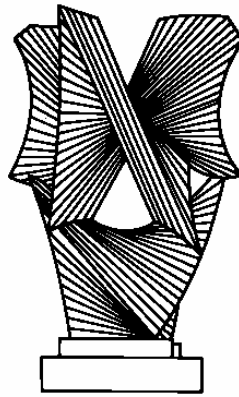


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Optimal Bail and the Value of Freedom: Evidence from the Philadelphia Bail Experiment

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Optimal Bail and the Value of Freedom: Evidence from the Philadelphia Bail Experiment

David S. Abrams and Chris Rohlfs*

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Abstract

This paper performs a cost-benefit analysis to determine socially optimal bail levels that balance the costs to defendants against the costs to other members of society. We consider jailing costs, the cost of lost freedom to incarcerated defendants, and the social costs of flight and new crimes committed by released defendants. We estimate the effects of bail amounts on the fraction of defendants posting bail, fleeing, and committing crimes during pre-trial release, using data from a randomized experiment. We also use defendants' bail posting decisions to measure their subjective values of freedom. We find that the typical defendant in our sample would be willing to pay roughly \$1,000 for 90 days of freedom. We find that judges set bail amounts close to optimum levels even in the absence of bail guidelines.

JEL Classifications: J17, J19, K14, K42

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On a typical day in the United States, roughly 300,000 untried defendants are incarcerated and 700,000 are free on bail.¹ While the tradeoffs a judge must consider when setting bail are well-recognized, little is known about optimal bail policy. Our objective is to provide a rigorous framework for understanding bail policy and to estimate socially optimal levels of bail. The objectives of this study are to provide a rigorous framework for understanding bail policy, to estimate socially optimal levels of bail, and to contribute to the literature on policy evaluation by exploring the welfare implications of one specific publicly-provided good with externalities (freedom from jail) that has measurable costs and benefits.

Following Landes (1973, 1974), we explicitly model the process of bail setting as a welfare maximization problem in which an optimal social planner would seek to minimize the total cost incurred by society. The four costs that enter the planner's problem are the social cost of jailing the defendant, the private cost to the defendant from being incarcerated, the cost of crimes a defendant may commit while awaiting trial, and the cost to society of a criminal absconding. An increase in bail levels would lead to higher numbers of defendants who could not afford to post bail and would have to remain in jail until their trials. Detaining these additional individuals would impose costs on the justice system (who must feed, house, and monitor the incarcerated defendants) and also on the defendants, who would suffer from lost freedom. A decrease in bail levels would increase the number of defendants who could afford to post bail. The justice system and potential victims would then face the risks of these defendants possibly absconding and/or committing new crimes.

¹ Sources and calculations described in Table 1 and in the web appendix.

The current study examines how to optimally balance these various consequences of changing the level of bail. First, we empirically estimate the effects of bail levels on the fraction of defendants posting, fleeing, and committing crimes during pre-trial release. Next, we assemble estimates of the per-unit costs associated with each of these pre-trial outcomes. We then combine these per-unit costs with our estimated causal relationships to measure the total cost incurred by society as a causal function of bail levels. Finally, using our estimates, we calculate optimal bail levels for different types of defendants, and we make recommendations for social welfare maximizing bail policies.

Ordinary least squares estimates of the effects of bail are likely to suffer from omitted variables bias. For example, judges assign higher bail levels to defendants deemed as “dangerous” in ways that may be unobservable to the econometrician. These defendants will also be more likely to commit subsequent crimes or to abscond. The omission of the “dangerous” variable will cause ordinary least squares to understate the effects of bail on flight and rearrest risk.

We address this concern by using data from the 1981 Philadelphia Bail Experiment (Goldkamp and Gottfredson, 1982). In this experiment, judges randomly assigned to the treatment group were given bail guidelines to use, while members of the control group set bail as they had previously. The bail guidelines caused the treatment judges to set considerably lower levels of bail than those set by the control group. Since defendants were randomly assigned to judges, the experiment induced exogenous variation in the bail levels faced by defendants. This experiment allows us to obtain unbiased estimates of the effects of bail on posting, failure-to-appear at trial, and rearrests.

In addition to estimating optimal bail policies, this study contributes to the economics of crime literature by estimating the value that defendants place on 90 days of freedom. This parameter is a necessary input into our estimates of the socially optimal bail and is of interest in its own right. This utility cost associated with incarceration is typically ignored in cost-benefit studies of crime (*e.g.*, Bierie, 2007; Levitt, 1996; Lochner and Moretti, 2004; Miller, Cohen, and Wiersema, 1996). To calculate the value to defendants of lost freedom, we apply the concept of revealed preference to defendants' bail posting decisions. If a defendant posts bail at a given level, we infer that his value of freedom exceeds the cost of posting that amount. Using a discrete choice framework, we construct a measure of the latent variable – the value of freedom – that motivates defendants' bail posting decisions.

After estimating the effect of bail on the probability of defendants posting, fleeing, and committing crimes during pre-trial release, we multiply these effects by the costs associated with the outcomes. We estimate the cost of detention to the defendant using the revealed preference approach described above. We use estimates from the literature of the cost to the justice system of incarceration and the cost of crime to victims, and we use expert estimates for the cost of apprehending an absconding defendant. Given our estimates of the total cost to society at each level of bail, we use a numerical optimization algorithm to solve for socially optimal bail levels for different types of defendants.

While imprecise, our estimates suggest that optimal levels of bail are similar to the levels set by the judges in our dataset in the absence of guidelines. Due to the structure of the experiment, our sample is restricted to defendants who were flight or

rearrest risks or were accused of serious crimes. Among these defendants, we estimate an elasticity of posting with respect to bail of -0.3. We find that the typical defendant in our sample has a willingness to pay of roughly \$1,000 (measured in 2003 dollars) for 90 days of freedom. This seemingly low estimate may result in part because they pertain to a particularly poor segment of the population. Credit constraints may also affect the estimate.²

For the typical defendant, we estimate optimal bail to be roughly \$17,700, which is close to the average bail observed in the data (\$19,000) and more than twice the average levels recommended by the guidelines in the bail experiment (\$6,380). For defendants with low, medium, and high levels of dangerousness, we estimate subjective values of freedom of \$6,800, \$800, and \$980; however the estimate for the first group is very imprecise. For these same three categories, our optimal bail estimates, while imprecise, are \$12,300, \$15,800, and infinity (*i.e.*, certain detention), respectively.

The rest of the paper is structured as follows. In Section II, we discuss some background on the institution of bail. Section III contains a model of optimal bail. In Section IV, we describe the data from the Philadelphia Bail Experiment. We describe the econometric methods that we use in Section V. Section VI details our main empirical results. Section VII concludes.

II. Background

Bail policy as it is commonly applied in the United States derives from English common law. The historical purpose of bail was to allow potentially innocent defendants to go free, but to provide monetary incentives for them to appear at their trials. In the

² These considerations are discussed in detail in the web appendix.

early to mid-20th century, however, a number of criminologists criticized the bail system for being arbitrary and unfair (Beeley, 1927; Foote, 1954). To address these concerns, researchers have studied ways of making bail more fair and systematic, such as accounting for defendant community ties in the Manhattan Bail Project (Ares, Rankin, and Sturz, 1963), judicial guidelines (Goldkamp and Gottfredson, 1982) and using economic modeling and empirical estimation of the costs and benefits of changing bail levels (Landes, 1973, 1974; Myers, 1981).

We attempt to build upon the previous economic studies in three ways. First, we use experimental data to disentangle the effects of bail policy from confounding factors such as the degree to which defendants appear dangerous. Second, we use data on the decision to post bail to estimate defendants' private valuations of being free before their trials. Third, we perform cost-benefit analysis in a more explicit way than has been done before, and we directly estimate the welfare-maximizing bail levels for different types of defendants.

Most of the previous work on the effects of bail-setting has used multivariate regression approaches (*e.g.*, Clarke, Freeman, and Koch, 1976; Landes, 1974). Fagan and Guggenheim (1996) use quasi-experimental evidence in examining the effects of rulings during the 1980s that expanded the use of pre-trial detention, particularly for juveniles. They find that the rulings generated the positive effect of reducing the number of rearrests, but that the ruling also led to large numbers of "false positives," defendants who were detained even though they posed little risk to society. A pair of recent, related studies use matching and quasi-experimental techniques to estimate the impact of policies to capture fugitive defendants (Helland and Tabarrok, 2004; Miles, 2005). Other recent

work includes experimental and quasi-experimental evidence on the effects of detention policies on recidivism (Bierie, 2007; Chen and Shapiro, 2007; Kuziemko, 2006).³

Table 1 presents some general features about bail in the United States. In mid-year 2000, roughly 2.1 million persons were incarcerated in America. Of those, we estimate that 300,000 had not yet been tried and were potentially innocent. At the same time, we estimate that roughly 700,000 felony defendants were free and awaiting trial. The average bail amount was nearly 10 times higher among defendants who were detained (\$59,700) than among defendants who were released (\$6,200). The statistics shown in Table 1 illustrate the tradeoffs between the costs and benefits of bail. On average, defendants who were released on bail are considerably less likely to be eventually sentenced than were defendants who were detained. Among those detained, roughly 64% were eventually sentenced to jail or prison. Among those released, only 25% were eventually sentenced. Hence, of the 1 million people awaiting trial, about 600,000 never received a jail or prison sentence, although roughly 100,000 of those people had been detained. Of the remaining 400,000 who were eventually sentenced, about half were free until their trials. Crime and flight are not uncommon among released defendants. In 16% of cases, released defendants were rearrested for other crimes during the pre-trial period. Moreover, roughly 22% failed to appear for at least one scheduled court appearance.

Because this study uses data from Philadelphia, it is helpful to establish some key features about bail in that city. Bail procedure in Philadelphia is similar to that in many large cities. Bail hearings typically occur within 24 hours of arrest, usually earlier. The

³ We provide further discussion of previous research on bail and related topics, as well as more background on the Philadelphia Bail Experiment in the web appendix.

hearings typically last a few minutes and include brief arguments and recommendations by the prosecutor and the defense attorney before the judge decides upon an amount (Goldkamp, 1984). In order to be freed, defendants were required to deposit 10% of the bail amount.

Bail bondsmen were illegal in Philadelphia during the time of the experiment; thus, defendants had to pay the bail amount themselves or borrow funds from friends or relatives. If they did pay bail, defendants were free until trial, unless they violated bail by failing to appear for scheduled court appearances or by being arrested for new crimes. Defendants not posting bail remained in jail until trial, an average of 90 days after arrest. Defendants could post bail at any time, but most did so within a few days of arrest.⁴ Following the completion of the trial, the 10% deposit was returned to defendants minus a 3% administrative fee, for a net of 7% of the original bail amount. The 3% was charged to all defendants regardless of the outcome of the trial. Defendants who violated the terms of release were liable for 100% of bail; however, the court was typically only able to extract a fraction of that amount.

III. Conceptual Framework

In this section, we develop a conceptual framework for estimating optimal bail amounts. First we consider the costs of bail and pre-trial detention to the defendant. Second, we consider the costs of bail to the justice system and to society at large. Finally, we model the bail-setting decision of a social planner who wishes to minimize total costs.

⁴ Defendants could petition for bail reductions. One limitation of the current analysis is that the data only include the initially assigned bail levels and do not include measures of bail reductions. We examine this issue in greater detail in the web appendix, and we find suggestive evidence that the bias caused by bail reductions is not large.

A. Costs to Defendants and the Value of Freedom

Consider a one-period model in which defendant i 's utility depends on consumption c_i and freedom f_i :

$$(1) \quad u_i = u_i(c_i, f_i)$$

Define $f_i = 1$ and $f_i = 0$ to be the levels of freedom under the cases of pre-trial release and detention, respectively. All defendants are endowed with initial wealth w_i and freedom $f_i = 0$. Wealth may be used for consumption or for payment of bail. Each defendant has the right to not post bail and to remain in jail, consuming w_i . In addition, each defendant is assigned a bail amount, $bail_i$. A defendant who posts bail can be free for the period until the trial, so that $f_i = 1$. A defendant who does not post bail is detained until trial, so $f_i = 0$.

To post bail, the defendant must pay 10% of the bail amount to the court. Once the trial is over, 7% of the bail amount is returned to the defendant. The total cost of posting bail is the permanent loss of 3% of $bail_i$ plus the temporary loss of 7% of $bail_i$ for 90 days. For this study, we assume a 90-day discount rate of 0.10, giving a discounted present cost of posting bail of $0.037 * bail_i$.⁵ The defendant posts if the following condition holds:

$$(2) \quad u_i(w_i - 0.037 * bail_i, 1) \geq u_i(w_i, 0)$$

Let V_i be the discounted value of bail at which i would be indifferent to posting. That is:

$$(3) \quad u_i(w_i - V_i, 1) = u_i(w_i, 0)$$

By revealed preference, defendant i chooses release if and only if:

⁵ This 10% discount rate is taken from the typical interest rate charged for bail bond services in the U.S. We explore the sensitivity of our results to this assumption in the web appendix.

$$(4) \quad V_i \geq 0.037 * bail_i$$

V_i represents the lump sum that defendant i would regard as equivalent to the freedom lost in detention, which we refer to as the value of freedom. The value of freedom modeled here includes all the costs and benefits of release, including the option to flee or commit new crimes. It is this composite measure that is relevant for cost-benefit analysis.

Let $Post_i$ be a dummy variable for whether the defendant chooses release or not. Many other factors such as family ties, probability of conviction, wealth, income, or employment may also be correlated with V_i . Some of these determinants of the value of freedom are observable to the social planner, and some are not. Hence, conditional on $bail_i$ and defendant characteristics \mathbf{X}_i , both $Post_i$ and V_i are random variables. Let $P^{Post}(bail_i, \mathbf{X}_i)$ be the probability that a defendant with characteristics \mathbf{X}_i chooses to post at the bail level $bail_i$. In the case of release, the total cost imposed on the defendant is $0.037 * bail_i$. In the case of detention, the cost to the defendant is V_i . Putting these together, the expected cost associated with bail amount $bail_i$ can be expressed as:

$$(5) \quad E[C_i^{Defendant} | bail_i, \mathbf{X}_i] = P^{Post}(bail_i, \mathbf{X}_i) * 0.037 * bail_i + E[(1 - Post_i) * V_i | bail_i, \mathbf{X}_i]$$

where $C_i^{Defendant}$ is the total cost imposed on the defendant.

B. Costs to the Justice System and to Potential Victims

In addition to costs to defendants, pre-trial detention and release impose costs on the justice system and on society at large. In the case of detention, the justice system must pay the administrative, food, and housing costs of the defendant in jail. Let C^{Jail} be the

cost to the justice system of jailing a defendant for 90 days. The expected cost to the justice system of detention is then $(1 - P^{Post}(bail_i, \mathbf{X}_i)) * C^{Jail}$.

In the case of release, the defendant may impose costs on the justice system or on potential victims by fleeing or committing new crimes. Let $P^{Flight}(bail_i, \mathbf{X}_i)$ and $P^{Crime}(bail_i, \mathbf{X}_i)$ be the probabilities that a defendant with characteristics \mathbf{X}_i facing bail level $bail_i$ will flee or commit new crimes.⁶ These two terms are calculated as the total number of incidents of flight and the total number of new crimes, each divided by the total number of defendants. Hence, these terms represent unconditional probabilities, and defendants who do not post are still included in the totals in the denominator. Let C^{Flight} and C^{Crime} represent the costs associated with flight and new crimes, respectively. C^{Flight} includes the administrative cost of rescheduling court dates plus the cost of recapture. C^{Crime} represents the total cost that an additional crime imposes on society and the justice system. In expectation, the total costs of flight and new crimes can be expressed as $P^{Flight}(bail_i, \mathbf{X}_i) * C^{Flight}$ and $P^{Crime}(bail_i, \mathbf{X}_i) * C^{Crime}$, respectively.⁷

Finally, in the case of release, the justice system benefits by receiving the defendant's deposit of 10% of $bail_i$. The justice system holds 7% of the bail amount for 90 days and it keeps the remaining 3%. For simplicity, we assume that the justice system discounts at the same rate as the defendant and that the total value of the transfer to the justice system is about $0.037 * bail_i$.

⁶ In principle, a defendant might flee multiple times or commit multiple crimes during pre-trial release. In practice, however, we ignore this possibility, and both rearrest and flight are measured as dummy variables, which is probably an accurate approximation.

⁷ Due to data limitations, we assume that C^{Jail} , C^{Flight} , and C^{Crime} are constant across criminals.

To obtain the total expected cost to the justice system and to society, we combine these four components. For a defendant with characteristics \mathbf{X}_i facing bail level $bail_i$, this total expected cost is:

$$(6) \quad E[C_i^{Society} | bail_i, \mathbf{X}_i] = \\ (1 - P^{Post}(bail_i, \mathbf{X}_i)) * C^{Jail} + P^{Flight}(bail_i, \mathbf{X}_i) * C^{Flight} \\ + P^{Crime}(bail_i, \mathbf{X}_i) * C^{Crime} - P^{Post}(bail_i, \mathbf{X}_i) * 0.037 * bail_i$$

where $C_i^{Society}$ is the cost imposed on the justice system and society by defendant i 's pre-trial detention and release.

C. The Social Planner's Problem

Next, we consider the problem of the optimal social planner. This social planner sets bail to minimize the total expected cost to defendants, the justice system, and to potential victims of new crimes. In principle, the social planner might place different weights on the costs imposed on these different groups. As a benchmark, we suppose that the planner values all three equally. Combining the cost terms from Equations (5) and (6) we can express the planner's problem as:

$$(7) \quad \min_{bail_i} E[C_i^{Total} | bail_i, \mathbf{X}_i] = \min_{bail_i} E[(1 - Post_i) * V_i | bail_i, \mathbf{X}_i] + \\ (1 - P^{Post}(bail_i, \mathbf{X}_i)) * C^{Jail} + P^{Flight}(bail_i, \mathbf{X}_i) * C^{Flight} + P^{Crime}(bail_i, \mathbf{X}_i) * C^{Crime}$$

The first term in the minimization, $E[(1 - Post_i) * V_i | bail_i, \mathbf{X}_i]$, measures the expected value of the freedom that is lost by detaining the defendant. The second term, $(1 - P^{Post}(bail_i, \mathbf{X}_i)) * C^{Jail}$, measures the expected cost to the justice system of jailing the defendant. The third term, $P^{Flight}(bail_i, \mathbf{X}_i) * C^{Flight}$, measures the expected administrative

cost associated with the possibility of the defendant fleeing. The fourth term, $P^{Crime}(bail_i, \mathbf{X}_i) * C^{Crime}$, measures the expected cost to potential victims of new crimes that the defendant may commit if released. Because the planner values the defendant's and justice system's welfare equally, the cash transfer of posting bail does not affect social welfare. The four terms appearing in Equation (7) represent the total expected cost associated with the pre-trial detention or release of defendant i .⁸

IV. Data and Descriptive Evidence

To obtain unbiased estimates of the derivatives of the probabilities in Equation (7), we use data from the 1981 Philadelphia Bail Experiment. This experiment was conducted by criminologists in conjunction with the Municipal Court of Philadelphia and is described in detail in Goldkamp and Gottfredson (1984, 1985). The experiment examined trials assigned to 16 Philadelphia bail judges from 1981 to 1982. Of these 16 judges, 8 were randomly assigned into a treatment group, in which they were asked to set bail amounts according to a pre-determined set of guidelines. The guidelines were constructed by the experimenters in cooperation with Philadelphia judges with the goal of reducing disparity in bail for “similarly situated” defendants. The remaining 8 judges were assigned into a control group and asked to continue assigning bail as they had before. For each judge, the researchers collected data on 120 cases with varying degrees of charge seriousness. The resulting sample includes a total of 1,920 observations, including 960 felony cases.

⁸ Potential criminals might also change their behavior in anticipation of the bail amounts they would be assigned if arrested. However, these costs are likely to be small relative to other costs associated with arrest. We assume that these effects are negligible.

Table 2 shows guidelines matrix that was presented to judges in the treatment group. The horizontal dimension of the grid shows probability of failure, a 5-point index based on observable defendant characteristics, including criminal history, age, and community ties. The vertical dimension of the grid shows charge severity, a 15-point index based on the statute the defendant is accused of violating. The 75 cells in the grid correspond to all the possible combinations of the 15-point and 5-point indices. Each cell contains a range of recommended dollar amounts for bail or “release on recognizance” if the recommended bail amount was zero. Both the minimum and maximum recommended amounts increase with charge severity and the estimated flight or rearrest risk of the defendant. In the upper left corner, charges are the least severe, defendants are the least risky, and the guidelines recommend \$0 bail. In the lower right corner, charges are the most severe, defendants are the most risky, and recommended bail ranges from \$3,000 to \$10,000 in 1981 dollars (\$6,070 to \$20,200 in 2003 dollars). For the purposes of this study, one important aspect of the guidelines is that they tended to recommend lower bail amounts than were typical at the time. Consequently, for many types of defendants in the study, assignment into the treatment group can be used as an instrument for bail amounts.

There are two key experimental features that are necessary to verify. First, we wish to verify that the treatment affected bail levels, and second, we wish to verify that the randomization was effective. We present evidence for the first feature in Figure 1. Panel A of Figure 1 compares the recommended bail amounts to the bail amounts assigned by judges in the control group. The horizontal axis shows in 2003 dollars the midpoint of the recommended bail range from the cells in Table 2. The dashed, 45-degree line shows bail levels that would be observed if judges always assigned the midpoint of

the assigned range. The circles show the average bail amounts that judges in the control group actually assigned. Since the control judges were not told what the recommended bail ranges were, the bail amounts tell us the levels at which judges would assign bail in the absence of the guidelines. On average, the guideline amounts are substantially lower than the bail levels chosen by the control group judges, particularly for more severe and riskier offenders.

An important aspect of the experimental design is that the randomization applies to cell of the guidelines. Thus, each cell may be seen as a separate experiment. For some cases, observed bail amounts among control judges were similar to the recommended levels. In these cases, judges were asked to do what they were already doing, and we should not expect to see an effect of treatment on bail amounts. In other cases, however, the recommended bail levels differ significantly from the levels observed among control judges. It is these cases that are useful for the purposes of this study, because in these cases, assignment to the treatment group has the potential to affect bail levels. The black circles in Panel A of Figure 1 indicate the cells for which the recommended bail levels differ significantly from the bail levels observed among judges in the control group. These are the cells that are included in the sample for the regressions. The white circles indicate cells for which the recommended bail levels do not differ significantly from bail levels in the control group. These cells are excluded from the regression sample, because for these cases, we do not expect to see an effect of treatment on bail levels.⁹

Panel B of Figure 1 compares observed and recommended bail amounts for the treatment group. In general, the observed bail amounts are higher than the recommended

⁹ Restricting the sample in this way should not affect the consistency of our estimates. We explore the implications of this sample restriction in detail in the web appendix.

bail amounts; however, these differences are smaller for the treatment group than for the control group. For both the \$15,000 to \$30,000 and \$30,000 to \$45,000 ranges on the graphs, we see more cells in the control group than in the treatment group, indicating that defendants in the control group were assigned higher bail levels. Notably, at the highest recommended bail levels, where the defendants are likely to have been the most dangerous, the treatment judges were most likely to deviate from the guidelines and assign high bail amounts.

Table 3 presents descriptive statistics for the data used in this study. Column (1) shows means for the treatment group, column (2) shows means for the control group, and column (3) shows the difference in means between the two groups. Column (4) shows robust standard errors for the differences in means, and column (5) shows these standard errors after clustering at the judge level. Of the 75 cells shown in Table 2, the regression sample includes data from 17 cells for which the recommended bail level was significantly different from the level observed in the treatment group (the black circles in Figure 1). Because the regressions take the log of bail, the sample also excludes 81 observations for which bail was equal to zero. Of the 1,920 defendants in the original sample, 487 satisfy these criteria and are included in the regression sample.

The evidence from Table 3 supports our conjecture that the experiment was truly random. The defendants in the treatment group are similar to defendants in the control group across a wide range of characteristics. Importantly, the midpoint of the recommended bail range is almost identical for defendants regardless of their treatment status (\$6,350 for treatment defendants and \$6,420 for control).

To verify that that the experiment affected bail, we compare bail amounts assigned by treatment and control judges. For the sample shown here, observed bail is marginally significantly lower for the treatment group than for the control group. Among treatment defendants, the average assigned bail is \$13,500. Among control defendants, the average observed bail is considerably larger, at \$19,000. At these rates, 68% of the treatment defendants posted bail – substantially more than the 54% in the control group. This difference is marginally significant using both robust standard errors and using clustering by judge and severity by risk category.¹⁰

Panels A through D of Figure 2 visually display differences between treatment and control for the variables of interest in this study. Panel A shows differences in observed bail. Panels B, C, and D show differences in the fractions posting, failing-to-appear, and rearrested, respectively. For each outcome, differences are plotted for the 75 different cells.

Treatment status appears to have had effects on some of the outcomes of interest. For the cells in the regression sample, the difference in bail set between the treatment and control groups is generally negative. For these same cells, we also observe positive differences for release and rearrest, and slightly positive differences for failure-to-appear.¹¹ Two of these 3 differences are significantly different from zero. For the remainder of the study, we focus on the cells that are included in the regression sample (the black circles). To increase the precision of our estimates, we consider all 17 of these cells together as a group.

¹⁰ The difference is significant when measured in logs. Multi-way clustering performed using Cameron, Gelbach, and Miller's (2006) `cgmreg.ado`. Single-way clustering (by judge only) is used for cases in which the multi-way approach did not converge.

¹¹ One limitation with the current study that should be noted is that, due to small sample sizes, the rearrest and failure to appear regressions are based on only 38 rearrests and 55 failures to appear.

V. Econometric Methods

In the next few paragraphs, we develop a revealed preference framework for estimating $E[V_i | \mathbf{X}_i]$ from defendants' release decisions. We then outline an instrumental variables probit approach for estimating $P^{Post}(bail_i, \mathbf{X}_i)$, $P^{Flight}(bail_i, \mathbf{X}_i)$ and $P^{Crime}(bail_i, \mathbf{X}_i)$. Finally, we describe our computational approach for estimating the socially optimal bail amount.

A. Revealed Preference and the Value of Freedom

Suppose that $\ln(V_i)$ can be expressed as a linear combination of defendant characteristics \mathbf{X}_i and normally distributed error ε_i^{Post} :

$$(8) \quad \ln(V_i) = \boldsymbol{\beta}^{Post} \cdot \mathbf{X}_i - \varepsilon_i^{Post}$$

As stated in Equation (4), defendant i posts bail if and only if i 's subjective value of freedom exceeds the cost of release. Hence, defendant i posts if and only if $V_i \geq 0.037 * bail_i$. The probability of this event can then be expressed as:

$$(9) \quad P_i^{Post} = \Pr(V_i \geq 0.037 * bail_i)$$

Taking logs and substituting Equation (8) into Equation (9), we obtain:

$$(10) \quad P_i^{Post} = \Pr(\boldsymbol{\beta}^{Post} \cdot \mathbf{X}_i - \varepsilon_i^{Post} \geq \ln(0.037 * bail_i))$$

Rearranging terms, we can express this probability in terms of $F^{Post}(\cdot)$, the cumulative distribution function of ε_i^{Post} :

$$(11) \quad P_i^{Post} = F^{Post}(\boldsymbol{\beta}^{Post} \cdot \mathbf{X}_i - \ln(0.037 * bail_i))$$

By the assumption that ε_i^{Post} is normally distributed, $F^{Post}(\cdot)$ is a cumulative normal distribution function. Let σ_{Post} be the standard deviation of ε_i^{Post} . If we divide the term

inside cumulative distribution function by σ_{Post} , we obtain a probit regression specification:

$$(12) \quad P_i^{Post} = \Phi\left(\frac{\boldsymbol{\beta}^{Post} \cdot \mathbf{X}_i - \ln(0.037 * bail_i)}{\sigma_{Post}}\right).$$

In a typical discrete choice setting, the latent variable (in this case V_i) has no natural units. In such cases, probit estimation identifies the parameters of interest up to scale, so that $\frac{1}{\sigma_{Post}} \boldsymbol{\beta}^{Post}$ would be known, but not $\boldsymbol{\beta}^{Post}$. In our case, however, both V_i and $bail_i$ are measured in dollars. The defendant's decision rule compares these two variables directly. We use this direct comparison to convert our predicted values from the probit regression from probability units into dollar units. Our estimated coefficient on $\ln(bail_i)$ in the posting equation is $-\frac{1}{\sigma_{Post}}$. To estimate $\boldsymbol{\beta}^{Post}$, we divide the coefficients on \mathbf{X}_i by negative one times the coefficient on $\ln(bail_i)$.¹²

Next, we consider the estimation of the value of freedom. There are two measures of freedom that we estimate in this study. The first measure is the average value of freedom for an individual with a specific set of characteristics. This term is expressed as $E[V_i | \mathbf{X}_i]$. This parameter provides information about the degree to which freedom is valued among criminal defendants. $E[V_i | \mathbf{X}_i]$, depends on $\boldsymbol{\beta}^{Post}$, the coefficients from the defendant's release decision. Substituting our formula for $\ln(V_i)$ from Equation (8), we can express $E[V_i | \mathbf{X}_i]$ as

$$(13) \quad E[V_i | \mathbf{X}_i] = E\left[e^{\boldsymbol{\beta}^{Post} \cdot \mathbf{X}_i - \varepsilon_i^{Post}}\right]$$

¹² Warner and Pleeter (2001) use a similar approach to estimate private discount rates from military employees' pension plan decisions.

$$= e^{\beta^{\text{Post}} \cdot \mathbf{X}_i + \frac{\sigma_{\text{Post}}^2}{2}}$$

where $E\left[e^{\varepsilon_i^{\text{Post}}}\right] = e^{\frac{\sigma_{\text{Post}}^2}{2}}$ by normality.

The second measure that we estimate is the expected value of the loss in freedom among individuals who do not post bail. This expected loss is the measure that appears in the social planner's cost function. As mentioned earlier, this expected value can be expressed mathematically as $E[(1 - \text{Post}_i) * V_i \mid \text{bail}_i, \mathbf{X}_i]$. Figure 3 illustrates this value graphically. The diagonal line shows the demand for freedom (*i.e.*, the fraction posting bail) for individuals with characteristics \mathbf{X}_i .¹³ The value of freedom varies among defendants with these characteristics, due to heterogeneity in $\varepsilon_i^{\text{Post}}$. At a given bail level bail_i , individuals with values of freedom lower than $0.037 * \text{bail}_i$ do not post. These individuals appear to the right of $P^{\text{Post}}(\text{bail}_i, \mathbf{X}_i)$ on the horizontal axis. The shaded area under the demand curve represents the total value of these individuals' lost freedom.

If Post_i and V_i were independent, then the expected loss of freedom would simplify to $(1 - P^{\text{Post}}) * E[V_i \mid \mathbf{X}_i]$. However, Post_i and V_i are correlated in a systematic way through revealed preference. The defendants who remain in jail will be those whose subjective values of freedom are especially low. Given the formulation of V_i in Equation (8), $E[(1 - \text{Post}_i) * V_i \mid \text{bail}_i, \mathbf{X}_i]$ can be simplified to the following expression:¹⁴

$$(14) \quad E[(1 - \text{Post}_i) * V_i \mid \text{bail}_i, \mathbf{X}_i] = \left[1 - \Phi\left(\frac{\beta^{\text{Post}} \cdot \mathbf{X}_i - \ln(0.037 * \text{bail}_i) + \sigma_{\text{Post}}^2}{\sigma_{\text{Post}}}\right) \right] * E[V_i \mid \mathbf{X}_i]$$

¹³ For Figures 3 and 4 and for the estimates in Table 7, the set of control variables \mathbf{X}_i includes only the fixed effects for the different cells shown in Table 2.

¹⁴ The derivation is provided in the web appendix.

This expression differs from $(1 - P^{Post}) * E[V_i | \mathbf{X}_i]$ through the term σ_{Post}^2 , which appears inside the cumulative normal. This σ_{Post}^2 term adjusts for the covariance between V_i and $Post_i$.

B. Estimation of Posting, Flight, and Additional Crime Probabilities

Next, we consider a probit framework for estimating each of the two remaining binary decisions: failing to appear and committing new crimes. Suppose that defendant i takes the action if a linear combination of $\ln(bail_i)$ and defendant characteristics exceeds some normally distributed error. Assuming that our relevant error terms, ε^{Flight} , and ε^{Crime} , have zero means and variances σ_{Flight}^2 , and σ_{Crime}^2 , we obtain a probit formulation:

$$(15) \quad P_i^j = \Phi\left(\frac{\alpha^j_0 + \alpha^j_1 \ln(bail_i) + \boldsymbol{\beta}^j \mathbf{X}_i}{\sigma_j}\right), j \in \{Flight, Crime\}$$

where $\Phi(\cdot)$ is the standard normal distribution.

One potential problem in estimating the effects of bail on posting, failure-to-appear, and additional crimes is omitted variables bias. Judges set especially high bail amounts for defendants whom they suspect may flee or commit new crimes. This policy on the part of judges may cause cross-sectional estimates to overstate bail's effects on flight and new crimes. These risky defendants may also be career criminals who place particularly low values on freedom from jail. Hence, cross-sectional estimates may underestimate the effect of bail on posting. Judges also frequently consider defendants' income levels and set especially low bail amounts for poor defendants. Hence, wealthier defendants (who are particularly capable of posting) may receive high bail amounts. These wealthier defendants may also face higher costs of committing crimes or fleeing,

due to employment or ties to the community. Due to these wealth effects, cross-sectional estimates may overestimate the effect of bail on posting. For the same reasons, cross-sectional estimates may underestimate bail's effects on flight and new crimes. These two factors (risk and wealth) bias the cross-sectional probit coefficients in opposite directions. Hence, the direction of the overall bias is unclear.

We use data from the Philadelphia Bail Experiment to avoid these omitted variables problems. Through the bail guidelines, judges in the treatment group were given recommended bail amounts that were lower than they would otherwise assign. Let $Treatment_i$ be a dummy variable for whether defendant i is in the treatment group. We can now write $\ln(bail_i)$ as a linear combination of $Treatment_i$, \mathbf{X}_i , and normally distributed random error u_i :

$$(16) \quad \ln(bail_i) = \gamma * Treatment_i + \boldsymbol{\delta}' \mathbf{X}_i + u_i$$

Our identifying assumption is that, due to the randomization, $Treatment_i$ is uncorrelated with ε_i and u_i . Substituting Equation (16) into Equations (12) and (15), we obtain the following reduced-form probit equations for release, failure-to-appear, and additional crime:

$$(17) \quad P_i^j = \Phi \left(\boldsymbol{\Pi}^j \cdot \begin{bmatrix} 1 \\ Treatment_i \\ \mathbf{X}_i \end{bmatrix} \right), j \in \{Post, Flight, Crime\}$$

where $\boldsymbol{\Pi}^j = \frac{1}{\sigma_{j,u}} \begin{bmatrix} \alpha_0^j \\ \alpha_1^j \gamma \\ \boldsymbol{\beta}^j + \alpha_1^j \boldsymbol{\delta} \end{bmatrix}$, $\sigma_{j,u}^2 = Var(\varepsilon_i^j + \alpha_1^j u_i)$, $\alpha_0^{Post} = -\ln(0.037)$, and

$\alpha_1^{Post} = -1$. We then estimate the parameters of Equation (15) using instrumental variables probit specifications.

C. Computation of the Socially Optimal Bail Amount

We estimate the optimal bail amount by finding the value of $bail_i$ that minimizes the social cost as in Equation (7)

$$(7) \quad \min_{bail_i} E[C_i^{Total} | bail_i, \mathbf{X}_i] = \min_{bail_i} E[(1 - Post_i)*V_i | bail_i, \mathbf{X}_i] + \\ (1 - P^{Post}(bail_i, \mathbf{X}_i)) * C^{Jail} + P^{Flight}(bail_i, \mathbf{X}_i) * C^{Flight} \\ + P^{Crime}(bail_i, \mathbf{X}_i) * C^{Crime}$$

Empirically, we construct this cost by combining separate estimates of $P^{Post}(bail_i, \mathbf{X}_i)$, $P^{Flight}(bail_i, \mathbf{X}_i)$, $P^{Crime}(bail_i, \mathbf{X}_i)$, C^{Jail} , C^{Flight} , C^{Crime} , and $E[(1 - Post_i)*V_i | bail_i, \mathbf{X}_i]$. Our approach for estimating $P^{Post}(bail_i, \mathbf{X}_i)$, $P^{Flight}(bail_i, \mathbf{X}_i)$, and $P^{Crime}(bail_i, \mathbf{X}_i)$ is described above. We obtain estimates of C^{Jail} , C^{Flight} , and C^{Crime} from other studies and from discussions with industry experts, as we discuss in Section VI.

Given our 7 parameters of interest, we construct an empirical counterpart to the social cost function in Equation (7). Next, we plug different values of $bail_i$ into our estimated probability functions $P^{Post}(bail_i, \mathbf{X}_i)$, $P^{Flight}(bail_i, \mathbf{X}_i)$, and $P^{Crime}(bail_i, \mathbf{X}_i)$, and $E[(1 - Post_i)*V_i | bail_i, \mathbf{X}_i]$. We then compute estimates of the social cost function for \$100 increments of $bail_i$ from \$1, \$100, \$200, \$300, . . . , up to \$100,000.¹⁵ Our estimate of the socially optimal bail amount is the value of $bail_i$ that produces the lowest estimated social cost.

¹⁵ At very high levels of bail, the probabilities of posting, flight, and rearrest are extremely close to zero. Hence, the social cost at \$100,000 bail is a reasonable approximation to the social cost of infinite bail (*i.e.*, certain detention).

VI. Results

In this section, we present the results of our analysis. First, we estimate the cross-sectional relationships between bail and posting, rearrest, and failure to appear in court. Second, we present instrumental variables probit estimates of the causal relationships between bail and these pre-trial outcomes. Third, we split the sample into defendants for whom the guidelines recommended low, medium, and high bail levels. As Table 2 showed, the guidelines from the experiment were constructed as increasing functions of charge severity and the defendant's probability of violating the terms of bail. Consequently, these recommended values can serve as a composite measure of the dangerousness of different defendants. We then estimate the subjective value of freedom and the socially optimal bail levels for the average defendant in each of these 3 categories of this proxy for dangerousness.

A. Cross-Sectional Probit Estimates

Table 4 presents cross-sectional probit regressions of bail on the pre-trial outcomes of interest. To examine the relationship between bail and these outcomes in a typical cross-section, we include only the 242 observations from the control group. Columns (1) and (2) show the effects of $\ln(bail_i)$ on bail posting. Columns (3) and (4) show the effects of $\ln(bail_i)$ on failure-to-appear. Columns (5) and (6) show the effects on rearrest. The probit specifications in Columns (1), (3), and (5) only include $\ln(bail_i)$ as a regressor. Columns (2), (4), and (6) include additional controls for defendant characteristics. The controls include prior convictions, prior arrests, age, weekly earnings, dummy variables for married, employed, has a fixed address, and owns a car, and the 17

fixed effects for the cells in the guidelines matrix. All 6 columns show the elasticity with respect to bail (*i.e.*, the marginal effect of $\ln(\text{bail}_i)$) for the mean observation.¹⁶

The estimates from Table 4 show negative and significant relationships between bail and both release and failure-to-appear in the cross-section. For bail posting, we estimate an elasticity of -0.17 to -0.18. We observe smaller elasticities for failure-to-appear and rearrest. For failure-to-appear, we estimate an elasticity of -0.05 to -0.06 with respect to bail. For rearrest, we estimate an insignificant elasticity of 0.00 to +0.02. Adding controls does not affect our estimated effects in any of the regressions. As discussed earlier, however, there are many reasons why these cross-sectional comparisons may produce biased estimates. Next, we exploit the structure of the experiment to estimate the causal relationships between bail and release, failure-to-appear in court, and rearrest.

B. Instrumental Variables Estimates

Table 5 reports first-stage and reduced-form probit estimates using our instrumental variables strategy. As in Table 3, the sample used here is the “regression sample” of the 17 cells in which the bail levels recommended by the experiment are significantly different from those observed in the control group. Columns (1) and (2) show the first-stage effects of treatment on $\ln(\text{bail}_i)$. Columns (3) and (4) show the effect of treatment on the fraction released. Columns (5) and (6) show the effects on the fraction rearrested. Columns (7) and (8) show the effects of treatment on the fraction failing to

¹⁶ Unlike with the mean differences in Table 3, only single-way clustering is used (by judge), due to the lack of availability of multi-way clustering algorithms for probit specifications.

appear. Columns (1), (3), (5), and (7) include only treatment as a regressor. Columns (2), (4), (6), and (8) add defendant controls.

The first two rows of Table 5 show that, on average, treatment reduced bail amounts by more than 50%. This result is consistent with the large differences in bail amounts between the treatment and control groups in Table 3. The magnitudes of the reduced-form effects are the same as in Table 3, and adding controls does not affect the estimates.

Table 6 presents the main results from the instrumental variables probit specification for the effects of bail on release, rearrest, and failure-to-appear. The specifications are the same as in Table 4; however, $\ln(bail_i)$ is instrumented with a dummy for treatment status. The estimated effect of $\ln(bail_i)$ on release is significant in both regressions. The elasticity estimates, -0.27 and -0.32, are roughly twice as large as those obtained from the cross-sectional comparisons. Similarly, the instrumental variables regressions indicate a substantially greater elasticity of rearrest with respect to bail level than obtained from the cross-sectional regression. Failure to appear is the one outcome of interest that yields similar elasticities when estimated by either method.

The substantial differences between the cross-sectional and instrumental variables results for release and rearrest suggest that there are many important omitted variables that do not appear in our dataset. One possible explanation for the differences between these estimates is that the omitted variables that are correlated with judges' bail decisions are positive predictors of release and rearrest, but not of flight. For example, judges may be especially sensitive to defendants who appear to be career criminals and pose risks to society. However, they may pay less attention to factors affecting flight, because the

consequences of failure to appear are not particularly severe. By using the Philadelphia experiment, we are able to obtain unbiased estimates that do not suffer from these confounding factors.¹⁷

C. Estimates of the Value of Freedom

Next, we estimate defendants' subjective values of freedom using the revealed preference approach described in Section V. First, we graphically illustrate our estimation strategy by plotting empirical demand curves. Then, we use our instrumental variables probit estimates to calculate the willingness to pay for release for 3 different categories of defendants.

Figure 4 shows empirical demand curves for freedom for the 17 different categories of defendants in the regression sample. These curves are the empirical analogue to the theoretical demand curve in Figure 3. The gray boxes show means for the treatment group, and the black boxes show means for the control group. Within each line segment, the charge severity and probability of failure indices are the same for the black box and the gray box. For the gray boxes, however, the judge was randomly assigned to use the bail guidelines and consequently assigned lower bail amounts. Hence, each line segment estimates a separate causal relationship between bail and release. The quantity of freedom consumed – the fraction released – is plotted along the horizontal axis. The price – the bail amount – is plotted along the vertical axis.

These estimated demand curves confirm the general results from Tables 3 and 6 and Panel A of Figure 2. Reductions in bail generally increase posting rates, and we

¹⁷ One alternative explanation for the differences between the OLS and instrumental variables estimates is heterogeneity in both the first-stage and second-stage coefficients (*c.f.*, Heckman, Urzua, and Vytlačil, 2006; Lochner and Moretti, 2004). We discuss this possibility in detail in the web appendix.

observe negative slopes in 14 and zero slope in 1 of the 17 line segments in Figure 4. The two cases with upward slopes involve small changes in bail and are probably attributable to sampling error.

We can use the demand curves in Figure 4 to construct a preliminary back-of-the-envelope estimate of $E[V_i | \mathbf{X}_i]$. Along the dotted vertical line in Figure 4, 50% of the defendants choose release. When the fraction posting is 50%, the median defendant is indifferent between detention and release. One informal way to estimate the value of freedom is to look at the bail level at which the fraction posting equals 50% for specific groups of defendants. This graphical analysis is one transparent way to estimate the value of freedom that does not require strong functional form assumptions. Two of the demand curves in Figure 4 intersect or come close to the dotted vertical line. The bail levels at which they intersect range from roughly \$21,000 to \$24,000. Our estimates of the discounted present values of these bail amounts are $0.037 * \$21,000 = \780 and $0.037 * \$24,000 = \890 . Hence, the rough estimates for these two cells suggest values of freedom between \$780 and \$890.

Next, we apply the formula $E[V_i | \mathbf{X}_i] = e^{\beta^{\text{Post}} \cdot \mathbf{X}_i + \frac{\sigma_{\text{Post}}^2}{2}}$ to formally estimate defendants' subjective values of freedom. The first row of Table 7 shows estimates of $E[V_i | \mathbf{X}_i]$ for the average defendant and for defendants at the three different levels of dangerousness, as proxied by the bail amounts recommended by the guidelines of the experiment. These estimates are computed as $e^{\hat{\beta}^{\text{Post}} \cdot \mathbf{X}_i + \frac{\hat{\sigma}_{\text{Post}}^2}{2}}$ for the mean defendant in each category. The terms $\hat{\beta}^{\text{Post}}$ and $\hat{\sigma}_{\text{Post}}^2$ are estimated separately for each of these three groups using the instrumental variables probit specifications with no controls, as in

Column (1) of Table 6. The standard errors are calculated using the delta method. Column (1) of Table 7 shows estimates for the average defendant in the regression sample. Columns (2), (3), and (4) show estimates for defendants at low, medium, and high levels of dangerousness, respectively. Our proxy for dangerousness is the midpoint of the recommended bail range in the defendant's cell. For the average defendant in the regression sample, we estimate a subjective value of freedom of \$1,050, which is marginally significantly different from zero (at the 10% level). For the least dangerous defendants, we find that the subjective value of freedom is \$6,770; however, this estimate is very imprecise. For defendants at medium and high levels of dangerousness, we estimate subjective values of freedom of \$800 and \$971, respectively. Both of these values are significantly different from zero.

The magnitude of the estimated subjective value of freedom seems intuitively low at first blush. But it is important to consider that these values are estimated on a particularly poor subset of the population, and are probably not representative of the broader population. One might expect a lower bound for the value of freedom to be foregone wages.

This calculation is easily accomplished using data from Table 3. Defendants in the sample have a mean weekly income of approximately \$73 (2003 dollars). This low value is partly due to the extremely high unemployment rate (74%) of the population. This figure is unconditional on employment status, so the 26% employment rate corresponds to an employed salary of approximately \$300/week or \$7.50/hour. Thus in ninety days of incarceration a defendant forgoes an average of \$949, a figure close to the estimated value of freedom.

There are certainly other costs that must add to the value of freedom beyond foregone wages, such as cost to friends and relatives, restrictions on movement, choice of activity, etc. But the low estimates indicate that either these costs are relatively low among the study population, or are somewhat offset by the medical care, food, and shelter provided while incarcerated. We are not making a normative statement about these tradeoffs; we merely seek to elaborate on the plausibility of our estimates.

D. Calculation of the Socially Optimal Bail Amount

Next, we put our probit estimates together with estimates for C^{Jail} , C^{Flight} , and C^{Crime} to calculate the total cost of different bail policies to defendants, the justice system, and potential victims of new crimes. We then determine the bail amounts that minimize this cost function for our 3 categories of defendant dangerousness.

Levitt (1996) reviews a handful of estimates of the judicial system's cost of jailing a defendant, ranging from \$84 to \$126 per day. We calculate C^{Jail} as the midpoint of these figures (\$105) times 90 days, or \$9,500.¹⁸

The cost of failure-to-appear (C^{Flight}) consists of the cost of re-capturing a fugitive defendant along with administrative court costs. We assume that the administrative costs are second order.¹⁹ Hence our estimate of C^{Flight} is simply the cost of recapturing a defendant. There are no well-known studies that include estimates of these costs, so we turned to industry experts for these values. In private conversations, two bail bond experts provided us with rough estimates of this cost: one saying \$500 and another saying

¹⁸ Bierie (2007, pg. 157) reviews the literature and finds a slightly lower cost per prison day ranging from \$50 to \$76. Using an estimate of \$63/day, we obtain a higher estimated optimal bail of \$25,400 compared with \$17,700 in the benchmark specification.

¹⁹ Bierie (2007, pg. 156) finds that the cost of scheduling a minor hearing is \$560. Taking this cost into account has little effect on our estimates, as we show in the web appendix.

5% of the bail amount. For the average control group defendant who failed to appear, 5% of the bail amount is \$395. It is this latter estimate of the cost of flight that we use in the main specifications. Previous research has shown that bail bondsmen are more effective than the public sector at catching fugitive defendants (Helland and Tabarrok, 2004). Hence, for court systems such as Philadelphia (in which bondsmen are illegal), this estimate may understate the cost of flight.²⁰ Due to the small number of failures to appear in the control group, we cannot obtain precise estimates of 5% of the bail level for each of the 3 categories of defendant dangerousness. Consequently, we use the \$395 estimate for each of these 3 groups.

Our estimates of the social cost of crime, C^{Crime} , include both costs to victims as well as detention and rearrest costs. Our estimated costs to victims are taken from Miller, Cohen, and Wiersema (1996). This study measures a variety of different costs including medical expenses, loss and damage of property, and pain and suffering (estimated from data on jury awards). These cost estimates, together with FBI arrest data (Carlson, 1998) imply that crimes resulting in arrest account for roughly 13% of the total cost of criminal victimizations. We combine the Miller, Cohen, and Wiersema estimates on charge-specific costs of crime with charge-specific counts of rearrests among defendants in our regression sample. We estimate that the average rearrest in our sample was for a crime with a social cost of \$5,790. After taking into account the cost of crimes that do not result in rearrest, we estimate that for each observed rearrest, society has incurred roughly \$44,700 worth of damage.²¹ It is this figure that we use for C^{Crime} . Sources and

²⁰ The effects of this bias should be fairly small in our context, because the costs of failure-to-appear are small relative to the costs of additional crimes.

²¹ This cost per arrest figure is higher than the estimates used in other studies (*e.g.*, Lochner and Moretti, 2004), in part because the cost estimates from Miller, Cohen, and Wiersema (1996) include long-term

calculations described in greater detail in the web appendix. As with C^{flight} , our estimate is the same for all three defendant types due to small sample sizes.

Next, we combine these costs with our estimated effects of bail on pre-trial outcomes. Figure 5 shows the functional relationships between bail and release, rearrest, and failure-to-appear. Each curve is an estimated causal relationship between bail and a pre-trial outcome for the average defendant in the regression sample. The solid black curve shows the predicted fraction posting bail. The dashed curve shows the predicted fraction failing to appear, and the solid gray shows the predicted fraction rearrested. These curves correspond to the instrumental variables probit regressions in Columns (1), (3) and (5) of Table 6.

All the components for the total social cost function have now been estimated empirically or obtained from other sources. Hence, we can now construct an estimate of this cost function. Figure 6 plots the estimated total social cost as a function of bail for the average defendant. This curve is the empirical analogue to the social cost in Equation (7). We compute this cost as a weighted average of the curves shown in Figure 5 plus the value of freedom.

The sharp decline at low levels of bail is primarily attributable to the effect of bail on rearrest. As this effect flattens out, our estimated social cost of bail reaches a minimum and begins a slight rise. For the specification shown here, the cost-minimizing

medical costs, lost hours of work and leisure, and more precise estimates of pain and suffering costs than had been used previously. The study also includes the costs of many criminal victimizations (particularly domestic abuse and rape) that are typically not reported. Some other recent studies obtain higher estimates of the costs of crime (Cohen, *et al.*, 2004; McCollister, 2004). The Miller, Cohen, and Wiersema study appears to be one of the most comprehensive studies available on the economic costs of crimes, which is why we use their estimates for our benchmark specification. In a comprehensive literature review of the costs of crime, Bierie (2007) finds similar estimates as the ones used here. Nevertheless, it is worth noting that our estimated optimal bail levels vary considerably depending on the assumed cost per rearrest, as we show in the web appendix.

bail amount is \$17,700. One notable feature Figure 6 is the asymmetry in the estimated social cost on either side of the estimated optimal bail level. We find that the social cost of inefficiently low levels of bail is considerably higher than the social cost of inefficiently high levels. Hence, after taking into account the imprecision in our estimates of the socially optimal bail, the bail level that minimizes expected social cost may be higher than the cost-minimizing level shown here.

Table 7 shows our estimates of the socially optimal bail for this average defendant and also separately for our 3 categories (low, medium, and high) of defendant dangerousness. Column (1) shows estimates for the average defendant in our 487-observation regression sample. Columns (2), (3), and (4) show estimates broken down into low, middle, and high categories of bail recommended by the guidelines of the experiment. Row 1 shows our estimates of the subjective value of freedom, as discussed in part C. Row 2 shows the bail levels that minimize the estimated cost to society for each category of defendant, along with bootstrapped 95% confidence intervals. For these same defendant types, row 3 shows the average bail level for defendants in the control group, and row 4 shows the average bail level recommended by the guidelines of the experiment. Rows 5, 6, and 7 show our estimates of the total cost per defendant incurred by society at each of these 3 bail levels.

Our estimates of the socially optimal bail are extremely imprecise, and in three of the four cases, either our estimate is infinity or the 95% confidence interval includes infinity (*i.e.*, certain detention). Given the considerable imprecision in our estimates, it is difficult to make policy recommendations in a conclusive way. Nevertheless, our

estimates provide suggestive evidence that, in the absence of bail guidelines, judges behaved in a roughly efficient way.

For the average defendant, our estimate of the socially optimal bail is \$17,700, as in Figure 3. For defendants at low, middle, and high levels of dangerousness, our estimated socially optimal bail levels are \$12,400, \$15,600, and infinity, respectively. With the exception of this infinite value, our optimal bail estimates are fairly close to the average bail levels observed for defendants in the control group. Hence, our socially optimal policy is reasonably close to common practice among judges prior to the implementation of the bail guidelines. In all 4 cases, the bail levels recommended by the guidelines of the experiment are considerably lower than our estimated social optima.

Across the 4 columns of Table 7, our estimates of the total cost to society at the optimal bail levels range from \$6,060 to \$10,700 and are increasing with the dangerousness of the defendant. For defendants at high levels of dangerousness, our estimate of the cost to society is 20% higher for bail levels assigned by control group judges than for the social optimum. For the average defendant and for the low and medium levels of dangerousness, our estimated cost for the control group is within 5% of our estimate of the cost at the social optimum. Hence, we find fairly small social benefits associated with adjusting bail from commonly assigned levels to our estimated social optima. By contrast, our estimate of the social cost associated with the bail levels recommended by the guidelines ranges from 17% to 116% more than our estimate of the cost at the optimal bail level. Hence, the social cost associated with adopting bail guidelines could be large – particularly for the most dangerous defendants.

VII. Conclusion

This paper uses experimental data and cost-benefit analysis to estimate the socially optimal bail amount for the average defendant. We estimate the effect of bail on bail posting, flight, and rearrest. We combine these estimates with data from a variety of sources to calculate the net social costs of these pre-trial outcomes. We calculate the cost of detention to defendants using a revealed preference approach from data on bail posting decisions. In 2003 dollars, we estimate a subjective value for 90 days of freedom of roughly \$1,000 for the average defendant in our sample.

Putting these estimates together, we arrive at a total social cost of pre-trial release and detention. We estimate the bail amount that minimizes this social cost for the average felony case. While imprecise, our estimates suggest that the socially optimal bail amount for the average defendant in our sample is roughly \$17,700. Our estimate of the socially optimal bail level is close to the levels that judges assigned in the absence of guidelines and is considerably higher than the levels recommended by bail reform policies.

This paper provides one empirical example of the benefits of empirical economic analysis in the judicial context. By applying cost-benefit analysis and willingness-to-pay estimation, we show that data from the Philadelphia Bail Experiment can produce a more comprehensive set of policy implications than previously believed.

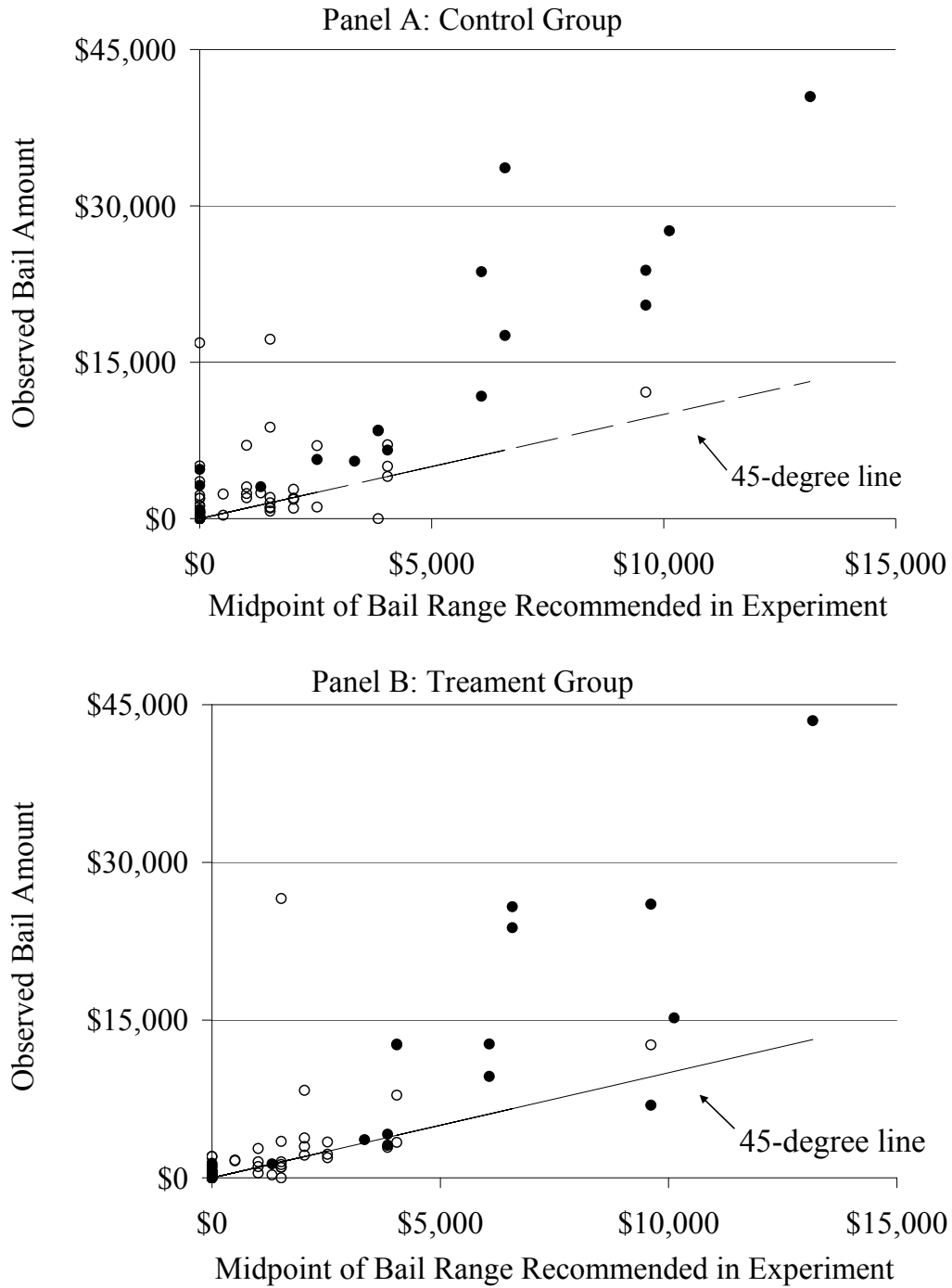
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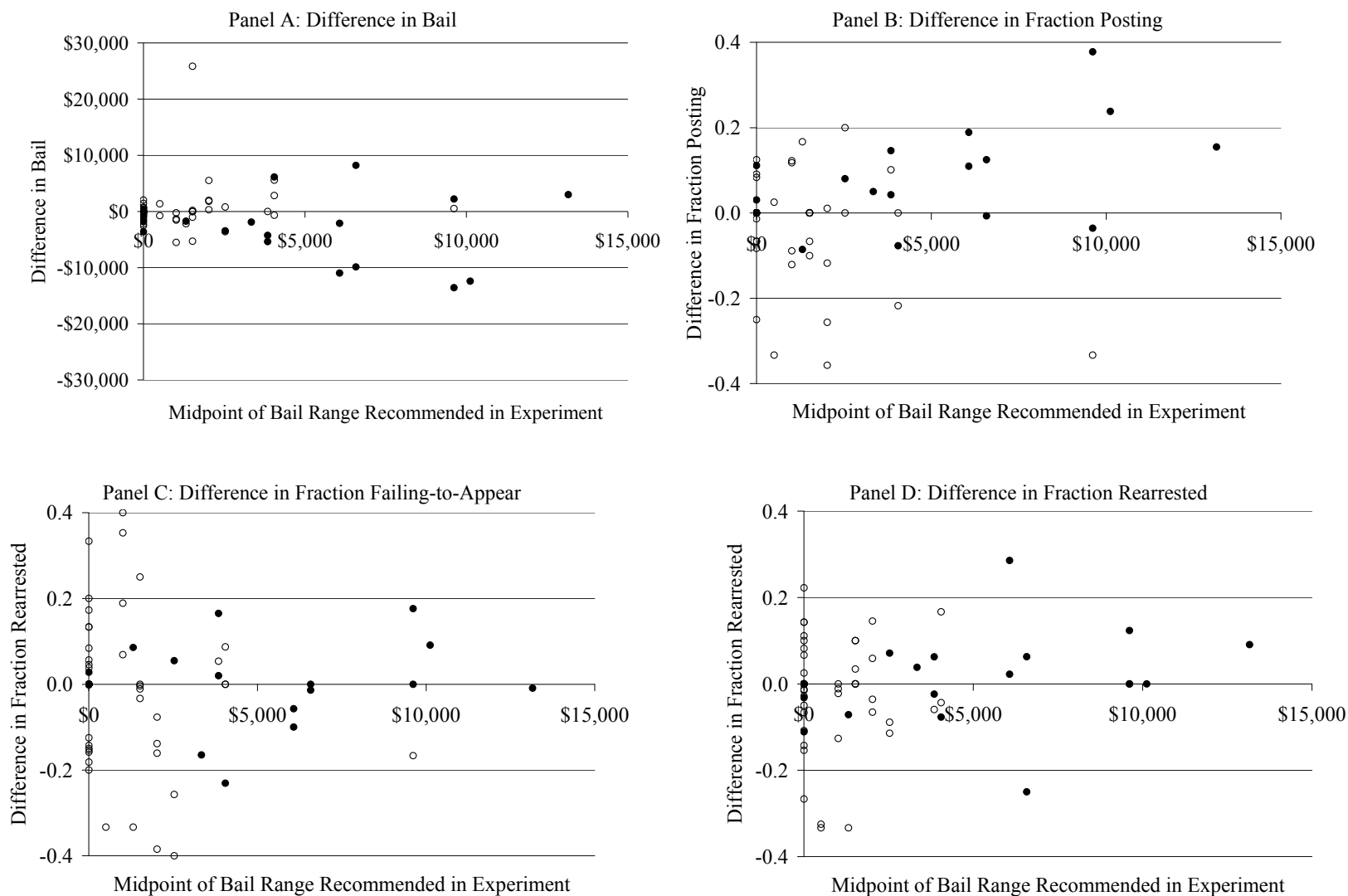
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Figure 1: Observed and Recommended Bail Amounts for Control and Treatment Groups



Notes: See notes to Tables 2 and 3. Each point in the graph corresponds to one of the cells in Table 2. The value on the vertical axis shows the observed bail amounts assigned at each recommended bail level. Treatment judges were assigned to use the recommended ranges when assigning bail amounts. Control judges were not. Unlike in the tables and in Figures 3 to 5, observations with zero bail amounts are included in Figures 1 and 2.

Figure 2: Differences in Bail, Posting, Rearrest, and Flight between Treatment and Control



Notes: See notes to Figure 1 and Tables 2 and 3. These graphs show differences between the treatment and control group for each of four pre-trial variables: bail, posting, rearrest, and failure-to-appear. Bail Posting is coded as one if the defendant posted bail within 7 days of arrest and zero otherwise.

Figure 3: Illustration of Demand Curve for Freedom

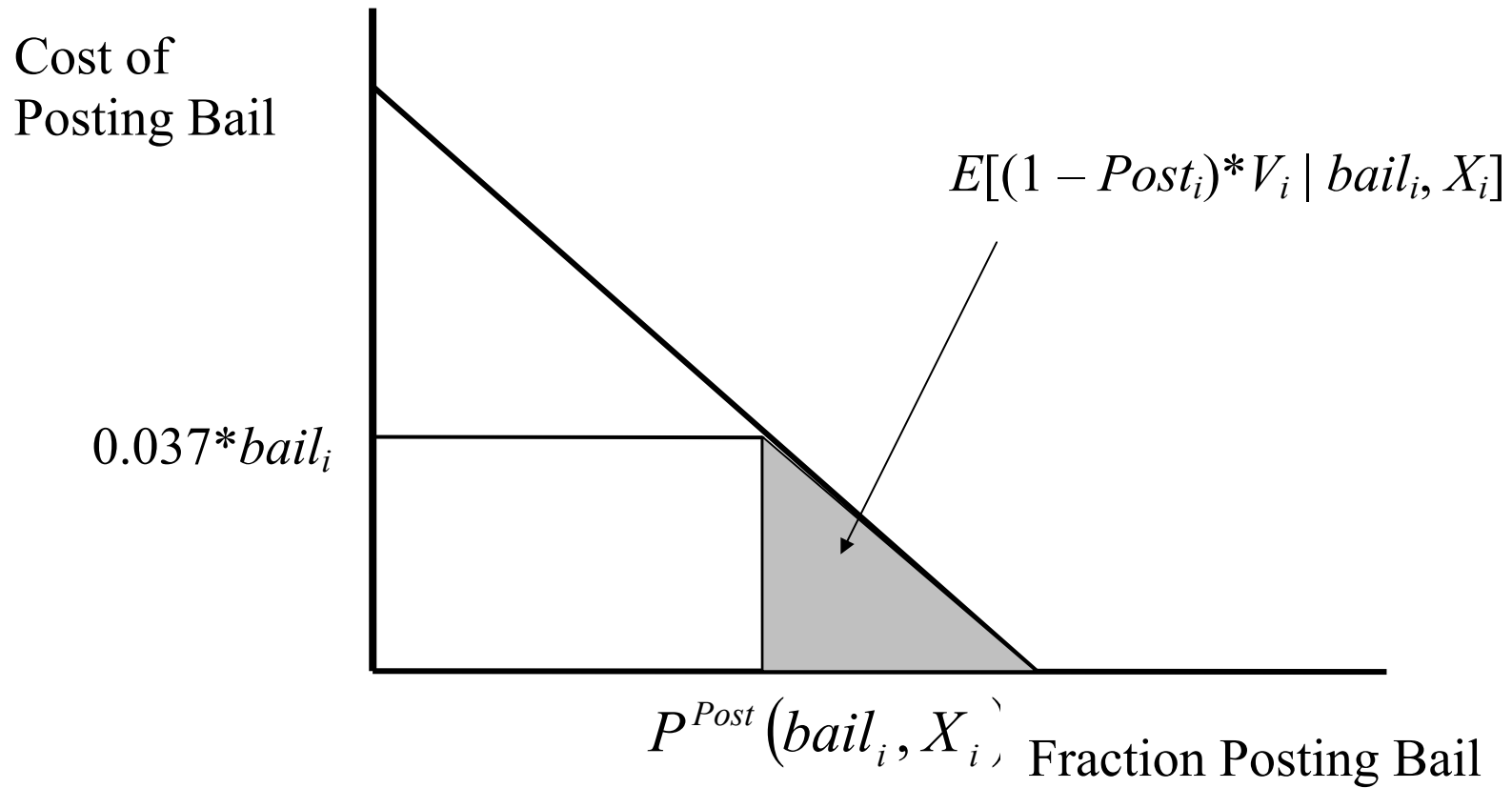
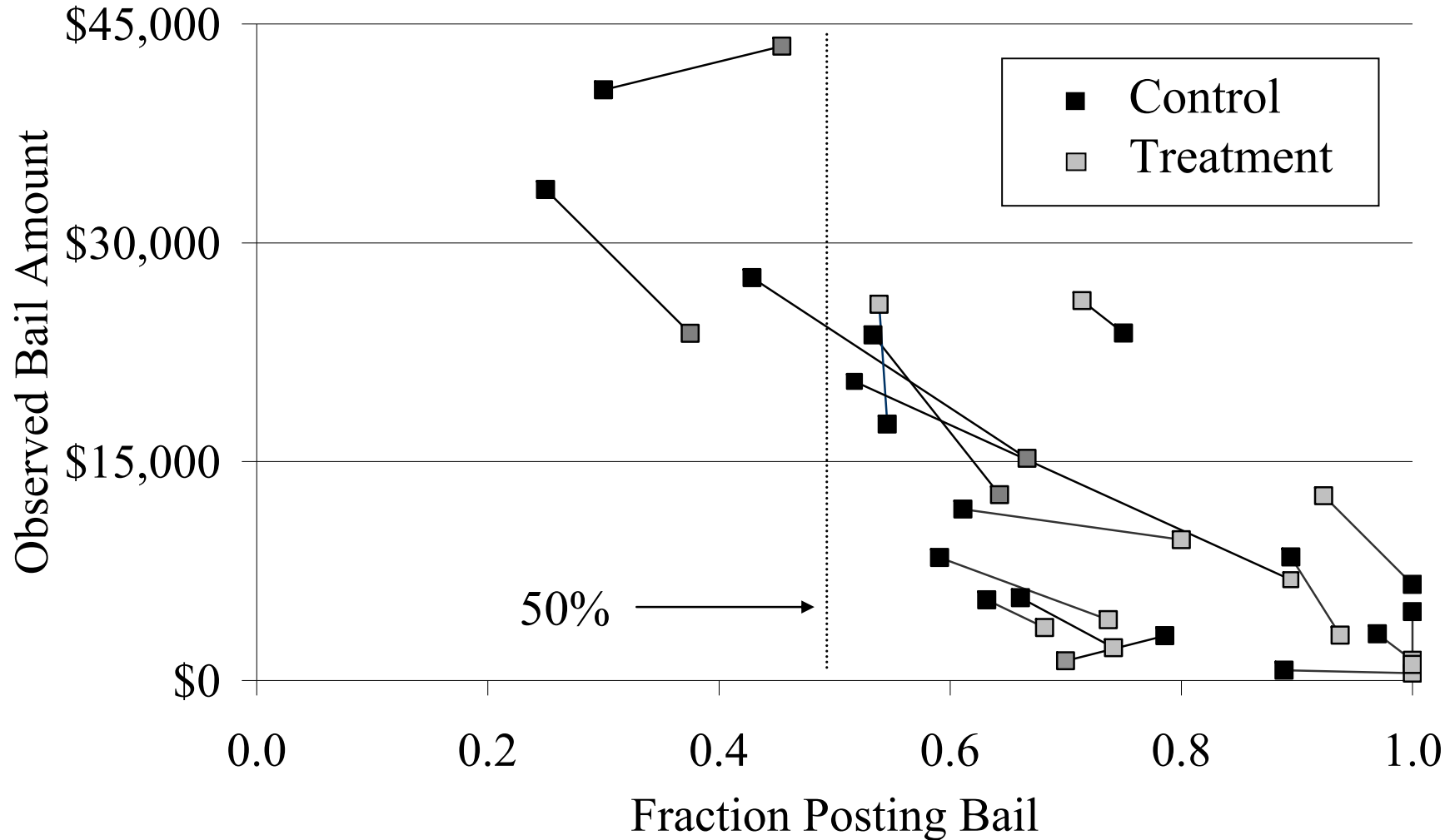
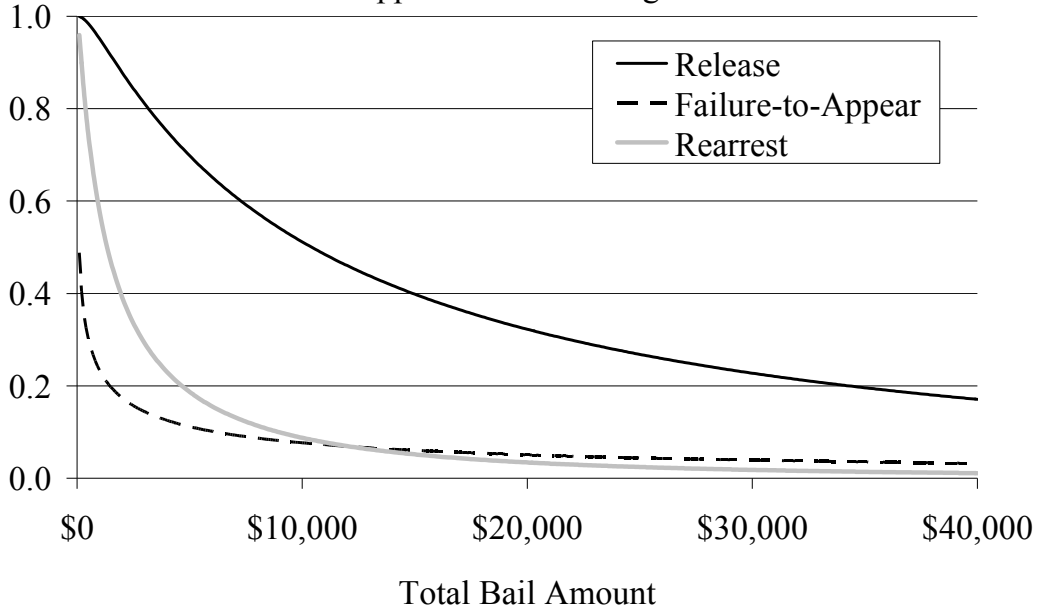


Figure 4: Estimated Demand for Freedom for Seventeen Charge Severity X Risk Combinations



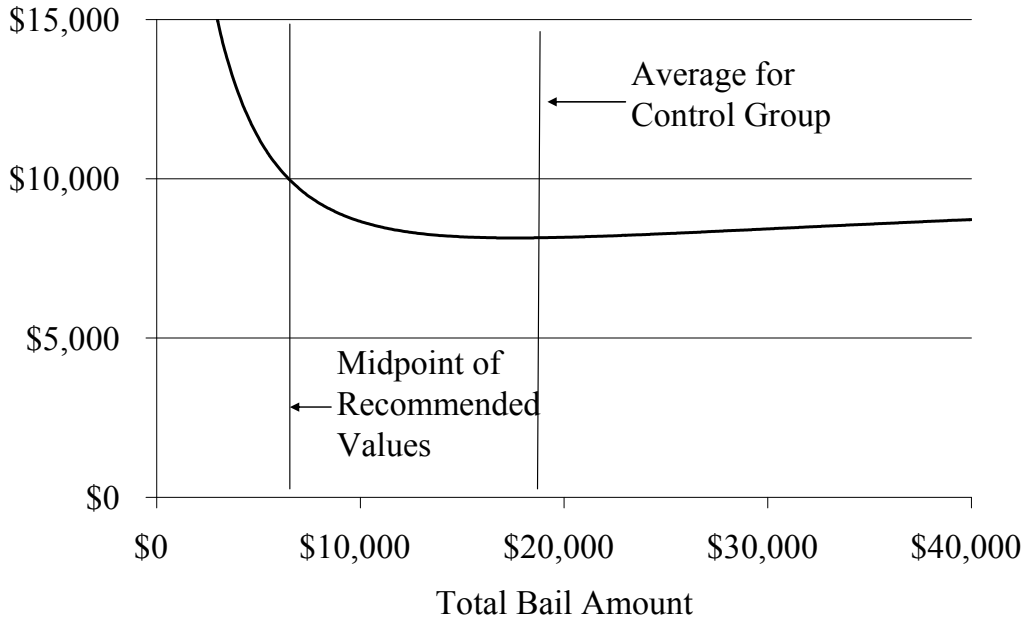
Notes to Figure 4: See notes to Figures 1 and 2 and Tables 2 to 4. Each line segment plots a demand curve for a different Midpoint of Bail Range Recommended Under Experiment. The gray squares show means for the treatment group, and the black squares show means for the control group. The line segments connect observations with the same levels of Midpoint of Bail Range. The sample is the same as in Tables 2 to 7

Figure 5: Estimated Probabilities of Release, Rearrest, and Failure-to-Appear for the Average Defendant



Notes: See notes to Figures 1 to 4 and Tables 2 to 6. Predicted probabilities from instrumental variables probit regressions are shown. Specifications without controls are shown, is in Columns (1), (3), and (5) of Table 6.

Figure 6: Estimated Total Social Cost for Average Bail Case



Notes: See notes to Figures 1 to 5 and Tables 2 to 7. This estimated social cost is constructed using the probabilities shown in Figure 5 and the social cost expression in Equation (7). Each probability in Figure 5 is weighted by the social cost of that outcome. The social cost of detention is estimated as the sum of the cost to the state plus the average defendant's value of freedom. The cost to the state is estimated to be \$9,450. The average value of freedom is estimated as the area under the demand curve for defendants who do not post, as illustrated in Figure 3 and in Equation (14). The cost per rearrest is estimated to be \$44,700, and the cost per failure-to-appear is estimated to be \$395. Additional details in the text

Table 1: Summary Statistics on Bail in the United States, May 2000

At Midyear 2000. . .	
Total Persons Incarcerated	2.1 million
Total Untried Defendants Incarcerated (Est.)	0.3 million
Total Untried Defendants Not Incarcerated (Est.)	0.7 million
Among Those Detained. . .	
Average Bail Amount	\$59,700
Fraction Eventually Sentenced	0.64
Among Those Posting . . .	
Average Bail Amount	\$6,200
Fraction Eventually Sentenced	0.25
Fraction Rearrested for Other Crimes	0.16
Fraction Missing at Least One Court Appearance	0.22

Notes: Data sources: Beck and Karberg (2001) for total persons incarcerated, State Court Processing Statistics (U.S. Bureau of Justice Statistics, 2006) for additional characteristics about trials. Calculations described in the web appendix.

Table 3: Sample Means by Treatment/Control Status for Regression Sample

Variable	(1) Treatment	(2) Control	(3) Difference	(4) SE For Difference (Robust)	(5) SE For Difference (Clustered)
Released	0.68	0.54	0.14	(0.04)**	(0.04)**
Rearrested	0.11	0.05	0.06	(0.02)**	(0.03)**
Failed to Appear	0.13	0.10	0.03	(0.03)	(0.03)
Bail Amount (in 2003 Dollars)	\$13,492	\$19,006	-\$5,514	(3,075)*	(3,229)*
Midpoint of Recommended Bail	\$6,348	\$6,419	-\$71	(334)	(316) ^a
Charge Severity	13.0	13.0	-0.03	(0.18)	(0.18) ^a
Index of Flight/Rearrest Risk (1 to 5)	3.94	3.86	0.08	(0.12)	(0.12) ^a
Time Until Trial	85.93	86.77	-0.8	(3.6)	(2.9)
Prior Convictions	1.69	1.47	0.22	(0.24)	(0.18)
Prior Arrests	5.39	5.08	0.31	(0.58)	(0.40) ^a
White	0.16	0.17	-0.02	(0.03)	(0.04)
Male	0.92	0.94	-0.02	(0.02)	(0.03)
Age	27.0	27.9	-0.93	(0.85)	(0.84)
Married	0.21	0.27	-0.06	(0.04)	(0.02)
Employed	0.26	0.26	0.01	(0.04)	(0.02)
Weekly Income	\$75.3	\$68.5	\$6.8	(14.0)	(8.1)
Fixed Address	0.76	0.73	0.03	(0.04)	(0.06)
Owens a Car	0.08	0.10	-0.01	(0.03)	(0.03)
Observations	245	242	487	487	487

Notes: See notes to Figures 1 and 2 and Table 2. Regression sample includes all cells (from Table 2) in which observed bail levels for the control group were significantly different from recommended levels. Excludes 81 observations for which bail was zero. Fixed address is coded as one if the defendant has lived at his/her present address for at least one year. For clustered standard errors, observations are grouped by judge and cell using the multi-way clustering approach of Cameron, Gelbach, and Miller (2006).

^a indicates that multi-way clustering did not converge, and single-way (by judge) was used instead. Additional details in the text.

Table 4: Cross-Sectional Probit Estimates for Control Group

	(1)	(2)	(3)	(4)	(5)	(6)
Elasticity with Respect to Bail Shown for the Mean Observation						
	Pr(Released)		Pr(Failed-to-Appear)		Pr(Rearrested)	
Ln(Bail Amount)	-0.17	-0.18	-0.05	-0.06	0.00	0.02
Robust SE	(0.03)**	(0.03)**	(0.01)**	(0.02)**	(0.01)	(0.04)
SE Clustered by Judge	(0.04)**	(0.04)**	(0.01)**	(0.01)**	(0.01)	(0.04)
Controls?		Yes		Yes		Yes
Pseudo-R ²	0.15	0.29	0.04	0.18	0.00	0.39
Observations	242	242	242	242	242	242

Notes: See notes to Tables 2 and 3 and Figures 1 and 2. Sample includes observations from the control group that appear in the regression sample (as in column (2) of Table 3). Each estimated effect comes from a different probit regression. The regressor of interest is Ln(Bail Amount). The elasticity estimated here is the marginal effect of log bail on the probability of interest. Controls include prior convictions, prior arrests, age, weekly earnings, and dummies for charge severity X flight/rearrest risk interactions, married, employed, has a fixed address, and owns a car. Efron's Pseudo-R² measure is used. Single-way clustering (by judge) is used for all regressions, due to the use of probit specifications. Standard errors for marginal effects calculated using the delta method.

** Denotes 5% significance.

* Denotes 10% significance.

Table 5: First-Stage Linear Regressions and Reduced Form Probit Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Effect of Unit Change in Treatment for the Mean Observation Shown for Probit Regressions							
	Ln(Bail Amount)		Pr(Released)		Pr(Failed-to-Appear)		Pr(Rearrested)	
Treatment	-0.52	-0.53	0.14	0.16	0.03	0.03	0.06	0.08
Robust SE	(0.11)**	(0.10)**	(0.04)**	(0.05)**	(0.03)	(0.03)	(0.02)**	(0.03)**
Clustered SE	(0.21)**	(0.22)**	(0.05)**	(0.05)**	(0.02)	(0.02)*	(0.02)**	(0.02)**
Controls?		Yes		Yes		Yes		Yes
R ²	0.04	0.36						
Pseudo-R ²			0.02	0.16	0.00	0.04	0.01	0.06
Observations	487	487	487	487	487	487	487	487

Notes: See notes to Tables 2 to 4 and Figures 1 and 2.

Table 6: Instrumental Variables Probit Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Elasticity with Respect to Bail Shown for the Mean Observation					
	Pr(Released)		Pr(Failed-to-Appear)		Pr(Rearrested)	
Ln(Bail Amount)	-0.27	-0.32	-0.05	-0.06	-0.14	-0.16
Robust SE	(0.06)**	(0.07)**	(0.05)	(0.05)	(0.07)*	(0.05)**
Clustered SE	(0.06)**	(0.09)**	(0.03)*	(0.02)**	(0.07)**	(0.07)**
Controls?		Yes		Yes		Yes
Pseudo-R ²	0.13	0.21	0.05	0.07	-0.49	-0.47
Observations	487	487	487	487	487	487

Table 7: Estimated Value of Freedom, Optimal Bail, and Social Cost at Different Bail Levels

	(1)	(2)	(3)	(4)
	Entire Regression Sample	Separately by Recommended Bail Levels		
		Low	Medium	High
1. Estimated Average Value of Freedom	\$1,050 (631)	\$6,770 (28,700)	\$800 (344)	\$971 (214)
2. Estimated Optimal Bail [Bootstrapped 95% CI]	\$17,700 [1, 30,100]	\$12,400 [1, ∞]	\$15,600 [1, ∞]	∞ [1, 67,800]
3. Average Bail for Control Group	\$19,000 (2,560)	\$8,430 (1,530)	\$21,600 (2,870)	\$36,400 (7,090)
4'. Average Bail Recommended by Guidelines	\$6,380 (157)	\$2,850 (75)	\$7,280 (125)	\$11,700 (150)
5. Estimated Social Cost at Optimal Bail Levels	\$8,140 [2,950, 10 mil]	\$6,060 [160, 10 mil]	\$8,770 [30, 10 mil]	\$10,700 [350, 10 mil]
6. Estimated Social Cost at Control Bail Levels	\$8,150 [4,070, 11,200]	\$6,280 [3,380, 7.6x10 ¹⁸]	\$8,930 [4,710, 2.9x10 ⁹]	\$13,300 [3,620, 39,900]
7. Estimated Social Cost at Recommended Bail Levels	\$10,100 [3,310, 27,500]	\$10,600 [4,090, 7.6x10 ¹⁸]	\$10,300 [4,850, 2.9x10 ⁹]	\$23,100 [2,550, 30,500]
Observations	487	197	192	98

Notes: See notes to Figures 1 to 6 and Tables 2 to 6. Average defendant's value of freedom is calculated as

$E[V_i | X_i] = e^{\hat{\beta}^{Post} X_i + \frac{\hat{\sigma}_{Post}^2}{2}}$, as in Equation (13). Standard errors for value of freedom calculated using the delta method. Optimal bail is calculated as the bail that minimizes the estimated social cost, as shown in Equation (7). For bail amounts other than the optimum and for value of freedom, standard errors, clustered by judge, are shown in parentheses. For optimal bail amount and social costs, bootstrapped 95% confidence intervals are calculated using a bootstrap with 1,000 repetitions of sample size N . Bootstrapping is clustered by judge, and C^{Crime} , C^{Flight} , and cutoffs for the dangerousness tertiles are recalculated in repetitions. However, the construction of the "regression sample" is taken as given. Infinite values for optimal bail indicate that no finite bail amount produced lower estimated social cost than did certain detention. All causal relationships are estimated using the instrumental variables probit regressions with no controls, as in Column (1) of Table 6. Additional details in the text.

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