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Jenny Williams
University of Melbourne and IZA

Don Weatherburn
Bureau of Crime Statistics and Research

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Can Electronic Monitoring Reduce Reoffending?*

This research evaluates the impact of electronic monitoring as an alternative to prison on reoffending. Leveraging plausibly exogenous variation in sentencing outcomes generated by quasi- random assignment of judges, we find electronic monitoring reduces reoffending within 24 months by 16 percentage points compared to serving a prison sentence. For offenders who are less than 30, the reduction is 43 percentage points, with sizeable and significant reductions in reoffending persisting for 8 years. Our calculations suggest that criminal justice costs are reduced by around $30,000 for each eligible offender who serves their sentence under electronic monitoring rather than in prison.

JEL Classification: K42

Keywords: electronic monitoring, prison, reoffending, crime

Corresponding author:
Jenny Williams
Department of Economics
The University of Melbourne
3010 Victoria
Australia

E-mail: jenny.williams@unimelb.edu.au

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1 Introduction

The incarceration rate has grown substantially in the United States, tripling between 1980 and 2010. The U.S. is not alone in this regard. The incarceration rate has increased in many OECD countries, particularly those in western Europe, as well as in countries such as Australia and New Zealand.[1] The high cost associated with growing prison populations, estimated to be on the order to 80 billion dollars in the U.S. (DeVuono-Powell *et al.* , 2015), has led to substantial interest in sentencing alternatives to incarcerating offenders in prison. One alternative that has attracted significant attention is the use of electronic monitoring. Electronic monitoring typically involves offenders serving their sentence in their home, with their location tracked using an electronic monitoring ankle bracelet. As such, it provides a low cost means of depriving offenders of their liberty. Nonetheless, there are concerns that allowing offenders to serve their sentence in their home rather than in prison is likely to perceived as a "soft" or lesser punishment, and may therefore be less effective at deterring reoffending.[2] We study whether this is the case, providing new evidence on the impact on reoffending of serving a sentence under electronic monitoring rather than in prison.

Electronic monitoring is not new. Its use in the UK dates back almost thirty years (Hucklesby & Holdsworth, 2016). In recent times, however, its popularity has grown considerably. In the United States, the number of accused and convicted criminal offenders subject to electronic monitoring is estimated to have risen nearly 140 per cent over the 10 year period ending in 2015 (The Pew Charitable Trusts, 2016). The use of electronic monitoring has also grown throughout Europe, Australia, New Zealand, Canada and in parts of South America. Despite this, there are few studies that provide convincing evidence as to whether electronic monitoring reduces recidivism relative to imprisonment (Renzema & Mayo-Wilson, 2005). This is because those who receive a sentence to be served under electronic monitoring are likely to differ in observable ways, such as committing less serious offences, and in unobservable ways, such as exhibiting greater remorse, that make them less likely to re-offend. As a consequence, the causal effect of serving a sentence under electronic monitoring rather than in prison on reoffending is difficult to identify.

A second difficulty with research seeking to evaluate the impact of electronic monitoring on recidivism is that electronic monitoring is not a single well-defined form of intervention applied at

[1] See Bhuller *et al.* (2016) for a discussion of the growth in the rate of imprisonment in western Europe.

[2] We focus on the impact of an individual serving a sentence under electronic monitoring rather than in prison on their own future reoffending, referred to as specific deterrence. We note that the impact of the use of electronic monitoring rather than imprisonment on deterring crime more broadly, or general deterrence, may also be of concern. While we are unable to address this issue, in their recent review of the literature on general deterrence, Chalfin & McCary (2017) conclude that "within the range of typical changes to sanctions in contemporary criminal-justice systems, the evidence suggests that the magnitude of deterrence owing to more severe sentencing is not large", and that "the current elasticity of crime with respect to prison populations is approximately 0.2".

a particular stage in the criminal justice process to a defined set of offenders (DeMichele, 2014). Electronic monitoring has been used as an alternative to pre-trial detention, as an alternative to a custodial sentence served in prison, as a condition of bail, as a requirement of community and suspended sentence orders and as a form of early release. In some jurisdictions it can be used for any type of offence, including violent offences, whereas other jurisdictions limit its use to non-violent and less serious offences. In this paper, we study electronic monitoring used as a front-end alternative to a custodial sentence served in prison for non-violent offenders.

In order to evaluate the impact on reoffending of serving a sentence under electronic monitoring we draw on detailed individual level administrative data from courts, prisons, and corrective services for a large urban population. An instrumental variables strategy is employed to address selection into electronic monitoring. Our approach exploits plausibly exogenous variation in sentencing outcomes generated by quasi-random assignment of cases to judges who differ in their tendency to use the sentencing options of electronic monitoring and prison.[3] Our baseline model examines reoffending within 24 months for offenders of all ages. Estimates from this specification show that that serving a sentence under electronic monitoring rather than in prison reduces reoffending from 58% to 42% (16 percentage points). This effect is robust to accounting for time spent under electronic monitoring and is not driven by those who have been previously imprisoned. The reduction in reoffending is, however, found to be concentrated amongst offenders who are less than 30 years old. For this group, serving a sentence under electronic monitoring rather than in prison reduces reoffending within 24 months from 64% to 21% (43 percentage points).

We also investigate the extent to which the reduction in reoffending that occurs within 24 months of free-time persists or fades out at longer durations of follow-up. To do so, we examine reoffending out to a ten year horizon. When considering all aged offenders, we find that the reduction in reoffending persists to five years of free-time. For those who are under 30, the reduction in reoffending persists to 8 years of free-time.

Finally, we combine our estimates with criminal justice cost information to provide a sense of the budgetary implications of diverting offenders from prison into electronic monitoring. Our back-of-the-envelope calculations show that each offender who serves their sentence under electronic monitoring rather than in prison saves the public purse close to $30,000 on reduced supervision and future court and prison costs.

Ours is not the first study to evaluate the impact of electronic monitoring on reoffending relative to prison. Di Tella & Schargrodsky (2013) use a similar identification strategy as this study

[3]This approach is similar to that used by others to study the impact of incarceration (Aizer & Doyle, 2015; Bhuller *et al.* , 2016; Dobbie *et al.* , 2018; Green & Winik, 2010), length of incarceration (Kling, 2006) and pre-trial electronic monitoring (Di Tella & Schargrodsky, 2013).

to examine the impact of pre-trial electronic monitoring in Argentina, Henneguelle *et al.* (2016) evaluate a pilot of electronic monitoring as a front-end alternative to prison in France using geographic and temporal variation in its availability during the role out, and Marie (2009) uses a regression discontinuity approach to examine the impact of electronic monitoring on reoffending in the context of early release for offenders serving prison sentences in England and Wales. All of these studies are unanimous in finding that electronic monitoring reduces reoffending.

In context of this nascent literature, our contributions are three-fold. First, we provide evidence that an electronic monitoring program that diverts offenders from prison, and that is operating at scale, reduces reoffending within 24 months of time spent living within the community. Previous research has studied the use of electronic monitoring at the pre-trial phase, where bail might otherwise be used, and for early release from prison, where parole might be considered an alternative. Studying the use of electronic monitoring as a front-end alternative to prison is important because, used in this way, it diverts offenders from prison and thereby serves as a genuine alternative to incarceration. Further, the electronic monitoring program we study is well established and operating at scale. This is important as positive findings from pilots are not always replicated when programs are scaled up.[4]

Our second contribution is that we provide the first evidence on the impact of a serving a sentence under electronic monitoring out to a ten year horizon. Previous evidence typically considers reoffending within 24 months. Our results show that there are significant reductions in reoffending at much longer durations. This suggests that the diversionary and rehabilitative aspects of the electronic monitoring program we study led to long term changes in offender behaviour. This is especially the case for younger offenders, who have potentially longer future offending careers.

Our final contribution is demonstrating that, in addition to the reducing reoffending, the electronic program we evaluate produced significant criminal justice cost saving for each offender diverted from prison. This is important evidence on the potential for the electronic monitoring to reduce the economic burden or crime.

The remainder of this paper is set out as follows. Section 2 provides background on electronic monitoring program we study, and the courts and sentencing environment in which electronic monitoring is available as an alternative to prison. Section 3 presents our conceptual framework and empirical strategy. Section 4 discusses the data we draw on and provides a descriptive analysis of the relationship between electronic monitoring, prison and reoffending. Section 5 investigates the validity of identifying assumptions we employ. Section 6 provides our baseline analysis, a sensitivity analysis, an examination of a potential violation of the exclusion restriction, an examination of the

[4]Further, in both the Argentine and French context, electronic monitoring is available and used as alternative to prison for violent offences including rape and murder, which may not be a scenario considered by other jurisdictions.

long run impacts of electronic monitoring, and our costing calculations. We conclude in section 7 with a discussion of the implications of our findings.

2 Background

2.1 Electronic Monitoring in NSW

Electronic monitoring has been available in Sydney, the capital of New South Wales (NSW) and Australia's most populous city, since 1997.[5] It was introduced as a sentencing alternative to prison for less serious, non-violent offenders. It provides a means of depriving offenders of their liberty to a degree similar to a minimum security prison, while allowing them to maintain family ties, to work, and to access support and treatment services. The aims of the electronic monitoring program we study are to divert less serious and non-violent offenders from prison while maintaining a high level of supervision, and to reduce the risk of future reoffending through rehabilitation (Auditor-General's Report, 2010).

Electronic monitoring involves offenders serving their sentence in the community rather than in prison but with restricted freedom of movement. While serving a sentence of electronic monitoring, offenders live at home, either alone or with others (including their family), and are not permitted to leave their home except when approval is given by their supervising community corrections officer for activities such as employment, education, intervention programs and medical appointments. All activities are scheduled on a weekly basis and compliance with the schedule and other requirements is monitored via an electronic monitoring anklet worn by the offender, through telephone calls, and regular home and field visits (for out of home activities) from their supervising community corrections officer (Studerus, 1997). Offenders must also abstain from alcohol and illicit drugs and are subject to random testing to ensure compliance.

In addition to diverting less serious offenders from the prison system by having them serve their sentence in the community, electronic monitoring in NSW also aims to reduce the risk of reoffending though rehabilitation. The aim of rehabilitation is pursued by designing offender-specific programs to be undertaken while under electronic monitoring.[6] For example, offenders whose sentence is served under electronic monitoring may be expected to be employed. If they are able to work but are not employed, they could be required to undertake vocational training courses and job search. For those who are not able to work, developmental activities are typically encouraged (Studerus, 1997).

[5] The population of Sydney is around 5 million according to the 2016 census (Australian Bureau of Statistics, 2016).

[6] In designing these programs, all aspects of the offender's lives are taken into consideration, including family issues, parental responsibilities, drug and alcohol issues, health issues and employment responsibilities and opportunities (Auditor-General's Report, 2010).

In addition, specific personal issues, often drug or alcohol related, are addressed through requiring the offender to undertake counseling or other support services. Rehabilitation programs are also available to offenders serving a prison term of greater than 6 months; however, undertaking these programs is optional in prison. Further, offenders serving sentences under electronic monitoring are supported in their rehabilitation by a high rate of face to face contact with their supervising officer, who liaises closely with supporting community agencies.[7]

2.2 Sentencing in NSW

In the NSW court system, the sentencing of guilty offenders is a two-step process whereby the judge must first decide, based on the seriousness of the offence and the need to protect the community, whether a custodial sentence is required and if so, the duration of the custodial term. If the judge determines that a custodial sentence is appropriate, the second step in sentencing is for the judge to decide the manner in which the sentence should be served. For non-violent offences for which the judge determines that a custodial sentence of no more than 18 months is appropriate, electronic monitoring is available as an alternative to prison.

In the event that the judge determines that the offender should serve their sentence under electronic monitoring, the offender is referred for assessment for suitability. The referral operates to stay the execution of sentencing pending the completion of the assessment by NSW Community Corrections. A Community Corrections Officer prepares a report on the offender and if the report is favourable, the judge may order the offender to serve the sentence under electronic monitoring. In preparing their report, the Community Corrections Officer first ensure that the offender is eligible. Eligibility is based on three factors: a sentence length of no more than 18 months; the offences for which electronic monitoring is being considered are not related to violent of threatening behaviour; and the offender's criminal history does not include violent or threatening offences. For eligible offenders, assessments consider the impact of electronic monitoring on family and/or co-residents as well as the offender. If the offender is assessed as posing no substantial threat to the family or other members of the community, can be managed successfully under the terms of electronic monitoring, and if the the offender and all co-residents consent, the offender is recommended as suitable (Studerus, 1997).

While electronic monitoring has been available in NSW since 1997, an organisational change within the NSW Department of Justice shifted the management of the electronic monitoring program to the newly established Community Compliance and Monitoring Group (CCMG) in the second half of 2007. Under the CCMG, assessments became more punitive and started with the

[7] To accommodate this, supervising officers have smaller case loads and more flexible working conditions.

premise that "everyone is unsuitable and must prove themselves to be suitable" (Auditor-General's Report, 2010). It required drug and alcohol testing as part of the assessment process and a positive drug or alcohol test lead to a negative assessment. Further, compliance monitoring included unannounced home visits and an increase in the use of random drug and alcohol testing. The approach of the CCMG was not well received by judges. The combination of the more stringent assessment process and the fall from favour amongst the judiciary lead electronic monitoring to all but disappear as a sentencing option. For this reason, this study focuses on the period 2000-2007.

Of importance to this study is the way that cases are allocated to judges in the NSW courts system. When offenders are charged with a crime in NSW, their case is heard in the court in the jurisdiction where the crime occurred. In urban locations, such as Sydney, courts are typically multi-court complexes, with each court comprising several court rooms and a different judge presiding in each courtroom. Offenders are provided with a date, time, and courtroom within a court (or court complex) for their hearing. There is no scope for offenders to influence the judge that hears their case. Judges are rotated across courtrooms within a court, across courts within a court complex, and across court complexes. The process by which judges are assigned to courtrooms does not depend on the nature of cases being heard, but rather on practical considerations such as the availability of judges and the case load at courts. On this basis, the Chief Magistrate of NSW allocates a pool of judges to each multi-court complex, and judges are then allocated to each court within the court complex by the Supervising Magistrate.[8] Given this process, the assignment of judge to case is effectively random.

3 Research Design

3.1 Conceptual Framework

The primary reason for the use of prison for non-violent offenders over alternate punishments is its greater potential for specific deterrence. The idea behind specific deterrence is that the criminal justice sanction imposed is sufficiently costly so as to deter the individual from engaging in crime in the future. In the case of a prison sentence, the direct cost of punishment is loss of freedom and autonomy as offenders are removed from the community and serve their sentence in the custody of the prisons system. Electronic monitoring seeks to restrict freedom to a degree similar to a minimum security prison with day release, but keeps offenders living within the community. As

[8]The Listing and Rostering Co-ordinator at the Chief Magistrate's Office gathers all the information in relation to required sittings and magistrate commitments and completes the roster for the following week, allocating magistrates to court locations. This roster is generally published by the Thursday for the following week. This information was provided to Don Weatherburn in personal correspondence by the Chief Magistrate of NSW.

such, serving a sentence in prison exerts a greater specific deterrence effect than serving a sentence under electronic monitoring. For this reason, and all else being equal, serving a sentence in prison should lead to a greater reduction in reoffending than electronic monitoring.

That being said, the empirical evidence on the deterrent effect of prison on reoffending is limited and mixed.[9] For example, Aizer & Doyle (2015) find that incarceration as a juvenile increases the likelihood of incarceration as an adult while Hjalmarsson (2009) finds that a custodial sentence reduces the recidivism rate of juvenile offenders. In terms of adult offending, Mueller-Smith (2015) finds that incarceration increases recidivism, Green & Winik (2010) find that it has no effect on recidivism, while in the context of Norway, Bhuller *et al.* (2016) find that it reduces reoffending.[10]

A potential explanation for the inconsistent findings on the impact of prison on reoffending is that, in addition to its potential deterrent effect, imprisonment may increase reoffending through other channels. For example, serving a sentence incarcerated in prison places offenders in the sole company of other offenders, providing them an opportunity to build their criminal networks and accumulate criminal human capital (Bayer *et al.* , 2009). In a similar vein, imprisonment is likely to reduce attachment to work and family, thereby reducing the cost of reoffending (Apel *et al.* , 2010; Dobbie *et al.* , 2018; Lopoo & Western, 2005; Mueller-Smith, 2015). Both the increase in criminal capital and networks and the reduction in attachment to work and family suggest that prison may increase reoffending behaviour.

In contrast, under electronic monitoring, strict conditions and close monitoring make opportunities for interactions with criminal peers less likely. Moreover, those serving a sentence under electronic monitoring often live with their family, are expected to work and undertake rehabilitative activities (such as drug and alcohol counseling). Collectively, the monitoring, promotion of attachment to work and family, and addressing drug and alcohol problems, is likely to reduce the probability of reoffending for those serving a sentence under electronic monitoring compared to an otherwise similar individual who serves their sentence in prison.

Overall, while specific deterrence suggests that imprisonment may lead to a lower rate of reoffending relative to electronic monitoring, reduced attachment to work and family, and the availability of criminal peers suggests that prison may increase the risk of reoffending relative to electronic monitoring. As we cannot disentangle these mechanisms, all of which may come into play, the

[9] Nagin *et al.* (2009) comments that "Remarkably little is known about the effects of imprisonment on reoffending." In their recent and comprehensive review of the literature from economics and criminology, Chalfin & McCary (2017) conclude that the magnitude of deterrent effects of incarceration are likely small.

[10] Bhuller *et al.* (2016) note that the Norwegian prison system differs from that in the US in important ways that are likely to lead to better post-prison outcomes. Specifically, the Norwegian prison system focuses on rehabilitation and preparing inmates for life after prison, which includes housing prisoners in low security environments and permitting visits to families. Further, Correctional Services in Norway works with other agencies to ensure that upon release, offenders have a home and a job.

question of whether electronic monitoring reduces reoffending relative to prison is an empirical one, the answer to which this paper seeks to provide.

3.2 Empirical Framework

In order to evaluate the impact of serving a sentence under electronic monitoring rather than in prison on reoffending, we model reoffending by individual i, $reoff_i$ as a function of serving a sentence under electronic monitoring, EM_i (the reference category is serving a prison sentence), a vector of control variables that always includes fully interacted court and year of court finalization fixed effects, X_i, and unobserved individual specific characteristics, ν_i.

$$reoff_i = \beta_{EM} EM_i + \beta' X_i + \nu_i \tag{1}$$

There are challenges in obtaining estimates of the causal effect of serving a sentence under electronic monitoring rather than in prison, β_{EM} on reoffending. First, the manner in which the offender's sentence is to be served is not randomly assigned; offenders who serve their sentence under electronic monitoring are likely to differ from those who serve their sentence in prison in unobserved ways that are negatively correlated with reoffending, such as the offender's remorse or extenuating circumstance contributing to the offender's behavior. If this is the case, OLS estimates will be biased towards finding that serving a sentence under electronic monitoring lowers the rate of reoffending.

A second issue we face is that while it is the judge who decides if an offender is to serve their sentence under electronic monitoring, in order to do so the judge must first receive a favorable assessment from Community Corrections.[11] Around 70% of those referred for assessment serve a sentence under electronic monitoring over the period we examine. This suggests a potential for the assessment process to contribute to a selection effect through positive recommendations to the case judge, and therefore in those for whom a judge is observed to sentence to electronic monitoring.

We address these issues of endogenous selection into punishment type using an Instrumental Variables / Two Stage Least Squares (IV/2SLS) approach where the instrumental variable is the tendency of a quasi-randomly assigned judge to *refer* eligible cases for assessment for electronic monitoring. This approach exploits the exogenous source of variation in the likelihood that an offender receives electronic monitoring that is generated because (a) judges differ in their tendency to *refer* offenders for electronic monitoring, and (b) the assignment of judges to cases within a

[11] Similarly, in the Argentine criminal justice system studied by Di Tella & Schargrodsky (2013), offenders must be assessed for suitability for electronic monitoring before a judge can make an electronic monitoring order, although the authors do not account for this in their study design.

court in a given year is effectively random. It is this variation that is used to identify the impact of electronic monitoring (relative to prison) on reoffending. This approach alleviates the selection into electronic monitoring that occurs via the assessment process, as well as selection due to unobserved offender characteristics because the decision to refer to assessment is made by the judge prior to assessment, and assignment of judge to case is as good as random.[12]

To be more concrete, we use 2SLS to estimate the causal impact of serving a sentence under EM rather than in prison, where the first stage is given by:

$$EM_i = \alpha_{EM}\pi_{ij}^{EM} + \alpha X_i + \epsilon_i^{EM} \tag{2}$$

and π_{ij}^{EM} is the tendency of judge j assigned to offender i to refer eligible cases for assessment for EM. The structural model for the reoffending is given by (1) above.

2SLS provides consistent estimates of the causal parameters of interest if (1) the instrumental variable, judge tendency to refer for assessment for electronic monitoring, is relevant in explaining whether individual i before judge j receives a sentence to be served under electronic monitoring (relevance), (2) conditional on court by year fixed effects, the judge tendency to refer to assessment for electronic monitoring is as good as randomly assigned (random assignment) , and (3) the judge tendency to refer for electronic monitoring assessment only impacts on reoffending through its impact on receiving a sentence of electronic monitoring (excludability). Further, under heterogeneous treatment effects, a Local Average Treatment Effects (LATE) interpretation requires (4) that the instrument satisfies monotonicity. In our application, this means that the probability that individual i receives as sentence of electronic monitoring is monotonically increasing in the tendency of judges to refer eligible cases for assessment for electronic monitoring. We examine the conditions of relevance, conditional independence and monotonicity in Section 4. We come back to the exclusion restriction later in the paper. If these assumptions are met, our empirical design identifies the causal impact of serving a sentence under electronic monitoring for individuals who would have served their sentence in prison had they faced a different judge. This is the Local Average Treatment Effect (LATE).

In our baseline model, the window over which reoffending is measured is 24 months of free-time, where free-time is defined as time spent in the community. For those who serve their sentence in prison, free-time begins at the date of release. For those who served their sentence under electronic monitoring, free-time begins at the date that their case is finalized because a sentence of electronic

[12]Differences across courts in the utilization of electronic monitoring has been noted repeatedly since the early days of its introduction. See for example (Heggie, 1999). While there may be a variety of reasons why judges (and hence courts) differ in their willingness to use electronic monitoring rather than imprisonment, the underlying reasons do not matter; the validity of the approach rests on the random assignment of judges to cases (Bhuller *et al.* , 2016).

monitoring is served in the community. While living in the community permits reoffending for both prison releasees and those who are serving their sentence under electronic monitoring, it is important to recognise that the later group are subject to a greater degree of specific deterrence while serving their sentence. This is because (1) detection of reoffending is highly likely while under the monitoring; and (2) reoffending is a serious breach of the conditions of electronic monitoring and, irrespective of the type of offence, results in immediate referral to the Parole Board and likely revocation of electronic monitoring, with a prison term equal to the balance of the original prison sentence less time served under electronic monitoring imposed.[13] This swift and certain punishment creates a specific deterrence effect for those serving a sentence under electronic monitoring for the duration of the monitoring sentence that is absent for prison releasees.[14] In order to get a sense of the importance of this on our baseline findings, we consider an alternative measure of reoffending in which free-time begins at the date of completion of electronic monitoring sentences, and at the date of release for prison sentences. Similarly, the specific deterrent effect of prison may be diminished by previous experience of imprisonment, including while awaiting trial (Dobbie *et al.* , 2018).[15] Alternatively, those who have been previously incarcerated may view serving a sentence under electronic monitoring as a "second chance", to which they respond by reducing reoffending (Henneguelle *et al.* , 2016). We investigate the extent to which our findings are impacted by previous incarceration in our sensitivity analysis.

4 Data

The data used in this analysis is drawn from two sources. The first is the Reoffending Database (ROD) provided by the NSW Bureau of Crime Statistics and Research (BOCSAR). ROD links individual case level data on all matters before Local, District and Supreme Criminal Courts, and Childrens Criminal Courts in New South Wales (NSW), with adult and juvenile custody data. Information on the judge overseeing each case was linked to the ROD data by BOCSAR. The second source of data used in this study is information on referrals of offenders to the NSW Community Corrections for assessment for suitability for electronic monitoring. These data was provided by the Corrections Research Evaluation & Statistics Unit (Corrective Services NSW) to BOCSAR,

[13]Serious or recurring minor breaches of conditions of electronic monitoring are immediately referred to the Parole Board for revocation. There are strict time lines for breach reports to be provided to the Parole Board and for the Parole Board to make their determination. In determining whether a breach has occurred, the Parole Board applies the administrative standard of proof, which is based on the "balance of probabilities" (Studerus, 1997).

[14]Evidence on the deterrence effect of swift and certain punishment in the context of Hawaii's Opportunity Probation with Enforcement (HOPE) program is reported by Hawken & Kleiman (2009) and in the context of South Dakota's 24/7 Sobriety Project by Kilmer *et al.* (2013).

[15]For example, Dobbie *et al.* (2018) find that pre-trial detention increases the probability of rearrest following case finalization, but it decreases it prior to finalization.

which linked it to the offender data extracted from the ROD for this study. The custody data are available from 2000. Given the changes in the administration of the electronic monitoring program than occurred in the second half of 2007, we focus our analysis on sentencing that occurred over the period 2000-2007. The follow-up period over which we measure reoffending extends to September 2016.

From the universe of the ROD, we extract all individuals whose primary offence is eligible for electronic monitoring and who are sentenced to prison or electronic monitoring. This includes proven offences for which the case judge deems imprisonment of a term of no more than 18 months is the appropriate punishment, where the sentence may be served in prison or under electronic monitoring. The requirement of eligibility for electronic monitoring excludes the following offences from our sample: murder; attempted murder; manslaughter; serious assault resulting in injury; all sexual assault and related offences; abduction; harassment and other offences against the person; importing, exporting, dealing or trafficking illicit drugs; and prohibited and regulated weapons and explosives offences. We further restrict our sample to include only those judges who presided over 10 or more electronic monitoring eligible cases over the period 2000-2007. This ensures that the judge tendency measure does not include judges who only appear once or twice for relevant cases over the sample period. As randomization of case to judge occurs at the court level, we also limit our sample to cases heard in courts for which more than one judge presided in each calendar year. As electronic monitoring was not generally available outside Sydney (the capital city of NSW) over the period of our analysis, we also limit observations to offenders living Sydney at the time they offended. Our final restriction is to limit the sample to offenders who are not identified as Aboriginal, as Aboriginals have a distinctly different relationship with the criminal justice system.

After applying the above set of restrictions, the sample consists of 16,475 cases. We refer to this sample as our full sample. Our judge tendency measure is based on the full sample. The sample used to estimate the structural parameter of interest consists of the first instance in which an offender in the full sample is before the court for an electronic monitoring eligible offence. This offence is referred to as the index case, and we refer to the sample of index cases as our estimation sample. There are 8,826 index cases in our estimation sample. Note that we have court data until September 2016, so we are able to measure reoffending in our estimation sample out to this horizon.

4.1 Reoffending

The primary outcome of interest is reoffending within 24 months of free-time (time living in the community). We construct the indicator for reoffending within 24 months of free-time using the elapsed time between either being released from prison and the first subsequent case before the

courts, or in the case of electronic monitoring, between the date of finalization of the index offence and the first subsequent case before the courts.[16] In addition to reoffending, the period of time an offender spends living in the community may end because he dies, or he is incarcerated for prior offences. If the offender's episode of free-time ends due to either of these reasons, or the follow-up period ends before 24 months of free-time elapses (that is their duration of free time is censored), the indicator for reoffending within 24 months is coded as missing since we do not know whether the offender would have reoffended with 24 months. This reduces the number of index cases in our estimation sample from 8,826 to 7,366.[17] Note that we use the term case and offender interchangeably as there is only a single index case for each offender in our estimation sample.

In an extended analysis we also consider the impact of convicted offenders serving a sentence under electronic monitoring relative to serving a prison sentence on recidivism within 12 months through to 120 months. This gives some sense as to whether any difference in reoffending by those serving a sentence under electronic monitoring is enduring or short lived. Each measure of recidivism within the given duration of time living in the community is constructed as an indicator equal to one if the individual reoffends within the period and zero otherwise, with those who die, are incarcerated for earlier offences, or whose follow-up period is shorter than the duration under study coded as missing.

4.2 Punishment

We limit our analysis to cases that are deemed punishable by imprisonment and are eligible for electronic monitoring. Table 1 shows the distribution of crimes in the full sample and the estimation sample (which consists of the index cases) by the manner in which their sentence is to be served. There are three main points to take away from Table 1. First, for the full sample we observe offenders receiving sentences of electronic monitoring and prison for each type of offence that is eligible for electronic monitoring. Second, for the full sample and the estimation sample the top three types of offences that are punished with electronic monitoring are traffic, fraud and government procedure, while the top three for prison are theft, traffic and government procedures. The third point to take away from Table 1 is that the distribution of offence type for each form of punishment is similar across the full sample and the estimation sample. For example, in the full sample 47% of cases punished with electronic monitoring have as their most serious offence a traffic offence compared to 45% in the estimation sample. Similarly, in the full sample, 20% of

[16] We include time serving a sentence under electronic monitoring as free-time as the individual is living in the community and is able to reoffend (more readily than if they were in prison).

[17] 85 are censored due to death; 1,355 are censored due to being incarcerated for prior offences; and 20 due to the follow-up period ending in less than 24 months of free-time.

cases receiving a prison sentence are for traffic offences compared to 21% in the estimation sample.

4.3 Control Variables

As noted earlier, all models we estimate control for a full set of interacted court and year of finalization fixed effects. This accounts for any differences in the types of cases heard, or culture of strictness, across courts and time, given that randomization occurs within courts at each point in time. We also control for crime type (injury, negligent driving, break and enter, theft, fraud, public order, and traffic with violations of government procedures as the omitted category) gender (with an indicator equal to one if the offender is male) and a quadratic in age. We additionally estimate models that control for an extended set of information, including the number of finalised court appearances within five years prior to the current court appearance, an indicator for the offender having no legal representation during their hearing, and a set of indicators for the local government area in which the offender lives. Descriptive statistics (sample mean and standard deviation) for the control variables can be found in Table 4.

4.4 Descriptive Analysis

Table 2 shows the reoffence rate by the manner in which the sentence is served for the estimation sample at 12 months through to 120 months of free-time. It shows that 47% of offenders in the estimation sample who are imprisoned face new charges before the courts within 12 months of being released, and this increases to 84% within 120 months of release. The reoffending rate for those who serve a sentence under electronic monitoring is 16% within 12 months, increasing to 66% within 120 months of free-time. These descriptive statistics suggests that imprisonment is associated with a greater likelihood of reoffending at any duration of free-time compared to electronic monitoring. Of course these associations could simply reflect favourable selection (in terms of risk of reoffending) into electronic monitoring. In order to determine the causal relationship between sentence type and reoffending, we follow the instrumental variables approach described in the previous section. We next turn to describing our instruments.

5 Instruments

5.1 Judge referrals to electronic monitoring

We use the full sample of 16,475 cases satisfying the restrictions discussed above to construct our measure of judge tendency to refer offenders for assessment for suitability for electronic monitoring. The measure we use is based on the judge specific leave-out mean rate of referral (Aizer & Doyle,

2015). This is constructed as the judge specific average rate of referral for all other cases the judge has handled, including past and future cases, and not only the index offences that comprise our estimation sample. The leave-out mean represents the case level probability that the assigned judge refers the offender to assessment for electronic monitoring based on the judge's past and future decisions for all other electronic monitoring eligible cases, excluding the case in question. Following Bhuller *et al.* (2016) and Dobbie *et al.* (2018), we construct the judge tendency measure for electronic monitoring as the residual from regressing the leave-out mean judge electronic monitoring referral rate on a set of fully interacted court and year of finalization fixed effects. This controls for differences across time and across courts in the types of cases heard, or culture of strictness. We do this as randomization occurs within the pool of available judges at the court level.

There are 139 judges and 52 courts in our estimation sample. The distribution of judge tendency to refer to assessment for electronic monitoring for the estimation sample is shown in Figure 1. For ease of interpretation, we re-center the distributions by adding the average of the leave out means to the residuals. The resultant mean tendency to refer to assessment for electronic monitoring is 0.12 with a standard deviation of 0.08. Figure 1 reveals a substantial range in the tendency of judges to refer to assessment for electronic monitoring, with judges at the 95th percentile referring to electronic monitoring 25% of the time compared to 2% of the time for judges at the 5th percentile.

5.2 Instrument Relevance

Table 3 contains the first stage estimates. This table reports the key results from OLS regressions in which the dependent variable is an indicator equal to 1 if offender i before judge j receives a sentence to be served under electronic monitoring. The explanatory variable of interest is the instrument; judge tendency to refer to electronic monitoring assessment. We report several specifications for this first stage model. In the first, reported in column 1, we control for the set of fully interacted court and year of finalization indicators only. In the second specification, we add controls for demographics (an indicator for gender is male, a quadratic in age) and indicators for type of crime (violation of government procedures is the reference category). The final specification adds further controls for the number of finalised court appearances within five years prior to the current case, an indicator for no legal representation in the current case, and indicators for the local government area (LGA) in which the offender resides. For each specification, we report the coefficient estimates for the instrument, judge tendency to refer to assessment for electronic monitoring, the results from a diagnostic test that examines whether the parameters in the model are under-identified, along with the commonly reported *F-statistic* testing the significance of the instrument. Note that standard errors (and test statistics) account for clustering at the court level.

As can be seen from Table 3, judge tendency to refer for assessment for electronic monitoring is a highly significant predictor of the offender receiving a sentence of electronic monitoring. The point estimates imply that a one standard deviation (0.08) increase in the tendency to refer to electronic monitoring by the judge faced increases the likelihood that the offender is sentenced to electronic monitoring by around five percentage points, or 39%.

Table 3 also reports diagnostic statistics on the significance of the instrument, along with the Sandersom-Winjmeijer under-identification test. As can be seen from Table 3, the standard *F-statistic* testing the significance of the instrument in the linear probability model for receiving a sentence of electronic monitoring are much larger than the rule of thumb value of 10, and this is the case across all specifications.[18] Also, the Sanderson-Windmeijer test leads to the rejection of the null hypothesis that the model is under-identified in all specifications. From Table 3 we conclude that the model is not under-identified, and that the instrumental variable is relevant, and not weak.

5.3 Instrument Validity

Key to the validity of our instrumental variable approach is the assumption that the instrument is as good as randomly assigned and therefore uncorrelated with unobserved offender characteristics that are related to the likelihood of reoffending. While we cannot directly test the assumption that judge tendency to refer for assessment for electronic monitoring is randomly assigned (conditional on the interacted court and year fixed effects), the results in Table 3 provides some evidence on this issue. If judges are as good as randomly assigned, then adding the pre-determined variables (that are used as controls) should not significantly change the first stage coefficient estimates on the instrument. As can be seen by looking across the specifications, as controls are added to the first stage regression model, the point estimates of the coefficient on the judge tendency to refer to electronic monitoring assessment do not change appreciably.

A further implication of random assignment of judge to case within courts, is that judge tendency to refer to electronic monitoring assessment should not be correlated with observable characteristics of offenders or their case (conditional on the court and year interacted fixed effects). We provide evidence on this in Table 4. Specifically, Table 4 shows that while receiving a sentence of electronic monitoring is correlated with characteristics of the offender and case conditional on interacted court and year of finalization fixed effects($F\text{-}stat$=31.29, $p\text{-}value$=0.000), judge tendency to refer cases for electronic monitoring assessment is not ($F\text{-}stat$=1.40, $p\text{-}value$=0.20).

[18] As the outcome of interest, reoffending, does not have *iid* errors, we are unable to test whether the instrumental variables are weak using Stock-Yogo values. This is because there are no tabulated values for the sampling distribution with which to compare the test statistic for weak instruments when errors are not *iid* (see Windmeijer for more on this)

While conditional random assignment of the instruments is sufficient for the reduced form estimates to have a causal interpretation, the exclusion restriction is additionally required in order for the IV estimator to provide causal estimates of the structural parameter of interest. We present an investigation of this issue following the discussion of our baseline findings.

5.4 Monotonicity

If the impact of receiving a sentence of electronic monitoring on reoffending is heterogenous, a LATE interpretation of the IV estimates requires monotonicity. In our application, monotonicity implies that an offender who receives a sentence of electronic monitoring from a judge who has a low tendency for referral will also receive a sentence of electronic monitoring from a judge with a high tendency for referral. If this condition is satisfied, then our estimates uncover the impact of serving a sentence under electronic monitoring among the sub-group who would have received incarceration if their case was heard by a different judge with a lower tendency to refer to electronic monitoring assessment.

While we cannot directly test whether monotonicity holds in our sample, we follow previous studies, and test two implications of monotnicity (Aizer & Doyle, 2015; Bhuller *et al.* , 2016; Dobbie *et al.* , 2018). First, the impact of judge tendency to refer to assessment for electronic monitoring on the probability that an offender receives a sentence to be served under electronic monitoring should be non-negative for any sub-sample. To examine whether this is the case, we construct the judge tendency variable using the full sample, but estimate the first stage on sub-samples defined by crime types, by whether the offender has been incarcerated in the past 5 years, and by age. The results are reported in Table 5. They show that for all sub-samples, judge tendency for referral is positive and statistically significant in the first stage model for the offender serving their sentence under electronic monitoring.

The second implication of monotonicity that we investigate is that judges who are more inclined than others to refer to electronic monitoring assessment for one crime type should also be more inclined to do so for other crime types. For example, judges who are more likely to refer traffic offences to electronic monitoring assessment should also be more likely to refer other crimes types to electronic monitoring assessment. If this is true, then the probability that an offender facing a non-traffic charge receives a sentence to be served under electronic monitoring should be non-negatively related to the (same) judge's tendency to refer traffic offences to electronic monitoring assessment, referred to as the 'reverse instrument'.[19]

[19] Bhuller *et al.* (2016) refers to this method of investigating the monotonicity assumption as reverse sample instruments since it involves instrumenting the endogenous variable for a sub-sample using an instrument constructed from the complement of the sub-sample.

The second panel of Table 5 reports the first stage results based on the reverse instruments defined by crime type, previous incarceration and age. In all cases, the reverse instruments for referral to assessment for electronic monitoring are significantly positively related to the probability of receiving a sentence of electronic monitoring. Moreover, the coefficient estimates are of a similar magnitude to those for the baseline instruments. Overall, we conclude that there is no evidence to suggest that the assumption of monotonicity is rejected in these data.

6 Effect of Electronic Monitoring on Recidivism

6.1 Baseline Results

Table 6 presents 2SLS estimates of the impact of serving a sentence under electronic monitoring relative to prison on the probability of reoffending within 24 months of free-time. The table also reports OLS estimates as a point of comparison, as well as reduced form estimates. The first column of Table 6 contains OLS, reduced form and 2SLS coefficient estimates based on a specification that controls for court and years of finalization interacted fixed effects only. The second column adds demographic characteristics of the offender, and crime type to the list of controls. The third column reports on our preferred specification, which additionally controls for the number of court appearances in the five years prior, having no legal representation during the court hearing, and indictors for the local government area of offender residence. Standard errors are clustered at the court level to account for the fact that quasi-randomisation with respect to judge occurs at the court level.

Beginning with the OLS estimates, we find a significant negative association between the probability of reoffending within 24 months of free-time and receiving a sentence of electronic monitoring relative to receiving a prison term in all specifications. When only court and year of finalization interacted fixed effects are accounted for, the point estimates suggest that serving a sentence under electronic monitoring is associated with a 25 percentage point reduction in the likelihood of reoffending compared to serving it in prison. This is a sizeable reduction given that the average rate of reoffending within 24 months of free-time amongst those who serve a prison sentence is 58%. Looking across the row, we see that accounting for the offenders demographic characteristics and the type of crime the offender is charged with significantly reduces the OLS point estimates, and additionally accounting for the number of finalized court appearances in the previous five years, a lack of legal representation during the court case and the local government area of their residence, reduces the OLS point estimates even further. Accounting for the full set of controls reduces the magnitude of the OLS coefficient on electronic monitoring by 40% relative to its magnitude in the

specification that only controls for court and year interacted fixed effects. This suggests that judges take these observable factors into account in choosing the type of sentence they hand down. In other words, judges are choosing the alternative of electronic monitoring for those who are less likely to reoffend on the basis of their observed characteristics.

Similarly, the reduced form estimates show that accounting for observable characteristics leads to sizeable reductions in the estimated impact of judge tendency for referral for electronic monitoring assessment on reoffending. For example, the impact of an increase in judges tendency to refer to assessment from 0 to 1 is estimated to reduce reoffending (within 24 months of free-time) by 17 percentage points in the specification controlling for court and year interacted fixed effects only, compared to 9 percentage points in the full specification that additionally controls for demographics, crime type, criminal history, legal representation and local government area of residence. The reduced form estimates of the impact of judge tendency for referral for assessment for electronic monitoring remains statistically significant at the 1% level even after controlling for the full set of covariates.

The IV estimates are reported in the bottom section of Table 6. These results provide robust evidence that serving a sentence under electronic monitoring reduces the probability of recidivism within 24 months of free-time between 27 percentage points (when only court and year of finalization interacted fixed effects are controlled for) and 16 percentage points (when the full set of controls are included). Given that the average rate of reoffending (within 24 months of free-time) amongst those who were incarcerated is 58%, the reduction in reoffending attributable to serving a sentence under electronic monitoring compared to imprisonment is between 47% in the specification that controls for court by year fixed effects only and 28% in our preferred specification (which includes the full set of controls).

6.2 The Exclusion Restriction

In order for our IV estimates to have a causal interpretation, the judge tendency to refer for electronic monitoring assessment must only impact on reoffending through the channel of receiving the punishment of electronic monitoring. A potential concern regarding this assumption is that judges may trade off severity of sentence and sentence length, or alternately, that judges who are more severe in their choice of punishment type may also be more severe in terms of punishment length (Aizer & Doyle, 2015).

These scenarios raise two potential threats to the exclusion restriction. The first occurs if judge tendency for sentence length has a direct effect on reoffending and is correlated with judge tendency to refer for assessment for electronic monitoring. If this is the case then the exclusion restriction

is violated because the instrumental variable, judge tendency to refer for electronic monitoring assessment, is correlated with the omitted (from the structural equation) regressor, judge tendency for sentence length. This source of bias can be addressed by including judge tendency for sentence length in the set of control variables.

A second way in which the baseline model may produce unreliable estimates of the causal parameter of interest is if the sentence length received directly impacts on reoffending (conditional on the manner in which the sentence is served and the control variables), and the sentence length received depends on the judge tendency to refer offenders for electronic monitoring assessment (conditional on judge tendency for length of sentence). The exclusion restriction is violated in this case because the instrument (judge tendency to refer for assessment for electronic monitoring) impacts on reoffending through (omitted) sentence length as well as sentence type. This potential source of bias can be addressed by augmenting the baseline model to include sentence length as an endogenous regressor and instrumenting it with judge tendency for sentence length (defined as the mean adjusted residual from regressing the leave-out mean sentence length on a set of fully interacted court and year fixed effects) as follows:

$$\begin{aligned} EM_i =& \alpha_{EM}\pi_{ij}^{EM} + \alpha_{lg}\pi_{ij}^{lg} + \alpha X_i + \epsilon_i^{EM} \\ LENGTH_i =& \delta_{EM}\pi_{ij}^{EM} + \delta_{lg}\pi_{ij}^{lg} + \delta X_i + \epsilon_i^{lg} \\ reoff_i =& \beta_{EM}EM_i + \beta_{lg}LENGTH_i + \beta' X_i + \nu_i \end{aligned}$$

where $LENGTH_i$ is the sentence length received by offender i and π_{ij}^{lg} is the sentence length tendency of judge j assigned to offender i. Because cases are randomly assigned to judges, judge tendency for sentence length in addition to their tendency to refer to assessment for electronic monitoring satisfy the independence assumption.

Table 7 shows the results from including the judge tendency for sentence length as an additional control variable in the baseline model (column 2) and by augmenting the baseline model to include sentence length as an endogenous regressor and instrumenting it with judge tendency for sentence length (column 3). We also repeat the results for the baseline model for ease of comparison (column 1). As is clear from the results reported in the table, there is no evidence to suggest that the exclusion restriction is violated due to judge tendency for sentence length impacting reoffending as shown in Column 2. In particular, the judge tendency for sentence length is uncorrelated with reoffending (conditional on the manner in which the sentence is served and the other control variables), and accounting for judge tendency for sentence length as an additional control has little

impact on the IV estimates of serving a sentence of electronic monitoring, with the point estimate increasing slightly in magnitude from -0.16 to -0.17. Similarly, when accounting for sentence length as an endogenous determinant of reoffending, judge tendency for electronic monitoring does not predict sentence length, and the coefficient estimate of the impact of sentence length on reoffending is not statistically significant. Overall, we conclude that it is unlikely that the exclusion restriction is violated through judge tendency for punishment type impacting on reoffending through sentence length.

6.2.1 Robustness

As previously discussed, there may be some concern that including time spent serving a sentence under electronic monitoring as free-time may lead to an overly optimistic estimate of the impact of serving a sentence under electronic monitoring. In order investigate this issue, we measure free-time for those serving their sentence under electronic monitoring from the time their sentence ends.[20] As can be seen from the results in the first column of Table 8, measuring free-time for all offenders from the time their sentence ends increases the magnitude of the estimated impact of serving a sentence under electronic monitoring on the probability of reoffending from -0.16 to -0.19.

Previous research has found that the reduction in reoffending from the use of electronic monitoring differs for those who have previously served a prison sentence compared to those who have not (Henneguelle *et al.* , 2016). In order to investigate whether this is the case in the context we study, we re-estimate our baseline model over the sub-sample of offenders who have not been imprisoned in the 5 years prior to the index offence. The results from doing so are reported in column 2 of Table 8. As can be seen from the table, the magnitude of the estimated impact on reoffending of serving a sentence under electronic monitoring increases slightly from -0.16 to -0.20 when we remove those who have served a prison sentence (in the last 5 years) from the sample.

Similarly, the impact of serving a sentence under electronic monitoring may differ for those who have been detailed pre-trial and those who have are remain living within the community. To examine if this is the case in our sample, we remove observations from the sample on individuals who were detained while awaiting trial for their current case in addition to those who had been imprisoned in the previous 5 years. The results from doing so are reported in column 3. They show that receiving a sentence of electronic monitoring for those who have not been in prison and were not detained pre-trial reduced the likelihood of reoffending within 24 months of free-time by

[20] We note that this not an ideal solution as 73 of those serving an electronic monitoring sentence (7.3% of the EM sample) reoffend while serving their sentence, with half of receiving a prison sentence for the new offense in addition to serving the balance of their original sentence in prison. For these 36 individuals, we do not observe free-time following their original sentence, and so they are dropped from the analysis. For the 37 individuals who do not receive a subsequent prison term, we measure free-time from the end of the sentence for the index offense.

13 percent, similar to our baseline estimated reduction of 16 percent.

Finally, we examine the extent to which the impact on recidivism of serving a sentence under electronic monitoring differs for younger and older offenders. To do so, we split the estimation sample into cases for which the offender is less than the median age of 30, and those for which the offender is at least 30 years old, and estimate over these subsamples. The results from doing so are reported in columns 4 (less than 30) and 5 (age is at least 30) of Table 8. They show that the reduction in reoffending is solely attributable to those offenders who serve their sentence under electronic monitoring who are less than 30 years old. This groups reoffending is reduced by 43 percentage points, which is significantly larger than the estimated impact for all ages. In contrast, there is no difference in reoffending for those who serve their sentence in prison or under electronic monitoring amongst those aged 30 or older.

From these analyses we conclude that the baseline results regarding the impact of electronic monitoring on reoffending are not driven by including in our measure of free-time, time in the community serving a sentence under electronic monitoring. In addition, we find no evidence that the impact of electronic monitoring on reoffending is greater for those who have previously been imprisoned, including those whose incarceration occurred while awaiting finalization of their case. We do, however, find significant evidence that the impact of electronic monitoring on reoffending is driven by offenders aged under 30.

6.3 Long Run Impacts

Table 9 explores whether the reduction in reoffending from serving a sentence under electronic monitoring rather than in prison endures through to a time horizon of ten years of free-time, or whether it fades out. We also investigate whether the differential effects for younger (aged less than 30) and older (aged at least 30) offenders are robust to the time horizon considered. The table reports on specifications for which the outcomes of interest are reoffending at 12 monthly intervals ranging from 12 months to 120 months of free-time, and that account for the full set of control variables. Panel A contains estimates based on the full estimation sample, Panel B reports estimates based on the subample of offenders who are aged less than 30 at their index offense, and Panel C reports estimates based the subample of offenders who are aged at least 30 at their index offense. Note that there is only a very modest amount of attrition at the longer follow-up period of 120 months of free-time relative to our baseline results of 24 months of free-time.[21]

As can be seen from Panel A of Table 9, using the full sample, serving a sentence under electronic

[21]The attrition rates are 8% for the full sample, 6% for the less than 30 subsample, and 11% for the 30 and older subsample.

monitoring rather than in prison is estimated to reduce reoffending by 20 percent points after 12 months of free-time and by 15 percentage points after 60 months, and these effects are statistically significant at conventional levels. The reduction in reoffending is estimated to be be 12%, 11% and 10% at 72, 84 and 96 months respectively, falling to 3% at 120 months of free-time, although these estimates drop below conventional levels of significance. The estimates in Panel B show that, for offenders who aged less than 30 at the time of their index offense, the reduction in reoffending is larger than in the full sample, estimated to be 41% after 12 months of free-time, 35% after 60 months, and 31% after 96 months of free-time, with statistically significant effects at 12 , 24, 84 and 96 months. For this younger group, the impact of serving a sentence under electronic monitoring falls to 22% at 108 and 120 months of free-time, although these estimates are not significant at conventional levels. The estimates in Panel C show that amongst those who are 30 years of age or older, there is no significant difference in reoffending amongst those whose serve their sentence under electronic monitoring and those who serve it in prison at all durations of free-time from 12 months to 120 months.

Overall, these estimates show that the impact of serving a sentence under electronic monitoring rather than in prison remains large and statistically significant, even at five years of free-time based on the full sample of offenders, and at eight years amongst offenders aged less than 30 at the time of the index offense.

6.4 Intensity, Seriousness, and Punishment for Reoffending

Our results provide robust evidence that serving a sentence under electronic monitoring reduces the likelihood of reoffending amongst eligible offenders who, had they faced a judge less inclined to use electronic monitoring, would have received a prison sentence. All else being equal, this provides a strong evidence base that policy makers can draw on to modify current sentencing policy for non-violent, and less serious offences. However, there may be more than one dimension along which serving a sentence served under electronic monitoring impacts on future offending behaviour that is relevant for informing policy makers. For example, serving a sentence under electronic monitoring may impact on the number of subsequent crimes committed, the seriousness of subsequent crimes, and the likelihood of future incarceration.

Our data provide some opportunity for examining the impact of serving a sentence under electronic monitoring on these more nuanced outcomes. We begin by considering the impact of receiving electronic monitoring on the intensity of reoffending, as measured by the number of times the offender is before the courts in the 24 month period of free-time following the index case. Given the potential for selection into reoffending we define our dependent variable for this analysis as

either a count of the number of times that the offender is before the courts, including zero for those who do not re-offend, or the log of the number of times the offender is before the courts.[22]

The results are shown in the last two columns of Table 8. When the outcome variable is the log of the number of court appearances, we estimate that receiving a sentence served under electronic monitoring reduces the number of subsequent court appearances by 50%. Evaluated at the sample mean of 2.5 court appearances, this translates into a reduction of 1.2 subsequent court appearances. When the outcome is the number of court appearances, we estimate that serving a sentence under electronic monitoring rather than in prison reduces the number of subsequent court appearances by around 1.1, which is in agreement with the estimate from the model in which the outcome is measured in log form.

We would also like to be able to determine if serving a sentence under electronic monitoring impacts on the seriousness of subsequent offences, and therefore the burden of subsequent reoffending on the criminal justice system, as measured by the degree of supervision required. Table 10 shows the empirical distribution of reoffence type (no reoffence, less serious reoffence, and serious reoffence) by whether the index offence attracted a sentence to be served under electronic monitoring or in prison.[23] As can be seen from the table, only 8% of those who serve their sentence under electronic monitoring reoffend with a serious offence within 24 months compared to 17% for those who served a prison sentence. Combined with the fact that only a small fraction of eligible offences in our estimation sample receive electronic monitoring, we conclude that these data do not provide sufficient variation to separately identify the impact of electronic monitoring on serious reoffending relative to not reoffending or less-serious reoffending.[24] It is interesting to note from Table 10 that, conditional on reoffending, the probability of committing a serious offence is similar for those receiving a sentence served in prison (29%) or under electronic monitoring (27%).

Given the infrequent use of electronic monitoring by judges, and the low rate of observed reoffending amongst those who serve their sentence under electronic monitoring, there is also insufficient variation in the data to identify the impact of electronic monitoring on subsequent sentencing. Table 11 shows that amongst those who served their sentence under electronic monitoring, 10% were subsequently sentenced to a custodial sentence within 24 months, compared to 25% of those who served a prison sentence for the index offence. Table 11 also shows that, once we condition on reoffending, the proportion serving a custodial sentence for a subsequent offence is 35% for those

[22] In order to define the logged outcome variable over all offenders, rather than the selected sample of re-offenders, we re-center the number of court appearances by adding 0.1 before taking the natural log.

[23] Serious offences are defined as homicide, injury, sexual assault, negligent acts, abduction and robbery. Less serious offences are defined as break and enter, theft, fraud, drugs, weapons, property damage, public order, traffic, government procedure and miscellaneous offences.

[24] Amongst the 996 individuals who served a sentence under electronic monitoring for the index offence, 294 subsequently committed an offence, and just 39 committed a serious offence within 24 months.

whose index sentence is electronic monitoring compared to 44% for those whose index sentence is prison.

All in all, the evidence points to electronic monitoring impacting on whether or not a person reoffends, and the intensity of their reoffending, but perhaps not on the seriousness of offending amongst those who do reoffend, and this is reflected in similar proportions serving a custodial sentence amongst reoffenders.

6.5 Cost Savings

Based on these findings, and using costing information on electronic monitoring and prison provided in the 2010 Auditors-General's Performance Audit Report, and the 2010 Report on Government Services, we are able to conduct some back-of-the-envelope calculations that illustrate the order of magnitude of the cost savings from using electronic monitoring rather than prison in sentencing eligible offenders. As shown in Table 12, we focus on savings per offender who serves a sentence under electronic monitoring attributable to the corrective services cost differential for electronic monitoring versus medium security prison, and those arising from reduced future court appearances and subsequent sentences served under incarceration.[25]

Table 12 shows the largest part of the savings per offender is from the direct cost of the index offence sentence. These savings are estimated to be of $25,200 per offender diverted from prison by serving a sentence under electronic monitoring. This figure assumes the average sentence length of 180 days (6 months) in our data and uses a per day cost of $47 for those serving a sentence under electronic monitoring and $182 for an individual serving a sentence in a medium security prison, as used by Auditor-General's Report (2010). Additional savings come from one fewer court appearances and reduced subsequent incarceration in the two year follow-up period.[26] We calculate the reduced cost due to averted subsequent custodial sentences of incarceration by assuming a reduction in the probability on reoffending of 0.16 (from our baseline estimates), and that the probability of a custodial sentence conditional on reoffending is 0.44 (which is the probability in the sample who are imprisoned for the index offence given in Table 11). We use the average sentence length for custodial sentences in the reoffending sample of 260 days, and a per day cost of incarceration of $217 (which is the average for secure prisons).

Collectively, these figures produce a cost saving per person who serves their sentence under electronic monitoring rather than in prison of $29,252. If we apply this cost saving to the annual

[25]The cost per case in the Magistrates' courts in 2008-2009 is $495 (table 7A.23) and the net operating expenditure per prisoner per day in a secure prison in 2008-2009 is $217 per day (table 8A.7) Productivity Commission (2010).

[26]In calculating these savings we assume the additional court hearing and subsequent custodial sentence occur in the second year and these costs discounted back to the initial period (assuming a discount rate of 5%).

average number under of offenders under electronic monitoring over the period 2000-2007 of 200, the cost savings that accrued to the Department of Corrections is around $5.8 million dollars per year (in $2008). This figure is modest, and is in line with the limited use of electronic monitoring by judges. However, an expansion of the use of electronic monitoring clearly has the potential to produce larger savings. While it is difficult to speculate as to the number of eligible offenders amongst those who served a prison sentence that would have been suitable to serve their sentence under electronic monitoring, the fact that a significant proportion of judges never chose to use a sentence of electronic monitoring suggests there is room for increased use of electronic monitoring without compromising the suitability criteria, and hence success of the program.[27]

7 Discussion

The significant growth in prison populations and the attendant financial and social costs have led to an increased interest in sentencing alternatives to imprisonment. A key concern when considering alternative punishment options is whether a move away from a heavy reliance on prison will increase reoffending. In this paper we examine electronic monitoring as a front-end alternative to imprisonment for non-serious and non-violent offences where the sentence length is up to 18 months. Our key objective is to evaluate whether the use of electronic monitoring rather than prison impacts of reoffending, and if so whether it increases reoffending, or whether it decreases it.

In order to identify its causal effect, we address non-random selection of offenders into electronic monitoring using an instrumental variables approach based on judge tendency for punishment type. When considering all aged offenders, our findings suggest that the use of electronic monitoring as an alternative to prison reduces the rate of reoffending within 24 months of free-time by 16 percentage points, or 28% relative to the reoffending rate of those who are imprisoned. This reduction in reoffending is sustained over a five year horizon. However, these impacts for all age offenders are driven by those who are less than 30 years old at the time of their offense. For this group the reduction in reoffending within 24 months is 43 percentage points, or 67%. Importantly, for this younger group, who have a potentially longer future criminal career, the reduction in offender from serving their sentence under electronic monitoring persists for 8 years. We also provide some rough back-of-the-envelope calculations that suggest that each eligible offender who serves their sentence under electronic monitoring rather than in prison produces a cost saving to the criminal justice system of close to $30,000. This underlines the strong case for consideration of the use of electronic

[27]For example, the Auditor-General's Report (2010) notes that over 6500 offenders were technically eligible for electronic monitoring in NSW in 2008, with 1400 of these offenders committing traffic and motor vehicle regulatory offences. They also note that in 2008-09 only 35 out of 47 Local Courts with access to home detention referred offenders for assessment.

monitoring as an alternative to imprisonment for less serious, non-violent offenders.

The interpretation of our findings as causal rests of several strong identifying assumptions. We carefully investigate each of these assumptions, including the exclusion of the instrumental variable from the structural equation, and monotonicity in the relationship between the instrument and the endogenous outcome, in order to establish the internal validity of our approach. We make a case for the external validity of our case study for jurisdictions considering the use of electronic monitoring as a front-end alternative for imprisonment based on the broad set of offences and sentence lengths eligible for electronic monitoring in the context studied, along with the program itself being mature and operating at scale.

It is important to note that in the context we study, electronic monitoring both diverts offenders from prison and provides individually tailored rehabilitation programs along with intense supervision while the offender is living and working within the general community. With this in mind, and given the strong case for both the internal and external validity of findings, the policy implications are clear. They indicate that combining close monitoring and prescribed rehabilitation for non-violent and non-serious offences, as occurs under electronic monitoring in the context we study, has sustained crime reducing effects. Given that it reduces criminal justice costs as well as reoffending, we conclude that electronic monitoring is a viable alternative to imprisonment.

References

Aizer, A., & Doyle, J.J. 2015. Juvenile Incarceration, Human Capital and Future Crime: Evidence from Randomly-Assigned Judges. *The Quarterly Journal of Economics*, **130**(2), 759–803.

Apel, R., Blokland, A., Nieuwbeertaand, P., & van Schellen, M. 2010. The impact of imprisonment on marriage and divorce: A risk set matching approach. *Journal of Quantitative Criminology*, **26**(2), 269 300.

Auditor-General's Report. 2010. *Home Detention: Corrective Services NSW.* Performance Audit.

Australian Bureau of Statistics. 2016. *Census of Population and Housing: Australia Revealed.*

Bayer, P., Hjalmarsson, R., & Pozen, D. 2009. Building Criminal Capital Behind Bars: Peer Effects in Juvenile Corrections. *Quarterly Journal of Economics*, **124**(1), 105 –147.

Bhuller, M., Dahl, G., Lken, K., & Mogstad, M. 2016. Incarceration, Recidivism and Employment. *National Bureau of Economic Research Working Papers 22648.*

Chalfin, A., & McCary, J. 2017. Criminal Deterrence: A Review of the Literature. *Journal of Economic Literature*, **55**(1), 5–48.

DeMichele, M. 2014. Electronic Monitoring: It Is a Tool, Not a Silver Bullet. *Criminology and Public Policy*, **13**(3), 393–400.

DeVuono-Powell, S., Schweidler, C., Walters, A., & Zohrabi, A. 2015. *Who pays? The true cost of incarceration on families.* Oakland, CA: Ella Baker Center.

Di Tella, R., & Schargrodsky, E. 2013. Criminal Recidivism after Prison and Electronic Monitoring. *Journal of Political Economy*, **121**(1), 28 –73.

Dobbie, W., Goldin, J., & Yang, C. 2018. The Effects of Pre-Trial Detention on Conviction, Future Crime, and Employment: Evidence from Randomly Assigned Judges. *American Economic Review*, **108**(2), 201–240.

Green, D.P., & Winik, D. 2010. Using Random Judge Assignments to Estimate the the Effects of Incarceration and Probabtion on REcidivism Among Drug Offenders. *Criminology*, **48**(2), 357–387.

Hawken, Angela, & Kleiman, Mark A. R. 2009. *Managing Drug Involved Probationers with Swift and Certain Sanctions: Evaluating Hawaiis HOPE.* Washington, DC: National Criminal Justice Reference Service.

Heggie, K. 1999. *Review of the NSW Homes Detention Scheme.* Sydney: NSW Department of Corrective Services.

Henneguelle, A., Monnery, B., & Kensey, A. 2016. Better at Home than in Prison? The Effects of Electronic Monitoring on Recidivism in France. *The Journal of Law and Economics*, **59**(3), 629–667.

Hjalmarsson, R. 2009. Juvenile Jails: A Path to the Straight and Narrow or to Hardened Criminality? *Journal of Law and Economics*, **52**(4), 779809.

Hucklesby, A., & Holdsworth, E. 2016. *Electronic Monitoring in England and Wales.* University of Leeds, UK: Centre for Criminal Justice Studies.

Kilmer, Beau, Nicosia, Nancy, Heaton, Paul, & Midgette, Greg. 2013. Efficacy of Frequent Monitoring with Swift, Certain, and Modest Sanctions for Violations: Insights from South Dakotas 24/7 Sobriety Project. *American Journal of Public Health*, **103**(1), 37–43.

Kling, J. 2006. Incarceration Length, Employment, and Earnings. *American Economic Review*, **96**(3), 863–876.

Lopoo, L. M., & Western, B. 2005. Incarceration and the formation and stability of marital unions. *Journal of Marriage and Family*, **67**(3), 72134.

Marie, O. 2009. The Best Ones Come Out First! Early Release from Prison and Recidivism A Regression Discontinuity Approach.

Mueller-Smith, M. 2015. The Criminal and Labor Market Impacts of Incarceration. *University of Michigan Working Paper*.

Nagin, D. S., Cullen, F. T., & Jonson, C. L. 2009. Imprisonment and reoffending. *Chap. 38, page 115200 of:* Tonry, M (ed), *Crime and justice: a review of research*. Washington, D.C: University of Chicago Press.

Productivity Commission. 2010. *Report on Government Services 2010,.*

Renzema, M., & Mayo-Wilson, E. 2005. Can electronic monitoring reduce crime for moderate to high-risk offenders? *Journal of Experimental Criminology*, **1**(2), 215–237.

Studerus, K.J. 1997. *Home Detention in NSW*. Sydney: NSW Department of Corrective Services.

The Pew Charitable Trusts. 2016. *Use of Electronic Offender-Tracking Devices Expands Sharply: Number of monitored individuals more than doubled in 10 years.* Tech. rept.

Table 1: Distribution of Crime Type by Manner in which the Sentence is Served

	Full Sample			**Estimation Sample**		
crime type	all	prison	electronic monitoring	all	prison	electronic monitoring
	%	%	%	%	%	%
injury	6.99	7.48	2.39	7.25	8.05	2.11
negligent driving	3.21	3.13	3.96	4.13	4.02	4.82
break & enter	9.65	10.28	3.77	9.96	10.96	3.61
theft	24.69	26.23	10.24	21.11	22.92	9.54
fraud	7.35	6.39	16.33	10.97	9.22	22.19
public order	6.56	7.05	1.95	5.81	6.41	2.01
traffic	22.58	19.92	47.42	24.4	21.13	45.28
Govt. procedures	18.98	19.52	13.94	16.37	17.3	10.44
Total	100.00	90.34	9.66	100.00	86.48	13.52

The full sample consists of all cases before the courts between 2000 and 2007 for which the offender is eligible to serve their sentence under electronic monitoring. The estimation sample consists the first instance that each offender in the full sample is observed before the courts. There are 16,475 cases in the full sample and 7,366 cases in the estimation sample.

Table 2: Reoffending Rates by Months of Free-time and Manner in Which Sentence is Served

	12 mth %	24 mth %	36 mth %	48 mth %	60 mth %	72 mth %	84 mth %	96 mth %	108 mth %	120 mth %
prison	47	58	65	70	73	74	76	78	81	84
electronic monitoring	16	30	37	43	47	51	53	55	60	66

There are 7439 cases for reoffending at 12 months and 6769 cases for reoffending at 120 months. Reoffending is defined as a court appearance subsequent to the index offence within x months of free-time, where free-time is time in the community.

Table 3: First Stage Estimates: Dependent Variable is Sentenced Served is EM

	Court X Year of Finalization Interacted Fixed Effects	Adds for Demographics and Crime Type	Adds Criminal History and Legal Representation
	Receive EM	Receive EM	Receive EM
judge tendency for EM	0.61***	0.59***	0.59***
	(0.08)	(0.08)	(0.08)
F test of excluded instruments			
F(1, 63)	57.53	60.57	54.88
	(0.00)	(0.00)	(0.00)
SW under identification test			
Chi-sq.(1)	60.92	64.23	58.66
	(0.00)	(0.00)	(0.00)
Observations	7,366	7,366	7,366

Controls include fully interacted court and year of finalization fixed effects in column 1. Column 2 adds controls for demographics (an indicator for gender is male, a quadratic in age) and indicators for offence type is injury, negligent driving, break and enter, theft, fraud, public order, and traffic. The reference category is violating government procedures. Column 3 additionally includes controls for the number of finalised court appearances within 5 years prior to the current case, an indicator for no legal representation in the current case, and indicators for the local government area in which the offender resides. Standard errors clustered on the court are reported in parentheses. *** p<0.01, ** p<0.05, * p< 0.1

Table 4: Testing for Random Assignment of Cases to Judges

	received EM	judge tendency	mean	sd
age	-0.0081***	0.0001	31.38	9.65
	(0.0020)	(0.0007)		
age Squared	0.0001***	0.0000	1077.75	705.36
	(0.0000)	(0.0000)		
gender is Male	-0.1048***	0.0002	0.88	0.32
	(0.0153)	(0.0040)		
no. court appearances in the past 5 years	-0.0077***	-0.0006*	3.24	2.65
	(0.0022)	(0.0004)		
no legal representative	0.1247***	0.0004	0.08	0.28
	(0.0202)	(0.0050)		
injury offence	-0.0402**	-0.0006	0.07	0.26
	(0.0160)	(0.0046)		
negligent driving offence	0.0603**	-0.0070	0.04	0.20
	(0.0229)	(0.0068)		
break & enter offence	0.0016	0.0020	0.10	0.30
	(0.0111)	(0.0031)		
theft offence	-0.0026	0.0017	0.21	0.41
	(0.0091)	(0.0026)		
fraud	0.1084***	0.0071	0.11	0.31
	(0.0278)	(0.0060)		
public order	-0.0081	0.0002	0.06	0.23
	(0.0147)	(0.0046)		
traffic	0.1373***	-0.0003	0.24	0.43
	(0.0214)	(0.0026)		
F-stat	31.29	1.40		
p-value	0.00	0.20		
Observations	7,366	7,366		
R-squared	0.2678	0.0358		

Column 1 reports the results from a regression of an indicator for receiving a sentence of EM on the offender's criminal and personal characteristics. Column 2 reports the results from a regression of the judge tendency to refer offenders' for assessment for EM on the offenders criminal and personal characteristics. Coefficients and standard errors clustered on at the court level (in brackets). The F-statistic and its p-value for the testing the null hypothesis that the coefficients are jointly zero is reported for each regression. The mean and standard deviation of the offenders' crime and characteristics are reported in the final 2 columns.

*** p<0.01, ** p<0.05, * p< 0.1

Table 5: Examining Monotonicity

	Baseline Instruments: First Stage						
	Offence Type			Past Imprisonment		Age	
	traffic	theft, fraud, B&E	other	past prison	no past prison	age<30	age>=30
judge tendency for EM	0.84***	0.50***	0.44***	0.14*	0.73***	0.46***	0.68***
	(-0.26)	(0.10)	(0.09)	(0.08)	(0.11)	(0.07)	(0.14)
mean of EM	0.251	0.114	0.078	0.035	0.175	0.103	0.172
Observations	1,797	3,097	2,472	2,103	5,263	3,937	3,429

	Reverse Instruments: First Stage						
	Offence Type			Past Imprisonment		Age	
	traffic	theft, fraud, B&E	other	past prison	no past prison	age<30	age>=30
judge tendency for EM	0.82***	0.38**	0.24***	0.73***	0.60***	0.71***	0.76***
	(0.29)	(0.13)	(0.06)	(0.21)	(0.09)	(0.14)	(0.16)
mean of EM	0.251	0.108	0.078	0.036	0.176	0.102	0.172
Observations	1,790	2,997	2,412	2,073	5,132	3,860	3,356

Coefficients and standard errors clustered on at the court level (in brackets). The top panel of the table reports the first stage estimate of the coefficient on the instrumental variable, where the IV is constructed using the full sample and where estimation of the first stage is over the sub-sample defined by the column headings. The lower panel reports the first stage estimate of the coefficient on the instrumental variable, where the IV is constructed using the complement of the sub-sample used for estimation and the sub-sample used for estimation is defined by the column headings.
*** p<0.01, ** p<0.05, * p< 0.1

Table 6: Baseline Instrumental Variable Results: Dependent Variable is Reoffending within 24 Months of Freetime

	Controls for Court X Year of Finalization Interacted Fixed Effects	Add Controls for Demographics and Crime Type	Add Controls for Criminal History and Legal Representation
	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)
OLS			
sentence is EM	-0.25***	-0.16***	-0.14***
	(0.02)	(0.02)	(0.02)
Reduced Form			
judge tendency for EM	-0.17***	-0.12***	-0.09***
	(0.06)	(0.05)	(0.04)
IV			
sentence is EM	-0.27***	-0.21***	-0.16***
	(0.08)	(0.07)	(0.07)
mean	0.58	0.58	0.58

Controls include fully interacted court and year of finalization fixed effects in column 1. Column 2 adds an indicator for gender is male, a quadratic in age and indicators for offence type is injury, negligent driving, break and enter, theft, fraud, public order, and traffic. The reference category is violating government procedures. Column 3 additionally includes controls for the number of finalised court appearances within 5 years prior to the current case, an indicator for no legal representation in the current case, and indicators for the local government area in which the offender resides. Standard errors clustered on the court are reported in parentheses. *** p<0.01, ** p<0.05, * p< 0.1

Table 7: Examining the Exclusion Restriction

First Stage	Receive EM	Receive EM	Receive EM	Sentence Length
judge tendency for EM	0.59***	0.56***	0.56***	-0.19
	(0.08)	(0.08)	(.08)	(0.69)
judge tendency for Sentence Length	–	0.01	0.01	0.77***
		(0.003)	(0.003)	(0.06)
F-stat (instrument)	54.88	51.19	–	–
	(0.000)	(0.000)		
SW Chi-sq(1) underID	–	–	55.31	145.3
			(0.000)	(0.000)
Reduced Form	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)	
judge tendency for EM	-0.09**	-0.10**	-0.10**	
	(0.04)	(0 .04)	(0.04)	
judge tendency for Sentence Length		0.001	0.001	
		(0 .004)	(0.004)	
IV	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)	Pr(Reoffend within 24 months)	
received EM	-0.16***	-0.17***	-0.17***	
	(0.07)	(0.06)	(0 .06)	
sentence length	–	–	0.003	
			(0.005)	
judge tendency sentence length	–	0.002	–	
		(0 .004)		
mean	0.58	0.58	0.58	

All specifications control for interacted court and year of finalization fixed effects, an indicator for gender is male, a quadratic in age, indicators for offence type is injury, negligent driving, break and enter, theft, fraud, public order, and traffic (reference category is violating government procedures), the number of finalised court appearances within 5 years prior to the current case, an indicator for no legal representation in the current case, and indicators for the local government area in which the offender resides. Standard errors clustered on the court are reported in parentheses. *** p<0.01, ** p<0.05, * p< 0.1

Table 8: Robustness

	Reoffend within 24 months					Court appearances within 24 months	
	adjust EM freetime	no prison in prior 5 yrs	no prison & not remanded	age<30	age>=30	ln no. appearances	no. of appearances
sentence is EM	-0.19**	-0.20***	-0.13**	-0.43**	0.02	-0.52*	-1.10
	(0.06)	(0.07)	(0.07)	(0.18)	(0.14)	(0.30)	(0.61)
Observations	7,328	5,263	2,933	3,644	3,722	6999	6999

Controls include fully interacted court and year of finalization fixed effects, demographics (an indicator for gender is male, and a quadratic in age) and indicators for offence type is injury, negligent driving, break and enter, theft, fraud, public order, and traffic, reference category is violating government procedures), criminal history (the number of finalised court appearances within 5 years prior to the current case), an indicator for no legal representation in the current case, and indicators for the local government area in which the offender resides. Standard errors clustered on the court are reported in parentheses. *** p<0.01, ** p<0.05, * p< 0.1

Table 9: Instrumental Variable Estimates: Impact of Receiving a Sentence of Electronic Monitoring by Duration of Freetime

	Probability of reoffending within									
	12 mth	**24 mth**	**36 mth**	**48 mth**	**60 mth**	**72 mth**	**84 mth**	**96 mth**	**108 mth**	**120 mth**
A. All Ages										
served sentence as EM	-0.20*	-0.16**	-0.14	-0.14*	-0.15*	-0.12	-0.11	-0.10	-0.06	-0.03
	(0.10)	(0.07)	(0.09)	(0.08)	(0.09)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)
mean	0.47	0.58	0.65	0.70	0.73	0.74	0.76	0.78	0.81	0.84
number of cases	7,459	7,366	7,327	7,309	7,288	7,271	7,253	7,221	7,013	6,769
B. Less than 30										
served sentence as EM	-0.41*	-0.43**	-0.39	-0.32	-0.35	-0.33	-0.37*	-0.31*	-0.22	-0.22
	(0.22)	(0.18)	(0.26)	(0.22)	(0.24)	(0.22)	(0.20)	(0.19)	(0.18)	(0.17)
mean	0.51	0.64	0.71	0.75	0.77	0.79	0.80	0.81	0.84	0.86
number of cases	3,683	3,644	3,624	3,618	3,615	3,609	3,602	3,589	3,511	3,443
B. At least 30										
served sentence as EM	-0.09	0.02	0.03	0.02	-0.01	0.05	0.07	0.07	0.09	0.12
	(0.14)	(0.14)	(0.15)	(0.16)	(0.15)	(0.14)	(0.14)	(0.12)	(0.13)	(0.14)
mean	0.41	0.52	0.60	0.65	0.68	0.70	0.72	0.74	0.77	0.81
Observations	3,776	3,722	3,703	3,691	3,673	3,662	3,651	3,632	3,502	3,326

All specifications include the full set of controls. Standard errors clustered on the court are reported in parentheses. *** p<0.01, ** p<0.05, * p< 0.1

Table 10: Seriousness of Reoffence Type

	prison (%)		EM (%)	
	all offenders	given reoffend	all offenders	given reoffend
did not reoffend	42	–	70	–
offence not serious	42	72	22	73
offence serious	17	29	8	27

Based on author calculations. Serious offences are: homicide, injury, sexual assault, negligent acts, abductions, and robbery. Less serious offences are: break and enter, theft, fraud, drugs, weapons, property damage, public order, traffic, government procedures, miscellaneous.

Table 11: Reoffending and Sentencing

	prison (%)		EM (%)	
	all offenders	given reoffend	all offenders	given reoffend
did not reoffend	42		70	
unsupervised	25	43	15	50
supervised, not custody	8	13	5	16
custodial sentence	25	44	10	35

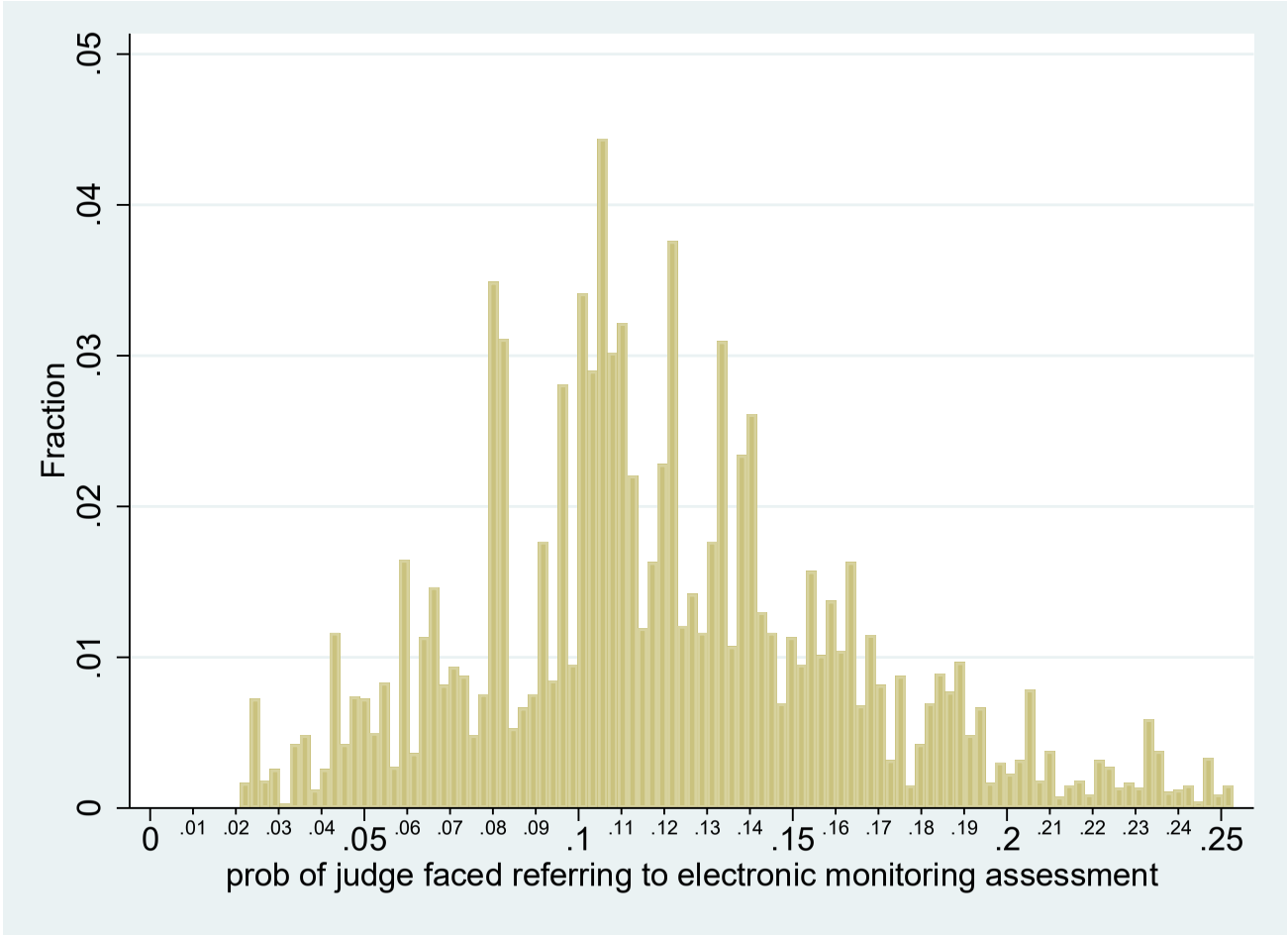
Based on author calculations. Custodial sentences: prison, electronic monitoring, periodic detention and intensive correction order. Supervised, noncustodial: suspended sentence with supervision, community service order, bond with supervision, probation with supervision. Unsupervised: suspended sentence without supervision, bond without supervision, probation without supervision, fine, non-criminal sentence, bond without conviction, no conviction.

Table 12: Net Savings per Offender Sentenced to EM

Savings per EM sentence	
savings from reduced cost for current offence	25200
court cases averted	449
custodial sentences averted	3603
Total	29252

As averted court appearances and custodial sentences occur any time from the start of free-time up to 24 months of freetime. We assume averted court appearances and custodial sentences occur at the end of the 24 month of freetime period, and discount these savings at the rate of 5%.

Figure 1: Tendency of Judges to Refer for Assessment for Electronic Monitoring



Estimation sample consists of 7,366 cases finalized between 2000 and 2007. The histogram shows the density of judge tendency for referring cases for assessment for suitability for the electronic monitoring program adjusted for court and year of finalization interacted fixed effects. The top and bottom 5% of observations have been excluded.