpreted and acknowledged by the court as a mitigating factor that allowed for a more lenient punishment. In 2008, monetary compensation for the damage caused by traffic offenses was officially recognized as a discretionary circumstance in the sentencing guidelines published by the SPC (2008). Furthermore, in the updated version of the interpretation (SPC 2010), the acts of voluntarily compensating victims, confessing his/her criminal conduct, or showing remorse, are all listed as discretionary circumstances that are associated with a reduced punishment. Thereafter, officials in the judicial system intentionally promoted the offering of monetary compensation in criminal cases (Pei 2014).

Many scholars have interpreted the role of monetary compensation from the perspective of restorative justice which emphasizes, "repairing the harm caused or revealed by criminal behavior" (Braithwaite 1999; Menkel-Meadow 2007). Prior studies have suggested that offering compensation is considered an acknowledgement of guilt and remorse (Rachlinski et al. 2013), which are generally accepted as mitigating factors in sentencing decisions (Seghetti and Smith 2007). For example, in light of "healing" victims through reparations, the U.S. federal courts acknowledge voluntary payment of restitution prior to adjudication of guilt as a sign of acceptance of responsibility, which is considered a mitigating factor under § 3E1.1(a) of the Sentencing Guidelines (United States Sentencing Commission 2016). However, showing remorse without compensation might not be officially recognized because it is deemed insincere in some legal systems (Stark and Frenkel 2013); while offering both compensation and showing remorse are discretionary circumstances acknowledged in the juristic interpretations of the SPC, the single act of offering compensation is not necessarily or officially considered as a sign of showing remorse (SPC 2014).

Although the concept of restorative justice was introduced by Western scholars, traces of such principles can be found in the Confucius thinking, which has a significant impact on the practice of criminal justice in China (Braithwaite 1999; Johnstone and Ness 2007; Zhe 2013). For instance, the policy of "balancing leniency and rigidity" ("Kuan Yan Xiang Ji" in Chinese), requires judges to consider both mercy and severity in their decisions, yet allows for leniency during the trial if the circumstances call for it (Zhao et al. 2013). In addition, the recent revision of the Chinese Criminal Procedure Law has incorporated the system of criminal reconciliation in the official criminal proceedings (Shen 2016; Xiang 2013), which allows a judge to close a case with a lenient punishment or an acquittal when the crime is minor and the offender and victim make an agreement on the compensational issues (Li 2015; Pei 2014).

Unfortunately, studies from the restorative justice perspective rarely investigate the influence of compensation on the sentencing outcomes and the mechanisms behind them (Jiang 2010; Ng and He 2017; Trevaskes 2013; Xiang 2013). Most of the existing studies on the effect of monetary compensation look at death penalty cases, for instance, the role of compensation in transforming an immediate death penalty to a suspended one (Lu and Zhang 2005; Trevaskes 2013). Although scholars argue that the effect of monetary compensation and the implementation of judicial discretion might be different in less serious crimes (Ng and He 2014), very few studies have examined the effect of compensation on less grievous offenses, such as traffic violations. One exception is Bai's 2011 study, which suggested that there is no relationship between the requested amount of monetary compensation and sentencing outcomes after controlling for potential legal and extra-legal factors in traffic accident cases. However, it is well known that there is a large discrepancy between the requested compensation amount and that which is actually received (Ng and He 2017), and only the received compensation is acknowledged as a discretionary circumstance in the legal interpretations (SPC 2014). Thus, the tenuous relationship between the requested amount of compensation and the sentencing outcomes is somehow acknowledged.

Three Approaches to a Lenient Punishment

Unlike the U.S. structure, which imposes a two-dimensional grid that takes into account both the seriousness of the crime and criminal history of the defendant when prescribing punishment (Lubitz and Ross 2001), the Chinese legal system, similar to England and Wales, employs a step-by-step methodology to regulate sentencing (Roberts and Pei 2016). Reaching a sentencing decision usually requires three principal steps (SPC 2014). The first step is for a judge or collegiate bench to identify the minimum sentence, which is based on the evaluation of the essential features of an offense. For example, the evaluation would include whether the charge is applicable, and which level of seriousness is appropriate. For criminal traffic offenses, the offense is further categorized based on whether the defendant escaped ("Hit and Run"), and whether or not other serious aggravating factors exist. When aggravating offenses are present, the minimum sentence is 3 years; the minimum sentence length increases to 7 years if deserting the scene of the crime leads to casualties. In the absence of any aggravating factors, crimes referred to as "conventional offenses," the maximum length of a sentence is 3 years. The courts are then required to set the baseline sentence with respect to a range of aggravating factors, such as the number of deaths, the number of injured, and the type of responsibility. The last step is to adjust the baseline sentence, by either increasing or reducing sentencing length, after considering circumstances that are relevant to the offender's level of culpability, such as if they turn themselves in, offer compensation to the victim, or complete meritorious services (SPC 2014).

Theoretically, there are three possible approaches with specific requirements to reducing the level of a punishment: (1) downgrading the category of the punishment; (2) trimming the length of the sentence; and (3) granting a probation.

In the Chinese criminal justice system, there are five categories of principle punishments: (1) public surveillance; (2) criminal detention; (3) fixed-term imprisonment; (4) life imprisonment; and (5) the death penalty (Article 33 of the Chinese Criminal Law). Each of the punishments corresponds to a specific level of severity of the offense. For example, public surveillance and criminal detention are applied primarily to the less blameworthy offenders and certain types of crimes with minor damage to both society and the victims. In China, the majority of cases are given fixed-term imprisonment, with terms varying

from 6 months to 15 years. Life imprisonment and the death penalty are only applied to those who commit extremely serious crimes, such as murder. In the Chinese legal system, the written law defines the constituents of criminal activities and sanctions, as well as the levels of seriousness and culpability (Roberts and Pei 2016), therefore, judges have little discretion in changing the category of punishment.

Another method used to mitigate the level of a punishment is reducing the sentence length, especially for fixed-term imprisonment. Given the severity of the criminal conduct, a judge may choose a shorter length of imprisonment as a mitigated punishment within the level that is delineated by the law, taking statutory and discretionary circumstances into consideration. For instance, according to the severity of an offense, there are three levels of fixed-term imprisonment for criminal traffic offenses in China: 6 months to 3 years; 3 to 7 years; and 7 to 15 years (Article 133 of the Chinese Criminal Law). For traffic offenses, the first level is applied to an offender who "violates traffic and transportation laws and regulations, giving rise to major accidents involving severe injuries, deaths, or great losses of public/private properties" (Article 133). If the offender flees from the scene of the accident, the punishment increases to the next level (three to 7 years). If escaping results in the death of victim(s), the third level of punishment shall be applied (Article 133). However, for a case with no aggravating or mitigating factors, the level of eligible punishment is usually unknown to the public and is not listed in the sentencing document. Compared to other cases with aggravating or mitigating factors, when judges have little discretion in changing the penalty categories, the cases that do not include these influential factors afford the judges greater discretion, and thus enable them to increase or reduce the length of imprisonment, considering statutory and discretionary circumstances (SPC 2014).

The last option in offering leniency is granting a probation. Although the probationer is required to follow similar regulations of public surveillance within the probation period (Tursun 2010), the original sentence will no longer be executed if the probationer does not violate any of the regulations within this period. Hence, probation can be considered as one way of downgrading the sentence type from detention or fixed-term imprisonment to public surveillance. In practice, probation has been granted to a substantial number of offenders who have committed less serious crimes, such as negligent homicide, corruption, and criminal traffic offenses (Lu et al. 2017; Zhao 2017). In theory, probation is only allowed to be offered to an offender who is sentenced to detention or imprisonment for no more than 3 years (Article 72 of the Chinese Criminal Law). However, the actual punishment that an offender with a granted probation receives is much less than that of one without probation for a similar length of imprisonment (Tursun 2010). With the exception of serious crimes, the Chinese Criminal Law offers judges greater discretion in granting probation compared with changing the category of the punishment. For instance, in criminal traffic offense cases, if the offenders satisfy the requirements of the second level of punishment (three to 7 years of imprisonment), it is much more difficult for a judge to authorize a 1-year imprisonment without probation than it is to grant a probation with a 3-year imprisonment, in which the de facto punishment is dramatically reduced. Unfortunately, the role that probation plays in reducing punishments has been largely ignored in the literature.

Among the three leniency approaches, shortening the length of term and declaring a probation are the most practical options for reducing punishment in the Chinese context. It is necessary to take the joint occurrence of imprisonment and probation into consideration when exploring the influences of legal or extra-legal factors on the sentencing outcomes. The existing literature provides a possible explanation for why monetary compensation might have an effect on sentencing outcomes, such as restorative justice. However, the literature also exposes a lack of empirical evidence, as well as poor generalizability of

the current findings gleaned primarily from death penalty cases. Furthermore, the previous studies fail to thoroughly explore which one of the three possible approaches to leniency is most influenced by monetary compensation. In addition, the picture would be incomplete if one was to examine the effect of monetary compensation on sentencing outcomes while ignoring the role of probation.

To bridge this gap, the current study seeks to understand the role of monetary compensation on the joint occurrence of imprisonment and probation. Theoretically, the chance of probation is independent of the length of imprisonment as long as the length of imprisonment is within the applicable range of probation of 6 to 36 months. However, in practice, these two decisions are always made interdependently; to make a probation possible, the length of imprisonment has to be limited to 36 months. Assuming the length of sentence is truly independent of a probation decision, we would expect no difference in the distribution of the length of sentence for the first level of imprisonment between those who received probation and those who did not. If the decision of probation is related to the length of sentence within 36 months, then a concentrated distribution within 36 months is anticipated.

Consequently, we hypothesize that instead of directly reducing the length of fixed-term imprisonment, the major role of monetary compensation is to increase the likelihood of probation for a criminal traffic offense. To make a probation possible, the monetary compensation is positively associated with the chance that the length of a sentence is within the range of 36 months. Since it is not possible to measure the counterfactual outcome of sentencing assuming that monetary compensation is not given, we argue that the effect of monetary compensation on compressing the sentence length could be partially proxied by its contribution to the concentration of sentencing length to 36 months of imprisonment. Specifically, for defendants receiving no more than 36 months imprisonment, the monetary compensation contributes to the chance that the length of sentence is exact at the value of 36 months, which leads to the so-called "heaping" or "inflation" phenomenon; while the probation itself might not correlate to a shorter sentence length.

Data and Methods

Data

To evaluate the above hypotheses, we analyzed all available sentencing documents for criminal traffic offenses from 2014 to 2016 that were uploaded on the website China Judgments Online (CJO), the official platform for archiving judicial documents. In an effort to improve the transparency and efficiency of the judicial system, starting in 2013, the SPC implemented the requirement for all levels of the People's Court to upload their sentencing documents to the CJO, with the exception of those involving state secrets, personal privacy, juvenile offenders, disputes concluded through mediation, or other documents deemed "inappropriate" to publicize (SPC 2013).

To retrieve all the criminal traffic cases, we utilized web-scraping techniques that have gained much attention within and outside of academia over the past two decades (Glez-Peña et al. 2014). Retrieving sentencing documents can be accomplished easily by first submitting a search query for all court cases filed under *Traffic Accident Crime*, and then downloading the documents. Once a search has been initiated, the returned results page lists all the sentencing documents with hyperlinks. For the average user, the CJO website provides a straightforward platform to review the contents of sentencing documents.

However, for the purpose of our research, it was not efficient or even feasible to review each individual case when thousands of documents satisfying our search query were returned. To avoid the tedious clicking and downloading process for each of the relevant sentencing documents, we automated the process via Hyper Text Transfer Protocol (HTTP) communication using GET and POST methods (Fielding et al. 1999). The first HTTP request (the GET method) submits the search query to the server that hosts the search engine of the CJO, and then parses and subtracts the URLs from the source code of the search results page. The second HTTP request (the POST method) sends a loop of requests for each of the URLs, and extracts the sentencing documents from the source code returned webpage.[1]

Due to the large amount of search requests submitted each day, the CJO website has been updating its anti-scraping strategies by requesting authorization, adding cross certification, or through verification codes to circumvent the overwhelming number of requests that could lead to a crash of the server. Most anti-scraping strategies can be evaded by analyzing the source code of the CJO webpage and developing corresponding bypass techniques, such as controlling the number of requests, or adding header information for the HTTP request to obtain authorization. However, sometimes the cost of bypassing the anti-scraping measures is too high, therefore, data collecting from the CJO website might require highly customized programming skills.

Each sentencing document contains three parts: the caption, the main body, and a conclusion. The caption lists the parties involved in the dispute, the court, and the case number. The main body consists of a description of facts: offender information (e.g., last name or alias), offense characteristics (e.g., time and location), and process (e.g., legal representation, and appeal). The conclusion includes the dispositional decisions, such as articles cited and sentences. For each of the documents, we extracted and tokenized the main body using R package *wordseg* (Li 2013) and *tm* (Feinerer and Hornik 2017). We then coded all the information regarding the legal circumstance of the offense, the monetary compensation, as well as the sentencing outcomes of the defendant(s) using keyword extraction. To assess the reliability of the coding, we had a randomly selected sample of 100 sentencing documents independently coded by three coders. The results of the independent coding were in strong alignment with ours. For example, all three coders presented over 99% agreement on the 17 variables coded in the study, likely due to the fact that most were dummy variables. Upon comparing the coding results, there were only two variables, *number of lightly injured* and *Driving Under Influence*, that were reported to have a low percent of agreement, 90% and 91%, respectively. The detailed comparisons for each of the variables used in the analysis are given in "Appendix 1".

We limited our analysis to the first trial and fixed-term imprisonment because nearly 97% of the defendants involved in criminal traffic cases were sentenced to a fixed-term imprisonment. After removing duplicated and misclassified cases (3496), there were 164,883 documents retrieved from the CJO website. We further excluded cases involving multiple offenses or crimes such as homicide, assault, theft, and dangerous driving (1891), those that were missing key sentencing information such as the sentence length (5464), as well as those sentenced before the year of 2013 (15,839). The final dataset has 141,689 observations with 96.08% of them receiving less than 36-months of imprisonment.

[1] The python code for HTTP requests is available upon request.

Measurements

The sentence length for criminal traffic offenses was coded as the length of imprisonment in months, which varied from 6 to 144 months. *Probation* was measured as a dummy variable, with 1 indicating that the defendant received probation, and 0 otherwise. Similarly, the *compensation* status was also coded as a dummy variable, with 1 indicating that the defendant offered compensation and the victim accepted it before the end of the trial process, and 0 if no compensation was offered.

All related legal factors for criminal traffic offenses were considered, such as: *the number of deaths, the number of seriously injured, the number of lightly injured,* whether the defendant had taken *full responsibility,* whether the defendant *escaped*, and whether the defendant had *insurance* coverage. Additionally, legal factors documented in the judicial interpretation of the SPC (2000) were also coded, including: whether the defendant was driving under the influence of alcohol or drugs (*DUI*), driving without a valid license (*no license*), and whether the vehicle was *overloaded*. Besides the legal factors directly relating to the traffic accident, a group of dummy variables measuring regular discretionary circumstances such as *turn-self-in*, obtaining *forgiveness*, *confessed*, showing *remorse,* and having a *lawyer* were also included. Since criminal traffic offenses belong to the non-premeditated category of offenses, defendants with a prior criminal history are not counted as recidivists, this legal factor was excluded from the current analysis. To address potential regional variations within China, a group of region dummies—*North*, *West*, *Middle* and *East* (National Bureau of Statistics of China 2011), as well as *Urbanicity* (*Rural* as the reference)—were controlled.

Analytic Strategy

The main purpose of this study is to investigate how monetary compensation influences the interdependent sentencing outcomes of probation and the length of sentence. We argue that instead of directly reducing the length of fixed-term imprisonment, the major role of monetary compensation is to increase the likelihood of being granted a probation for a criminal traffic offense. To make a probation possible, the length of a sentence has to be confined to 36 months, which nullifies the effect of money on the length of sentence. In other words, for defendants receiving less than 36 months imprisonment, the monetary compensation contributes to the chance that the length of sentence is exact at the value of 36 months; while the probation itself might not correlate to a shorter sentence length.

To probe the interdependent outcomes, we employed a joint model framework (Guo and Carlin 2004), which allowed us to estimate the effect of compensation for the two interdependent outcomes simultaneously. Previous studies have applied linear regression, loglinear models, or quantile regression to study the sentence length, with the assumption of normal or restricted normal distributions (Britt 2009; Grundies and Zhao 2016; Hauser and Peck 2017; Hester and Hartman 2017). However, recent research has pointed out the discrete nature of sentence length (in months), and the need to address non-zero values (Rydberg et al. 2017; Zhang and Li 2014; Zhe 2013).

Let dichotomy random variable Z indicate the outcome of probation (1 as probation granted, and 0 otherwise), the probability mass function could be written as,

$$p\left(Z = z_i\right) = q_i^{z_i} \times \left(1 - q_i\right)^{1-z_i}$$

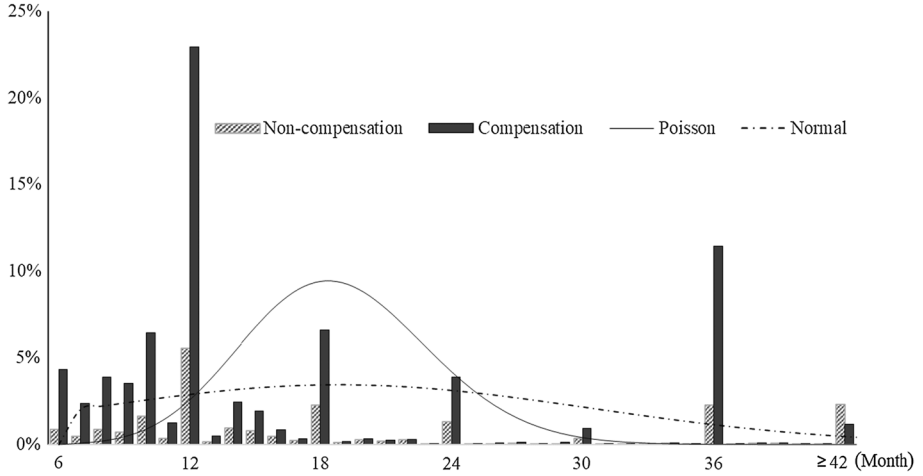

Fig. 1 Percentage distribution of sentence length by compensation status with Normal and Poisson curves

where $q_i = \frac{1}{1+\exp(-\boldsymbol{m}_i\boldsymbol{\beta})}$ is the probability of granting a probation with covariates $\boldsymbol{m}_i$, and the corresponding parameter vector $\boldsymbol{\beta}$. Similarly, we define random variable Y as the length of sentence, which follows a Zero-Truncated Poisson (ZTP) distribution with discrete integer outcome k ($k>0$) because the length of sentence is discrete and contains no zero values. The probability mass function is,

$$p(Y_i = k|\lambda_i) = \frac{\lambda_i^k}{(1-e^{\lambda_i})k!}$$

where $\lambda_i = exp(\boldsymbol{x}_i\boldsymbol{\gamma})$ with covariates $\boldsymbol{x_i}$, and the corresponding parameter vector $\boldsymbol{\gamma}$. The *probation* variable serves as the dependent variable in the logistic part; while it enters to the ZTP part as the independent variable in $\boldsymbol{x}_i$. The joint probability for the ith individual for the interdependent outcomes is the product of $p(Z = z_i)$ and $p(Y_i = k|\lambda_i)$.

In addition, one of the distributional characteristics of sentence length is the concentration on certain values, e.g., 12 and 24 months (Abrams 2010; Rydberg et al. 2017). Similar to other countries, inflations on specific values of sentence lengths have been reported for various types of offenses in China (Cai 2015; Wang 2016). As shown in Fig. 1, for both of the compensated and non-compensated cases, there is an unusually high percentage of sentence lengths concentrated on the values 12 (29.8% vs. 24.1%), 24 (5.0% vs. 5.8%), and 36 (14.9% vs. 9.9%), which exceeds the predicted probabilities from regularly assumed normal and Poisson distributions (Poston and McKibben 2003). Without appropriate measures to handle data inflations, standard models for discrete values such as Poisson and negative binomial lead to biased estimates and incorrect inferences (Lambert 1992).

In this study, we utilized a Zero-Truncated-Generalized-Inflated-Poisson (ZTGIP) model to address the distributional characteristics of sentence length such as non-zero values, discrete integers, and inflations at certain points (Cai et al. 2018b). Developed from the generalized inflated Poisson model (Begum et al. 2014), the ZTGIP model is a mixture of two distributions: a logistic/probit component to account for the probability of inflation, and a zero-truncated-count component for the non-zero discrete counts. To simplify our

notation, we dropped the subscript for individuals and used the subscript to differentiate the inflated values. For example, suppose a discrete random variable Y has inflated probabilities at values $k_1, \ldots, k_m \in \{0, 1, 2, \ldots\}$, the probability mass function can be written as:

$$p\left(Y = k|\lambda, \pi_i, 1 \le i \le m\right) = \begin{cases} \pi_i + \left(1 - \sum_{i=1}^{m} \pi_i\right) \times p(k|\lambda), & if\ k = k_1, \ldots, k_m \\ \left(1 - \sum_{i=1}^{m} \pi_i\right) \times p(k|\lambda), & if\ k \ne k_i, 1 \le i \le m \end{cases}$$

where π_i is the probability of inflation at the value k_i with $1 \le i \le m$, and $\sum_{i=1}^{m} \pi_i \in (0, 1)$; $p(Y = k|\lambda)$ is a ZTP distribution with the parameter λ for $k = 1, 2, \ldots$ defined as

$$p(Y = k|\lambda) = \frac{\lambda^k}{\left(1 - e^{\lambda}\right)k!}.$$

Compared to the joint model, the ZTGIP model implements additional logistic parts to account for inflations. It also allows predictors to be included in both the length of sentence (modeling λ in the ZTP part) and the probabilities of inflations (modeling each π_i with a logit or probit link function).

Although a large sample size is always desirable because it reduces the type II error, it also amplifies the detection of trivial differences that are not substantially significant. Since the overall sample contained approximately the entire population (literally all cases filed under *Traffic Accident Crime*) for the years 2014–2016, the exploratory analysis showed that almost all variables included in the study were highly significant with a p value less than .001. To avoid such problems, with the exception of descriptive statistics, we reported coefficients estimated from the whole sample but with 95% Bootstrapping Confidence Intervals (BCIs) which were generated from 1000 bootstrapped replicates along with the original model-based p values. The bootstrapping procedure drew a sample of 3100 with replacement stratified by province (100 per province) out of the overall sample, and then the models were estimated. The procedure was repeated over 1000 times. For each of the parameters, all the estimates were then grouped to calculate the BCIs. In general, BCIs are asymptotically more accurate than the standard intervals obtained using sample variance and assumptions of normality (Davison and Hinkley 1997; Efron and Tibshirani 1994).

In addition, the BCIs are much more appropriate than the standard confidence intervals to control and check the stability of the results with potential selection processes and omitted variables (Clougherty et al. 2016). Establishing a causal relationship by non-experimental data is challenging (Rosenbaum 1999). Even with experimental design, omitted variables or unobserved heterogeneity can always bias the estimated effects and pose a threat to the validity of the causal inference (Gormley and Matsa 2014). Using a collection of non-randomly selected sentencing documents to posit the causal relationship between monetary compensation and sentencing outcomes and rule out alternative explanations would be extremely difficult, if not entirely impossible. Although it is hard to know the true confidence intervals for our key variable *compensation*, the empirical BCIs provide a more robust statistical inference than regular model-based confidence intervals (Fox 2002).

Results

Descriptive Analyses

Table 1 provides descriptive statistics for the variables included in the study. In the full data, the length of fixed-term imprisonment for criminal traffic offenses ranges from

Table 1 Descriptive statistics for the variables included in the study

Variable	All Mean (SD)	Sentence length ≤ 36 m Mean (SD)	Sentence length > 36 m Mean (SD)
Sentence length	17.86 (11.54)	16.51 (9.36)	50.9 (10.69)
Probation	0.81 (0.39)	0.84 (0.37)	–
Compensation	0.77 (0.42)	0.79 (0.41)	0.36 (0.48)
# of deaths	0.98 (0.46)	0.96 (0.40)	1.46 (1.15)
# of seriously injured	0.10 (0.31)	0.10 (0.31)	0.14 (0.42)
# of lightly injured	0.07 (0.39)	0.07 (0.36)	0.18 (0.85)
Escaped	0.19 (0.39)	0.16 (0.37)	0.74 (0.44)
DUI	0.11 (0.31)	0.11 (0.31)	0.18 (0.38)
Overloaded	0.03 (0.18)	0.03 (0.18)	0.05 (0.21)
No license	0.14 (0.35)	0.14 (0.34)	0.26 (0.44)
Full responsibility	0.60 (0.49)	0.60 (0.49)	0.75 (0.43)
Turn-self-in	0.52 (0.50)	0.52 (0.50)	0.46 (0.50)
Forgiveness	0.76 (0.43)	0.79 (0.41)	0.12 (0.33)
Confessed	0.28 (0.45)	0.28 (0.45)	0.32 (0.47)
Insurance	0.28 (0.45)	0.27 (0.44)	0.36 (0.48)
Remorse	0.24 (0.43)	0.25 (0.43)	0.11 (0.31)
Lawyer	0.28 (0.45)	0.28 (0.45)	0.50 (0.50)
Year 2014	0.33 (0.47)	0.33 (0.47)	0.32 (0.47)
2015	0.32 (0.47)	0.32 (0.47)	0.32 (0.46)
2016	0.35 (0.48)	0.34 (0.48)	0.36 (0.48)
Urbanity	0.58 (0.49)	0.57 (0.49)	0.64 (0.48)
Region North	0.08 (0.27)	0.08 (0.27)	0.08 (0.27)
West	0.22 (0.41)	0.22 (0.41)	0.20 (0.40)
Middle	0.26 (0.44)	0.26 (0.44)	0.23 (0.42)
East	0.44 (0.50)	0.44 (0.50)	0.49 (0.50)
N	141,689	136,143	5546

6 months to 144 months (12 years), with a mean of 18 months. As high as 81% of defendants received probation, which is consistent with findings reported in other studies, e.g., 91.7% among 139 cases (Cai 2015), 83% in aggregated national data from 2014 to 2015 (Bai 2016), and 78% on average for certain offenses (Zhao 2017). In most of the cases (77%), the defendants compensated the victims, even those who were not eligible for probation (36%). Compared to the defendants who were not eligible for probation (i.e., those with a sentence length greater than 36 months), the consequences of the crimes conducted by those receiving less than 36 months imprisonment were less serious, for example, they had a lower average number of deaths (.96 vs. 1.46), seriously injured (.10 vs. .14), and lightly injured (.07 vs. .18). Similar patterns can be found in other related traffic accident legal factors, as those who received less than 36 months imprisonment showed: lower rate of escaped (.16 vs. .74), DUI (.11 vs. .18), driving without a valid license (.14 vs. .26), and taking full responsibility (.60 vs. .75). While for the measures of regular discretionary circumstances, the defendants who were eligible for probation reported a higher rate of turn-self-in (.52 vs. .46), obtaining forgiveness (.79 vs. .12), and showing remorse (.25 vs. .11), but lower rates of insured (.17 vs. .36), and having a lawyer (.28 vs. .50).

Effect of Monetary Compensation on Sentencing Outcomes

To investigate the effect of compensation on sentencing outcomes, we followed a joint model approach using both the length of sentence and probation as outcomes (Guo and Carlin 2004; Cai et al. 2018b). Reported in Table 2, the coefficients were estimated from the whole sample, whereas the confidence intervals were obtained from the empirical distribution of the bootstrapped replicates. For all defendants, monetary compensation was slightly negatively associated with the sentence length. For example, the log of expected months of sentence was anticipated to be −0.05 units lower for those who compensated victims compared to those did not, holding the other variables constant in the model. In other words, adjusting for other covariates in the model, the ratio of the expected months of sentence for defendants who compensated victims versus those who did not was .95 (exp(−.05)). The number(s) of deaths, fled from the scene, driving under the influence, no valid license, and taking full responsibility were associated with a longer length of sentence; while turn-self-in, and obtaining forgiveness were negatively correlated to the length of sentence. Having a lawyer was also positively correlated to the length of sentence, which is probably due to the fact that defendants who are involved in severe cases are more likely to hire a lawyer. Likewise, compensation, remorse and forgiveness strongly increased the chances of receiving a probation. For instance, providing compensation increased the odds of being granted a probation by 132% (exp(.84)–1), holding other covariates in the model as constant. All other legal factors, such as the number of deaths, seriously injured, escaped, driving under the influence or without valid license, taking full responsibility, and having a lawyer were negatively associated with the chance of probation.

To further elaborate on the mechanisms of compensation, we broke down the entire sample by eligibility for probation. For those receiving no more than 36 months imprisonment, consistent to the previous findings and the regulations outlined in the judicial interpretations, the effects of number of deaths and seriously injured, fleeing the accident, driving without a valid license, and taking full responsibility were positively correlated in predicting the length of a sentence; conversely, turn-self-in and obtaining forgiveness were negatively correlated to the sentence length. Similarly, the number of seriously injured, driving under the influence or without a valid license reduced the likelihood of receiving a probation, while obtaining forgiveness and showing remorse increased the likelihood.

As we expected, the chance of probation increased when monetary compensation was provided; the direct effect of monetary compensation on the sentence length was not significant. Interestingly, probation was associated with a longer length of imprisonment. One possible reason is that since the actual imprisonment is not executed if a probated defendant does not violate any of the regulations during the probation period, the sentence length only has symbolic meaning for both the defendant and the judge—it simply must be within 36 months. Another interpretation is that in order to be eligible for a probation, the length of sentence has to be compressed into the eligible range, which results in a disproportionately large amount of cases being given a 36-month sentence. Therefore, the length of sentence for those cases that would receive more than 36 months if probation were not offered become clustered exactly at the 36-month point, which causes the “heaping” or “inflation” phenomenon.

For those receiving more than 36 months imprisonment, legal factors such as the number of deaths, driving under the influence, taking full responsibility, and obtaining forgiveness were associated with the sentence length in the expected ways, however, except for the number of deaths, none of these factors were robust when evaluated by BCIs.

Table 2 Results of the joint model for the sentencing outcomes by eligibility of probation

Parameter	All		Sentence length ≤ 36 m		Sentence length > 36 m
	Sentence length	Probation	Sentence length	Probation	Sentence length
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
Intercept	2.50 [2.24, 2.61]***#	0.59 [−0.16, 0.85]***	2.16 [2.03, 2.27]***#	0.27 [−0.46, 0.62]***	3.75 [3.50, 3.90]***#
Probation	−0.09 [−0.13, 0.00]***#	–	0.06 [0.02, 0.13]***#	–	–
Compensation	−0.05 [−0.10, −0.01]***#	0.84 [0.53, 0.99]***#	−0.04 [−0.08, 0.00]***	0.78 [0.49, 0.99]***#	−0.02 [−0.12, 0.05]***
# of deaths	0.26 [0.18, 0.46]***#	−0.61 [−0.86, −0.38]***#	0.40 [0.30, 0.50]***#	−0.16 [−0.51, 0.13]***	0.06 [0.03, 0.14]***#
# of seriously injured	0.02 [−0.03, 0.19]***	−0.87 [−1.14, −0.37]***#	0.13 [0.04, 0.24]***#	−0.64 [−1.03, −0.19]***#	0.02 [−0.08, 0.13]***
# of lightly injured	0.03 [−0.14, 0.09]***	−0.25 [−0.44, 0.19]***	0.04 [−0.01, 0.09]***	−0.21 [−0.40, 0.22]***	0.00 [−0.06, 0.05]+
Escaped	0.79 [0.76, 0.84]***#	−0.70 [−1.19, −0.63]***#	0.76 [0.72, 0.79]***#	−0.18 [−0.68, −0.04]***#	0.06 [−0.05, 0.18]***
DUI	0.06 [0.00, 0.11]***#	−0.76 [−0.85, −0.22]***#	0.06 [−0.01, 0.09]***	−0.73 [−0.83, −0.20]***#	0.04 [−0.06, 0.14]***
Overloaded	0.04 [−0.08, 0.16]***	−0.49 [−0.97, 0.24]***	0.01 [−0.06, 0.13]***	−0.44 [−0.88, 0.36]***	0.01 [−0.24, 0.16]+
No license	0.06 [0.02, 0.11]***#	−0.67 [−0.97, −0.38]***#	0.08 [0.02, 0.11]***#	−0.60 [−0.93, −0.29]***#	0.00 [−0.09, 0.08]+
Full responsibility	0.16 [0.12, 0.19]***#	−0.23 [−0.45, −0.01]***#	0.17 [0.12, 0.19]***#	−0.19 [−0.42, 0.04]***	0.06 [−0.04, 0.14]***
Turn-self-in	−0.10 [−0.14, −0.07]***#	−0.06 [−0.22, 0.26]***	−0.09 [−0.13, −0.06]***#	−0.13 [−0.34, 0.18]***	−0.03 [−0.10, 0.05]***
Forgiveness	−0.14 [−0.20, −0.10]***#	2.57 [2.28, 2.77]***#	−0.11 [−0.15, −0.06]***#	2.40 [2.09, 2.61]***#	−0.07 [−0.19, 0.09]***
Confessed	0.02 [−0.01, 0.07]***	−0.10 [−0.42, 0.09]***	0.02 [0.00, 0.07]***#	−0.08 [−0.42, 0.12]***	0.01 [−0.07, 0.11]+
Insurance	0.00 [−0.04, 0.04]***	−0.23 [−0.51, −0.01]***#	−0.01 [−0.04, 0.03]***	−0.21 [−0.52, 0.01]***	0.01 [−0.07, 0.09]**
Remorse	−0.02 [−0.06, 0.02]***	1.32 [0.91, 1.66]***#	−0.01 [−0.06, 0.01]***	1.34 [0.96, 1.74]***#	0.01 [−0.15, 0.14]+
Lawyer	0.06 [0.02, 0.10]***#	−0.78 [−0.96, −0.44]***#	0.05 [0.03, 0.10]***#	−0.77 [−0.97, −0.43]***#	−0.01 [−0.09, 0.08]+
Year 2014	0.00 [−0.04, 0.05]+	0.36 [0.05, 0.62]***#	0.01 [−0.02, 0.06]***	0.35 [0.03, 0.62]***#	0.00 [−0.08, 0.12]+
2015	−0.01 [−0.05, 0.04]***	0.27 [0.01, 0.60]***#	0.00 [−0.04, 0.04]*	0.26 [−0.02, 0.58]***	0.01 [−0.07, 0.11]**
2016		−0.36 [−0.58, −0.07]***#		−0.34 [−0.57, −0.04]***#	
Urbanicity	−0.01 [−0.03, 0.04]***		0.00 [−0.03, 0.04]+		0.00 [−0.06, 0.10]+
Region North	0.09 [−0.01, 0.11]**	0.68 [0.57, 1.40]***#	0.05 [−0.01, 0.10]+	0.72 [0.58, 1.48]***#	0.07 [−0.05, 0.23]**
West	0.05 [0.00, 0.07]*	0.31 [0.35, 0.90]***#	0.04 [0.00, 0.08]+#	0.33 [0.35, 0.94]***#	−0.02 [−0.09, 0.07]+
Middle	−0.01 [−0.06, 0.04]+	−0.09 [−0.13, 0.50]***	0.00 [−0.06, 0.04]+	−0.11 [−0.17, 0.48]***	0.01 [−0.10, 0.13]+

Table 2 (continued)

Parameter	All		Sentence length ≤ 36 m		Sentence length > 36 m
	Sentence length	Probation	Sentence length	Probation	Sentence length
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
East	–	–	–	–	–
σ	.05***		.05***		.04***
− 2LL	1,123,171.67		1,005,237.19		41,285.77
AIC	1,123,263.67		1,005,329.19		41,331.77
BIC	1,123,329.63		1,005,395.16		41,364.75
N	141,689		136,143		5,5456

Coefficients were estimated from the whole sample, while BCIs were obtained from 1000 Bootstrapping replicates with size of 3100

[#]indicates the 95% BCIs do not include zero; and Model-based *p* values were indicated by: $^{+}p < .1$, $*p < .05$, $**p < .01$, $***p < .001$

Effect of Monetary Compensation on Inflations

To further evaluate the effect of monetary compensation on constricting the sentence length, we employed the ZTGIP model to examine the inflation at points 12, 24, and 36 months. Shown in Table 3, the first model included a logistic component for whether the sentence length inflated at the point of 12 months in addition to the ZIP component for the sentence length and the logistic component for probation. The significant intercept indicated a possible inflation on the value of 12 months, however, the effect of monetary compensation was not significant, and the probation was still positively associated with the sentence length (e.g., .09 in log scale). The second model with the inflation component for 24 months yielded similar results. When the value of 36 months was introduced into the inflation component of the model, the monetary compensation positively contributed to the chance of inflation (the odds of inflation increased 43%); meanwhile, the effect of probation lost its significance on the sentence length. The final model added all three inflations, and the effect of monetary compensation was only significant for the inflation at 36 months. Results from the four models all suggested that monetary compensation only contributes to the inflation at 36 months, and that the concentration at the value of 36 months is a possible reason why the probated defendant receives a longer length of sentence, even when controlling for other relevant legal factors. When comparing fit indices across the four models, the models with the inflation at 36 months were also superior to the others with better fitting indices.

Built on the results from Table 3, we argue that the effect of compensation is two-fold. First, compensation does not only make a probation-eligible case more likely to be granted a probation (.78 in the logit scale reported in Model 4) with little influence on the length of sentence (− .05 in the log scale reported in Model 4); but more importantly, compensation takes a potentially ineligible case that would have resulted in more than 36 months of imprisonment, and makes it eligible for probation by compressing the length to exactly 36 months (0.36 in the logit scale reported in Model 4).

Discussion and Conclusion

The main purpose of this study was to investigate the effect of monetary compensation on sentencing outcomes, specifically looking at probation and the sentence length for fixed-term imprisonment. Built on the restorative justice perspective, the previous literature suggested that monetary compensation paid by the defendants could reduce the sentence length (Liebman 2014), however, the effect of monetary compensation on probation was largely ignored. Drawing from three possible approaches for a more lenient punishment in the Chinese judicial system, we argued that the major role monetary compensation played in securing a lenient punishment was through probation. Specifically, we argued that compensation would directly boost the chances of being granted a probation, while the effect on the sentence length might not be perceptible. Furthermore, due to little discretion on the part of an individual judge and strict criteria for applicable punishment, to mitigate a punishment by granting a probation, the length of a sentence has to be limited to a maximum of 36 months, the upper-bound of the eligible range. Therefore, the indirect outcome of monetary compensation is the concentration of sentence terms at the value of 36 months. Our results showed that the likelihood of probation raises when monetary compensation is

Table 3 Results of the ZTGIP model for defendants receiving less than 36 months imprisonment

Parameter	Model 1: inflation at 12 m Beta [2.5th, 97.5th BCIs]	Model 2: inflation at 24 m Beta [2.5th, 97.5th BCIs]	Model 3: inflation at 36 m Beta [2.5th, 97.5th BCIs]	Model 4: all inflations Beta [2.5th, 97.5th BCIs]
Probation				
Intercept	0.27 [−0.47, 0.64]***	0.28 [−0.49, 0.66]***	0.27 [−0.47, 0.58]***	0.29 [−0.50, 0.67]***
Compensation	0.78 [0.49, 0.98]***#	0.78 [0.49, 0.98]***#	0.78 [0.50, 0.99]***#	0.78 [0.49, 0.98]***#
Inflation				
Intercept	−1.34 [−1.87, −1.16]***#			−1.30 [−1.80, −1.12]***#
Compensation	0.16 [−0.10, 0.39]***			0.20 [−0.05, 0.42]***
Intercept		−3.40 [−4.37, −2.90]***#		−3.30 [−4.09, −2.82]***#
Compensation		−0.40 [−0.80, 0.15]***		−0.28 [−0.65, 0.25]***
Intercept			−1.97 [−2.55, −1.81]***#	−1.98 [−2.56, −1.81]***#
Compensation			0.36 [0.02, 0.61]***#	0.36 [0.03, 0.61]***#
Sentence length				
Intercept	2.18 [2.04, 2.30]***#	2.12 [1.98, 2.23]***#	2.23 [2.10, 2.33]***#	2.17 [1.99, 2.31]***#
Probation	0.09 [0.05, 0.17]***#	0.07 [0.03, 0.15]***#	0.00 [−0.04, 0.06]*	0.03 [−0.03, 0.10]***
Compensation	−0.05 [−0.09, 0.00]***	−0.04 [−0.08, 0.01]***	−0.04 [−0.08, −0.01]***#	−0.05 [−0.11, −0.02]***#
σ	0.06***	0.05***	0.05***	0.08***
−2LL	944,072.30	990,464.58	869,842.45	789,172.98
AIC	944,180.30	990,572.58	869,950.45	789,312.98
BIC	944,257.73	990,650.02	870,027.89	789,413.36
N	136,089	136,089	136,089	136,089

The model parts—probation (logistic), and sentence length (ZIP) controlled intercept, #of deaths, #of heavily injured, #of light injured, Escaped, DUI, Overloaded, No license, Full responsibility, Turn-self-in, Forgiveness, Confessed, Insurance, Remorse, Lawyer, Year 2014, and 2015, Urbanicity, and Region

The inflation parts also controlled Year 2014, and 2015, Urbanicity, and Region

Coefficients were estimated from the whole sample, while BCIs were obtained from 1000 Bootstrapping replicates with size of 3100

#Indicates the 95% BCIs do not include zero; and Model-based p values were indicated by: $^{+}p < .1$, $*p < .05$, $**p < .01$, $***p < .001$

provided, and that the monetary compensation does not make a significant difference on the length of sentence for those defendants receiving less than 36 months imprisonment. When the sentence term inflation is taken into consideration, monetary compensation is only positively associated with the chance of inflation at the value of 36 months, and the probation itself becomes not significant in predicting sentence length.

Our study contributes to the current literature in several ways. First, based on prior studies, we posited how monetary compensation influenced the interdependent sentencing outcomes, and provided empirical evidence to support it. To the best of our knowledge, this is the first study that scrutinizes the effect of monetary compensation on the joint outcomes of sentencing. Judging by the results obtained from the simple models in Table 2, monetary compensation contributed little to the length of sentence, and probation was slightly negatively correlated to the length of sentence. However, what is not shown is that some of these cases would not have been included in the "36 months or less" category if monetary compensation was absent. This possible underlying cross-category movement constitutes the so-called "heaping" or "inflation" phenomenon. Although it is not possible to observe the counterfactual sentencing outcomes in the absence of monetary compensation, by investigating the concentration of various sentence length points (i.e., 12, 24, and 36), we demonstrated that as a piece of indirect evidence, the monetary compensation serves as an important influential factor for the irregular distribution of sentence length at 36 months.

Secondly, one of the difficulties of studying legal processes in China is the lack of data. In an effort to improve judicial transparency, more than 39 million sentencing documents have been made available on the CJO website. Using web crawling techniques, we showed that those publicly accessible documents could be new sources of data. As a general methodology, our study could be beneficial not only for researchers who are interested in studying legal processes in China, but for a broader scientific community in response to the "crisis of reproducibility" (Maniadis and Tufano 2017). Compared to other types of data for sentencing studies, such as official statistics, archives, in-depth interviews, surveys, etc., publicly accessible documents are traceable, verifiable, and reproducible. Although replicability is one of the vital rules of science, replication studies are rarely conducted by social scientists (Freese and Peterson 2017), and only a few journals enforce a strict data availability policy (Herndon and O'Reilly 2016). Reasons for this may include increasingly complicated study designs and barriers to accessing or sharing data (Camerer et al. 2018). As one of the ways to improve open sharing and research transparency, utilizing publicly accessible data might curtail doubts about whether the findings from social sciences research can be replicated by different teams using the same data and analytical models. For example, to replicate a published quantitative study on sentencing using survey data or in-depth interviews, the biggest obstacle is obtaining permission to access the data, which is ultimately the decision of the researchers or the third party (e.g., funding agencies) to release. In contrast, sentencing documents such as those retrieved from the CJO website, can be accessed by anyone with little cost, and with the same coding scheme and modeling strategies, the findings are reproducible.

Moreover, collecting the online sentencing documents could be a dynamic process that offers an opportunity to study any changes in the legal process as well as interactions between institutions and external stakeholders over time. For instance, after 3 years of running the CJO website, the SPC has further regulated case exemptions for uploading documents, extending exemptions to include cases involving state secrets, as well as basic information of exempted cases, such as case ID, court, date of sentencing, and more importantly, the reason of exemption, which needs to be publicized within 7 days of sentencing (SPC 2016). Therefore, a closer look at the process of implementation by the different

levels of the People's courts and the pattern of selective uploading across various types of crimes could be possible in the near future. In addition, dynamic data collection can also help researchers to accumulate longitudinal data that link cases from different trials or judges. For example, a longitudinal dataset on individual judges would allow researchers to evaluate the time-varying impact of a judge's political affiliation on sentencing by using more rigorous methods, such as difference-in-differences (Card and Krueger 1994) and randomization (Cohen and Yang 2018).

In addition, to avoid the problem of detecting effects of little scientific importance due to a large sample size, and to reduce the inevitable spuriousness resulting from using non-experimental data, we took extra caution to evaluate our results using bootstrapping techniques which provide asymptotically more accurate and robust results than the standard model-based inference using sample variance and assumptions of normality does. We found that the effects of monetary compensation on the joint outcomes are robust, even for a relatively small-to-moderate dataset size such as our 3100 observations.

Nevertheless, there are several limitations in the current study: First, the sample in the current study does not cover all criminal traffic offense cases, as only cases with the first trial were included. More importantly, selective uploading or purposeful deleting of cases on the CJO can also challenge our findings. Although the SPC of China required all levels of courts to upload sentence documents starting on January 1, 2014, several types of cases were exempted from the uploading request, such as those involving state secrets, personal privacy, juvenile offenders, disputes concluded through mediation, or other documents deemed "inappropriate" to publicize. Yet, the SPC did not require enforcement decisions or official notification of withdrawals to be posted online. We have searched all available sources (e.g., official gazettes, news reports, and research articles) but failed to find any information on the pattern of uploading or deleting. In 2016, the SPC issued a judicial interpretation to further regulate what courts should post. According to the interpretation, enforcement decisions and withdrawals are required to be uploaded (SPC 2016). However, a rough indicator of the percent of documents placed online is still not available for evaluating the issue of selective uploading or purposeful deleting.

Secondly, relying on sentencing documents may restrict a researcher's ability to investigate mechanisms of sentencing. Perhaps the most serious shortcoming is the lack of covariates. Using the retrieved sentencing documents as an example, many of the common extra-legal factors for defendants and victims, such as age, gender, and occupation, are not collected or released in full. In particular, the SPC requires that all information of litigants for cases involving disputes over marriage, family, or inheritance are anonymized while uploading, which hinders studies on gender-related issues for those cases. Failing to control for those factors imposes potential threats on the internal validity of our conclusion, although the previous findings were mixed. For example, some studies showed that ethnic minorities were less likely to receive death penalties and that gender was not a significant factor in legal decisions (Li et al. 2018; Xie and Ji 2008); while others reported that female offenders were given lenient punishments for narcotics cases (Liang et al. 2009), but not for violent crimes in China (Lu et al. 2013). However, few studies have examined the effect of extra-legal factors on criminal traffic offenses, which gives us little guidance as how to adjudge the possible effects of those extra-legal factors in our conclusion. To alleviate the potential threats, we implemented a randomized procedure— bootstrapping by sampling with replacement—to evaluate our statistical results. Being used as a way to assess the variation of the estimated model and to gauge the sensitivity of the model to various inputs (Efron and Tibshirani 1994), the procedure ensures that each of the observations has an equal chance of being included in the samples, in hopes of averaging out the effect

of known and unknown confounding variables, and forming an assumption-free basis to evaluate results (Di Ciccio and Efron 1996; Efron 2004). Even with such a strategy, we still cannot say that the potential influences of extra-legal factors on sentencing outcomes are controlled. We acknowledge that our results are subject to potential threats on the internal validity.

Third, due to a lack of well-developed software and an individually customized structure of the target website, to fit the various research needs, our process of document collection was completed with specialized programming, which poses great challenges to social scientists, sociologists, and criminologists. As stated previously, the level of complexity in collecting online documents might exceed that in the analog world (Salganik 2017). We believe the research community's response to this challenge will undoubtedly shape this entire enterprise's future development, however, there is still a need for help from other disciplines.

Furthermore, with the exception of cases with aggravating factors, the sentencing documents did not include any information regarding which level of punishment was eligible for cases with a lesser degree of legal factors. For example, if a defendant fled from the scene, consequently causing a victim's death, then the default minimum length of imprisonment would be 7 years without any mitigating factors. However, without any clearly documented aggravating factors to help ascertain the default level of punishment, the "initial charge" was unknown, as the uploaded case documents did not provide any information on the initial level of punishment. It is possible that the legal factors included in the model may not influence the outcome uniformly according to the presence or combination of some factors. We conducted additional analyses to include interactions between all the covariates and the variable *escaped*, the only aggravating factor singled out by Article 133, to see whether the effects of the legal factors on the length of sentence vary by *hit and run*. According to the bootstrapping results, the interaction effects on the variables *compensation*, *full responsibility*, *no license*, *sentencing years* (2014 and 2015), *urbanicity* and regional dummies (*North*, and *Middle*) are significant, which indicates that a longer sentence is assigned to cases where there is a coexistence of the above conditions and *hit and run*, as compared to their counterparts without *hit and run*. The discrepancies between the coefficients of the main effect only model and those of the interaction model on the main effects are not substantial, with the exception of the effect of the variable *overloaded*, signs of the two sets of coefficients are consistent; the size of the difference is not large, and the significance for each pair of the coefficients are similar. Although it is not possible to make a conclusion about all potential interactions, except for the variables listed above, it is safe to say that the legal factors included in the model might have a similar influence on the length of sentence according to the presence of *hit and run*, as it is the only aggravating factor that is singled out by Article 133. To address the effect of the unobserved offense level, we constructed a variable to measure the level of severity by assessing the combinations of the number of deaths, the number of heavily injured, the type of responsibility, whether the defendant escaped, and other aggravating factors, in accordance with the juridical interpretation issued by the SPC (SPC 2000). Consistent with our previous findings, after controlling for the level of severity, the effect of compensation is still positively correlated to the chance of probation for all cases, as well as for cases where the length of sentence was no more than 36 months. Furthermore, the variable *compensation* is only robust for the probability of inflation at 36 months.[2]

[2] Due to space limitations, full tables were not included in the main text; the full results and the code are available upon request.

In addition, we acknowledge that when using secondary data, such as sentencing documents, it is not possible to access the actual process of negotiation among the defendant, victim, and judge on what the sentence length would be with and without monetary compensation. More experimental studies are required to further explore the role of monetary compensation in the decision-making process. Therefore, our conclusions were built on incomplete information and might not be generalized to a broader population.

Albeit the limitations, we hope this study will not only help researchers to better understand the legal process in China, but that it will also benefit the larger community as an example of utilizing new sources of data.

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Appendix 1: Results for the coding agreement

Variable	% of agreement		
	3 coders	Coders to ours	Cohen's kappa
Sentence length	100	100	1.00
Probation	100	100	1.00
Compensation	100	93	0.81
# Death	100	100	1.00
# Seriously injured	100	100	1.00
# Lightly injured	100	91	0.13
Escape	100	99	0.97
DUI	100	90	0.23
Overload	100	99	0.66
No license	100	92	0.51
Full responsibility	100	100	1.00
Turn-self-in	100	94	0.85
Forgiveness	100	96	0.89
Confess	100	99	0.98
Insurance	100	95	0.87
Remorse	100	100	1.00
Lawyer	100	96	0.91

Results were based on 100 randomly selected sentencing documents

Appendix 2: SAS code for models reported in Table 2 and 3

```
/*Model 1 in Table 2*/
proc nlmixed data= traffic;
  parm a0-a21 .5 c0 1 c1-c22 .05;
  theta=a0+a1*comp_agr2+a2*ndeath+a3*nheaveinj+a4*nlightinj+a5*escape+a6*drunk+a7*overload+
        a8*nolicense+a9*_responsibility+a10*selfin+a11*forgiveness+a12*confess+a13*insurance+
        a14*penitence+a15*lawyer+a16*y1+a17*y2+a18*_city+a19*_north+a20*_west+a21*_middle;
  p1=1/(1+exp(-theta));
  l1=nprobation*log(p1)+(1-nprobation)*log(1-p1);
  lambda=exp(c0+c1*nprobation+c2*comp_agr2+c3*ndeath+c4*nheaveinj+c5*nlightinj+c6*escape+
           c7*drunk+c8*overload+c9*nolicense+c10*_responsibility+c11*selfin+c12*forgiveness+
           c13*confess+c14*insurance+c15*penitence+c16*lawyer+c17*y1+c18*y2+c19*_city+
           c20*_north+c21*_west+c22*_middle);
  l2=senlength*log(lambda)-lambda-log(1-exp(-lambda))-lgamma(senlength+1);
  ll=l1+l2;
  dummy=1;
  model dummy ~ general(ll);
run;

/*Model 4 in Table 3*/
proc nlmixed data=_traffic;
  parm a0-a21 .5 b01-b03 -2 b11-b13 b21-b23 b31-b33 b41-b43 b51-b53 .3  c0 1 c1-c22 .05;
  where _length=1;
  theta=a0+a1*comp_agr2+a2*ndeath+a3*nheaveinj+a4*nlightinj+a5*escape+a6*drunk+a7*overload+
        a8*nolicense+a9*_responsibility+a10*selfin+a11*forgiveness+a12*confess+a13*insurance+
        a14*penitence+a15*lawyer+a16*y1+a17*y2+a18*_city+a19*_north+a20*_west+a21*_middle;
  pp=1/(1+exp(-theta));
  l1=nprobation*log(pp)+(1-nprobation)*log(1-pp);
  mu1=b01+b11*comp_agr2+b21*_city+b31*_north+b41*_west+b51*_middle;
  mu2=b02+b12*comp_agr2+b22*_city+b32*_north+b42*_west+b52*_middle;
  mu3=b03+b13*comp_agr2+b23*_city+b33*_north+b43*_west+b53*_middle;
  p1=1/(1+exp(-mu1));
  p2=1/(1+exp(-mu2));
  p3=1/(1+exp(-mu3));
  lambda=exp(c0+c1*nprobation+c2*comp_agr2+c3*ndeath+c4*nheaveinj+c5*nlightinj+c6*escape+
           c7*drunk+c8*overload+c9*nolicense+c10*_responsibility+c11*selfin+c12*forgiveness+
           c13*confess+c14*insurance+c15*penitence+c16*lawyer+c17*y1+c18*y2+c19*_city+
           c20*_north+c21*_west+c22*_middle);
  if senlength=12 then l2=log(p1+(1-p1-p2-p3)*exp(senlength*log(lambda)-lambda-log(1-exp(-
lambda))-lgamma(senlength+1)));
  else if senlength=24 then l2=log(p2+(1-p1-p2-p3)*exp(senlength*log(lambda)-lambda-log(1-exp(-
lambda))-lgamma(senlength+1)));
  else if senlength=36 then l2=log(p3+(1-p1-p2-p3)*exp(senlength*log(lambda)-lambda-log(1-exp(-
lambda))-lgamma(senlength+1)));
  else l2=log(1-p1-p2-p3)+senlength*log(lambda)-lambda-log(1-exp(-lambda))-lgamma(senlength+1);
  ll=l1+l2;
  dummy=1;
  model dummy ~ general(ll);
run;
```

Appendix 3

To address the effect of the unobserved offense level, we constructed a variable to measure the level of severity by the combinations of the number of deaths, the number of heavily injured, the type of responsibility, whether the defendant escaped, and other aggravating factors, according to the juridical interpretation issued by the SPC (2000). To avoid the problem of multicollinearity, we excluded the variables that were used to construct the level of severity in the models.

Consistent with our previous findings, after controlling for the level of severity, the effect of compensation is still positively correlated to the change of probation for all cases, and cases where the length of sentence was less than 36 months (marked in

yellow below). Furthermore, the variable *Compensation* is only robust for the probability of inflation at 36 months.

Coding scheme for variable severity according to the juridical interpretation (SPC 2000).

	# of deaths	# of heavily injured	Responsibility	Escaped	Aggravating factors, e.g., DUI, no license.
Level 1	0	1–2	Full or major	Yes	
	1		Full or major	No	No
	0	3–4	Full or major	No	
	3–5		Equal	No	
Level 2	0	1–2	Full or major	Yes	Yes
	1		Full or major	Yes	
	0	3–4	Full or major	Yes	
	3–5		Equal	Yes	
	> = 2		Full or major		
	0	> = 5	Full or major		
	> = 6		Equal		
Level 3				Caused death	

Results using variable severity for the models presented in Table 2.

Parameter	All		Sentence length ≤ 36 m		Sentence length > 36 m
	Sentence length	Probation	Sentence length	Probation	Sentence length
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
Intercept	3.75 [3.67, 3.79]***#	−1.19 [−2.07, −1.15]***#	3.53 [3.44, 3.57]***#	−0.41 [−1.34, −0.30]***#	3.92 [3.77, 4.01]***#
Probation	−0.09 [−0.13, −0.03]***#		0.04 [0.00, 0.10]***		
Compensation	−0.05 [−0.09, −0.01]***#	0.83 [0.51, 0.98]***#	−0.03 [−0.08, −0.01]***#	0.78 [0.48, 0.97]***#	−0.02 [−0.10, 0.07]***
Severity	−0.94 [−0.97, −0.91]***#	0.85 [0.78, 1.27]***#	−0.87 [−0.89, −0.84]***#	0.21 [0.04, 0.67]***#	−0.01 [−0.21, 0.25]+
Turn-self-in	−0.09 [−0.13, −0.07]***#	−0.05 [−0.23, 0.26]***	−0.09 [−0.12, −0.06]***#	−0.12 [−0.33, 0.18]***	−0.02 [−0.10, 0.06]***
Forgiveness	−0.16 [−0.19, −0.10]***#	2.58 [2.28, 2.76]***#	−0.12 [−0.15, −0.06]***#	2.39 [2.09, 2.59]***#	−0.06 [−0.17, 0.11]***
Confessed	0.02 [0.00, 0.07]***#	−0.20 [−0.50, 0.00]***#	0.02 [0.00, 0.06]***#	−0.19 [−0.52, 0.03]***	0.01 [−0.07, 0.11]***
Insurance	0.00 [−0.03, 0.03]**	−0.21 [−0.48, 0.01]***	−0.01 [−0.04, 0.02]***	−0.18 [−0.48, 0.05]***	0.01 [−0.06, 0.10]***
Remorse	−0.01 [−0.05, 0.02]***	1.26 [0.87, 1.61]***#	−0.01 [−0.05, 0.02]***	1.29 [0.92, 1.70]***#	0.01 [−0.16, 0.12]+
Lawyer	0.03 [0.00, 0.07]***#	−0.79 [−0.96, −0.46]***#	0.04 [0.01, 0.08]***#	−0.79 [−0.97, −0.44]***#	0.00 [−0.08, 0.09]+
Year 2014	0.01 [−0.02, 0.06]***	0.27 [−0.02, 0.53]***	0.01 [−0.02, 0.05]***	0.26 [−0.05, 0.55]***	0.01 [−0.06, 0.13]***

Parameter	All		Sentence length ≤ 36 m		Sentence length > 36 m
	Sentence length	Probation	Sentence length	Probation	Sentence length
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
2015	0.00 [−0.03, 0.04]$^{+}$	0.19 [−0.04, 0.53]***	0.00 [−0.03, 0.04]$^{+}$	0.19 [−0.08, 0.52]***	0.02 [−0.06, 0.12]***
2016					
Urbanity	0.00 [−0.02, 0.04]$^{+}$	−0.31 [−0.52, −0.03]***$^{\#}$	0.00 [−0.03, 0.03]$^{+}$	−0.31 [−0.51, 0.00]***$^{\#}$	0.00 [−0.07, 0.10]$^{+}$
Region North	0.06 [0.01, 0.11]*$^{\#}$	0.58 [0.45, 1.30]***$^{\#}$	0.05 [0.00, 0.10]$^{+}$	0.62 [0.48, 1.38]***$^{\#}$	0.07 [−0.05, 0.23]**
West	0.04 [0.01, 0.08]*$^{\#}$	0.25 [0.31, 0.84]***$^{\#}$	0.05 [0.01, 0.08]**$^{\#}$	0.28 [0.32, 0.88]***$^{\#}$	0.00 [−0.09, 0.10]$^{+}$
Middle	−0.01 [−0.05, 0.04]$^{+}$	−0.12 [−0.14, 0.47]***	−0.01 [−0.05, 0.03]$^{+}$	−0.13 [−0.20, 0.46]***	0.02 [−0.09, 0.15]$^{+}$
East					
Sigma	0.05***		.05***		0.04***

Coefficients were estimated from the whole sample, while BCIs were obtained from 1000 bootstrapping replicates with a size of 3100

*Indicates the 95% BCIs do not include zero

Results using variable severity for the models presented in Table 3.

Parameter	Model 1: inflation at 12 m	Model 2: inflation at 24 m	Model 3: inflation at 36 m	Model 4: all inflations
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
Probation				
Intercept	−0.41 [−1.31, −0.30]***$^{\#}$	−0.41 [−1.38, −0.34]***$^{\#}$	−0.41 [−1.29, −0.31]***$^{\#}$	−0.41 [−1.29, −0.31]***$^{\#}$
Compensation	0.78 [0.48, 0.96]***$^{\#}$	0.78 [0.48, 0.96]***$^{\#}$	0.78 [0.47, 0.96]***$^{\#}$	0.78 [0.47, 0.96]***$^{\#}$
Inflation				
Intercept	−1.39 [−1.95, −1.20]***$^{\#}$			−1.33 [−1.85, −1.15]***$^{\#}$
Compensation	0.16 [−0.12, 0.40]***			0.20 [−0.05, 0.43]***
Intercept		−3.18 [−4.08, −2.75]***$^{\#}$		−3.24 [−4.10, −2.81]***$^{\#}$
Compensation		−0.41 [−0.75, 0.12]***		−0.38 [−0.71, 0.15]***
Intercept			−1.99 [−2.55, −1.81]***$^{\#}$	−2.01 [−2.58, −1.82]***$^{\#}$
Compensation			0.37 [0.04, 0.62]***$^{\#}$	0.39 [0.05, 0.65]***$^{\#}$
Sentence length				
Intercept	3.55 [3.46, 3.61]***$^{\#}$	3.53 [3.44, 3.58]***$^{\#}$	3.25 [3.12, 3.30]***$^{\#}$	3.34 [3.18, 3.41]***$^{\#}$

Parameter	Model 1: inflation at 12 m	Model 2: inflation at 24 m	Model 3: inflation at 36 m	Model 4: all inflations
	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]	Beta [2.5th, 97.5th BCIs]
Probation	0.06 [0.02, 0.13]***#	0.06 [0.00, 0.11]***#	−0.02 [−0.06, 0.04]***	0.01 [−0.05, 0.07]**
Compensation	−0.04 [−0.09, −0.01]***#	−0.03 [−0.08, −0.01]***#	−0.04 [−0.08, −0.01]***#	−0.05 [−0.11, −0.01]***#
sigma	0.06***	0.04***	0.05***	0.07***

Coefficients were estimated from the whole sample, while BCIs were obtained from 1000 bootstrapping replicates with a size of 3100

*Indicates the 95% BCIs do not include zero

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