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Abstract

In 143 countries incarcerated women serve their sentence in a typically small separate section within prisons that mainly house male inmates, while 79 countries have prisons exclusively dedicated to women. Exploiting data from Italy, where both prison types coexist, and a quasi-random institutional assignment rule, we find that women-only prisons lower three-year recidivism by up to 16 percentage points. We use policy-relevant treatment effects to identify the optimal location of an additional women-only prison. As for the mechanisms, a driver is the presence of a large enough number of women for a given facility.

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1 Introduction

Around the world, convicted women serve their sentences in different institutional settings. One possibility are mixed-gender prisons, i.e., facilities that predominantly house male convicts and have a separate female section, with virtually no interaction between the two genders.[1] Another possibility are women-only prisons, i.e., facilities entirely dedicated to women. Currently, in 79 countries, representing 14% of the world's population, there are exclusively mixed-gender prisons. In 56 countries, with 30% of the world population, there are exclusively women-only prisons. In 64 countries, with 54% of the world population, there are both types of prison.[2]

It is not clear why some countries choose one model and others choose a different one. In some cases, it might have been the legacy of historical developments. For example, in the U.S., the so-called reformatory model, more attuned to women's needs, replaced at the beginning of the twentieth century the so-called custodial model, in the wake of social feminism and the purity movement, and left both cultural and infrastructural inheritances favoring the women-only model.[3]

In some other cases, cost considerations might have played a role. Given that women represent only about 7% of the global prison population, it would often appear less costly to ring-fence a few women in an existing building, already occupied by men, rather than to build from scratch a separate facility.

However, we lack a balanced assessment of the potential benefits of these different models, for example in terms of rehabilitation. It is becoming increasingly important to have a better understanding of their consequences, given that, unfortunately, the number of female inmates is on the rise: while the world male prison population witnessed a 22% increase from 2000 to 2022, the number of incarcerated women grew by nearly 60% during the same period, surpassing 740,000 (Penal Reform International, 2023).

Women recidivism has received relatively little attention and has been explored through descriptive studies (Morash et al., 2017; Cobbina et al., 2012; Mathiassen, 2017). To our knowledge, there are no previous studies on the causal effects of prisons that differ by gender composition.

Our main contribution is to explore the role of women-only prisons as a determinant of women's recidivism. To do so, we propose a novel instrumental variable strategy that

[1] The expression mixed-gender prison is sometimes referred to the few correctional facilities in which male and female prisoners share some common spaces and possibly rehabilitation treatments (an example is Spain's Teixeiro Prison). Our use of the expression is different.

[2] The distribution across the world is shown in Appendix Figure A2. For 12 countries, representing 2% of the world population, we were unable to find information on the type of female prisons.

[3] See Rafter (1983).

leverages a default preference of the Prison Administration for keeping inmates as close as possible to their place of residence.

Given that similar proximity-based assignment rules are common in international correctional standards, including binding EU regulations and UN guidelines (United Nations, 2010), our empirical strategy can be applied in other countries and, most importantly, can be used to evaluate the causal effects of other (binary) prison characteristics, besides the gender composition which is the focus of this study. Furthermore, our approach suggests the possibility of constructing a test, based on a revealed preference argument, to infer what drives a Prison Administration in allocating inmates to prisons. These claims will be justified in Section 2.2.

The widespread concerns raised by NGOs and international organizations have brought attention to the difficult conditions often experienced by female prisoners, highlighting the need for improved standards.[4] Depending on their gender composition, different prisons might be differently equipped to address women's specific needs, such as healthcare, tailored care for pregnant women, education policies, training and rehabilitation programs crafted with a specific focus on women's needs (World Health Organization, 2009), thereby differently affecting the conditions experienced during the time served by the women inmates. In turn, this might impact their behavior after release and in particular have an effect on female recidivism and the societal costs it entails.

In this paper, we focus on the relative benefits of the two prison types and in particular we estimate the causal effect on female recidivism of serving a given sentence in a women-only rather than in a mixed-gender one.

To obtain this result, cross-country comparisons are hardly useful, due to multifaceted and difficult-to-control variations in prison systems between countries, compounded with distinct characteristics of the justice system. The analysis within the same country is also not free from difficulties, mainly because the allocation of inmates across the two types of prisons is typically non-random, and might be correlated with perceived recidivism, thus contaminating with selection the estimated coefficient.

We conduct our analysis using data from Italy, whose prison system contains both mixed-gender and women-only prisons, albeit with a large prevalence of the first kind: 52 prisons housing male inmates with a separate small female section, and 4 relatively large women-only prisons spread across the country, two in the South (Trani and Pozzuoli), one

[4] Penal Reform International: "Addressing the 105,000 increase in the global female prison population, ten years after the Bangkok Rules were adopted" The challenging conditions faced by female convicts were acknowledged as early as 1833, when Auburn's prison chaplain noted that enduring a prolonged period as a female convict in often overcrowded small corners of predominantely male prisons would be worse than death, contrasting it with the relatively tolerable conditions for male convicts in the same prison (Rafter, 1983).

in Central Italy (Rome) and one in the North (Venice). As a background, it is useful to recall that in Italy, similarly to many other countries, the prison system is characterized by widespread poor conditions and overcrowding (Council of Europe, 2022).

We address the selection problem by leveraging institutional details of the assignment of inmates to prisons that allow us to mimic a quasi-random allocation of women between prisons of the two kinds. In Italy, the decision concerning the prison where a convicted woman will serve her sentence is taken by the Prison Administration Department (DAP), balancing two criteria. On the one hand, the four women-only prisons are considered to be more attuned to the women needs and are in principle the preferred choice. On the other hand, the allocation tries to minimize the distance between the prison and the residence of the convict, to reduce the disruption of family and social links. Interestingly, this rule is present in many other democratic countries.[5]

When the (closest) mixed-gender prison is closer to the residence of the convict than the (closest) women-only prison, there is a tension between these two criteria. If the difference between the two distances is not too negative (i.e., when the women-only prison is not much more distant from the residence of the convict), the first consideration tends to prevail and the assigned prison is often a women-only one. If, instead, the mixed-gender prison is much closer to the residence of the convict, the second consideration tends to prevail, and the assigned prison is often a mixed-gender one.

As a result, the more negative is the difference between the two distances (mixed-gender to residence minus women-only to residence) the lower is the probability of being assigned to a women-only prison. If the (closest) women-only prison is in fact closer to the residence of the convict than the (closest) mixed-gender one, there is no conflict between the two criteria and the women-only prison tends to be chosen.[6]

The first criterion is likely to imply a selection problem, as inmates who are perceived to be more (or less) likely to recidivate might be more (or less) likely to be assigned to prisons with better environments and treatment opportunities. However, the second criterion is arguably exogenous, being only dependent on the difference between two geographical distances.

We therefore use the difference between the two distances (each from the inmate's residence) as an instrument for the likelihood of being assigned to a women-only prison.[7]

[5]The rule is contained in the Penitentiary code (Ordinamento Penitenziario), Art. 14, and, for example, is similar to Title 18 of the U.S. Code §3621 - Imprisonment of a convicted person.

[6]In these cases, the probability of being assigned to a women-only prison is, however, not yet 1, as other considerations, like, for example, the capacity of the prison or the need to sever the social links of high-security convicts, might play a role. However, we see that the probability is close to 0.8 and is fairly constant, regardless of the relative distance.

[7]In the Appendix Figure A3 we show the distribution of these distances across Italy.

In this way, we retain only the variability of the assignment that is attributable to an exogenous factor, thus getting close to random assignment. This instrumental variable (IV) approach enables the identification of the causal effect on recidivism stemming from the gender composition of prisons.[8]

A nice feature of our setting is that we can actually test the exclusion restriction, i.e., the assumption that the effect of the instrument on recidivism is only the one mediated by the assignment to the two types of prisons, and not a direct one. Indeed, when the difference between the two distances is positive, we expect no effect on the assignment, once we control for the actual difference between the residence and the assigned prison. Hence, if the exclusion restriction is satisfied, we should observe no correlation between the instrument, on its positive range, and recidivism.

Our analysis is based on individual inmate data kindly provided by the DAP, covering the period 2012-2022. We complement these data with annual surveys conducted by the Italian NGO Antigone,[9] which provide detailed information on conditions in all Italian prisons.

We find a remarkable reduction in recidivism (measured over the three years following the release from prison), with Two-Stage Least Squares (2SLS) estimates ranging from 8 to 16 percentage points (14 percentage points in our preferred, most restricted specification), among inmates quasi-randomly assigned to women-only prisons, compared to otherwise similar inmates serving the same sentence in a mixed-gender prison. This effect is present and significant for both Italian and foreign inmates, and it is robust to various specifications and robustness tests detailed below.

In our setting (with heterogenous treatment effects and a continuous instrument) the 2SLS estimates are a variance-weighted average of covariate-specific Local Average Treatment Effects (LATEs). From these, we can also recover the so-called Marginal Treatment Effects (MTEs). These give the treatment effect for individuals at a given point of the distribution of the unobserved "resistance to treatment", which captures idiosyncratic motives that might offset the assignment to a women-only prison. We find that inmates are indeed selected on unobservables to maximize treatment effects, but this selection is of limited importance and the MTE curve is fairly flat, making it possible to

[8]This instrument is similar in spirit to those used to instrument schooling choices (see, among others, Card, 2001, 1995), though with the advantage of exploiting relative differences across locations. As mentioned later, this allows us to control for the distance bwteeen the inmate's place of residence and the prison the inmate ends up serving time.

[9]Antigone (https://www.antigone.it/) is a leading Italian non-governmental organization specializing in justice, human rights and prison-related matters. Each year, their independent representatives gain access to Italian prisons, documenting the conditions of inmates and identifying key challenges within the prison system.

interpret the 2SLS estimates as a good approximation of the Average Treatment Effect.

Leveraging on these results, we conduct two simple policy experiments: in the first, we compute "optimal" policy-relevant treatment effects (Heckman and Vytlacil, 2001b), that is, we identify the location of a single, new women-only prison that would generate the maximal effect in curbing women recidivism, given the local number of inmates, the geographic distribution of their residences and the individual MTE.

In the second, we verify the possibility to repurpose some of the existing mixed-gender prisons so as to move to a system with only single-gender prisons. In both cases, we compute the implied overall reduction in recidivism.

We have no conclusive and sharp evidence to identify the exact mechanism behind our results.

However, a large enough number of women inmates in a given facility appears to be a relevant driver of our results, making it easier to meet their needs and design more effective and targeted rehabilitation initiatives. Indeed, we observe larger effects when the control group consists solely of women's sections within men's prisons that house a smaller share (or a smaller number) of women, which arguably lowers their bargaining position with respect to the male counterparts. This also aligns with qualitative evidence (Palmisano, 2015) suggesting a minimum-scale effect: too few women might not justify activating programs tailored to their specific needs.

Women-only prisons typically exhibit better conditions in terms of improved health services, enhanced social and working spaces, better employment opportunities, and greater autonomy in organizing inmates' time and movements within the facility. It is difficult to disentangle the contributions of these different features to the estimated effect of recidivism. Rather, we are likely dealing with a bundled treatment, with the overall effect arising from the simultaneous improvement in various dimensions.

A considerable body of research has investigated the effects of imprisonment (Aizer and Doyle, 2015; Bhuller et al., 2020; Rose and Shem-Tov, 2021) sometimes with a specific focus on deterrence (Abrams, 2012; Helland and Tabarrok, 2007; Drago et al., 2009; Katz et al., 2003; Kuziemko, 2013; Vollaard, 2013) and incapacitation effects (Barbarino and Mastrobuoni, 2014; Buonanno and Raphael, 2013; Owens, 2009; Levitt, 1996).[10] Researchers have explored the influence of alternatives to traditional incarceration policies on recidivism and examined various preventive measures, such as the use of electronic monitoring or diversion (Di Tella and Schargrodsky, 2013; Mueller-Smith and T. Schnepel, 2021), rehabilitative practices (Lotti, 2022; Heller et al., 2017; Alsan et al., 2025; Arbour et al., 2024), peer effects (Bayer et al., 2009; Drago and Galbiati, 2012), better prison conditions (Drago et al., 2011), the contrast between high and minimum security

[10] For an overview see Doleac (2023).

levels in prisons (Chen and Shapiro, 2007), the comparison between new and old facilities (Tobón, 2022), and the distinction between open and closed prisons (Mastrobuoni and Terlizzese, 2022). Collectively, these studies indicate a consistent trend: less severe prison conditions - whether achieved through electronic monitoring, lower security level placement, or alternative approaches such as open cells — are associated with lower rates of recidivism.

2 Institutional Context

Historically, the approach towards women imprisonment in Italy has been characterized by the separation between sexes in prison and by the protection of the "incarcerated mother" (Agnella, 2023). This approach reflected a gender identity that is narrowly defined by motherhood and traditionally feminine activities, a view that traces back to early modern institutions designed for women, which aimed to preserve or rehabilitate their virtue, often related to sexual deviance. Despite reforms aimed at social reintegration and ensuring formal equality of treatment, the contemporary Italian female prison system still echoes elements of its past. According to Italian NGOs working on this topic,[11] the treatment and rehabilitation opportunities for women are limited, with a focus on stereotypically female jobs and insufficient rehabilitative, educational and vocational training. Women face inadequate healthcare, limited employment opportunities, and poor support for reintegration, exacerbating the challenges after release.

The prison system includes only four women-only facilities. The women who are not housed there are assigned to one of the 52 mixed-gender prisons. The heavy reliance on the latter has been criticized for neglecting gender-specific needs, treating their issues as secondary among the various prison management challenges. A 2008 directive by the Prison Administration[12] has sought to address the absence of female-specific treatments, introducing standards that recognize and protect gender differences to mitigate the marginalization of women in prison (for example, with respect to psychological, social, and emotional needs, maternity, relationships with children, emotional well-being, specific health needs and specialized healthcare services, like gynecology, mammography,...)

2.1 The Allocation Rule

The default rule for allocating women inmates is to place them in the closest facility that can accommodate females, which can be either a women-only prison or a mixed-gender

[11]See "Dalla parte di Antigone: Primo Rapporto sulle donne detenute in Italia (2023)" (in Italian)
[12]*Circolare n.0308268 del 17 settembre 2008.*

one.[13] This aims to minimize the disruption experienced by women inmates, allowing for easier access by family and legal representation, and contributing to better overall welfare.

However, this default rule is not absolute and the Department of Prison Administration (DAP) office tasked with the assignment retains some discretion. Convicted women can be assigned to facilities further away from the closest one due to security requirements,[14] capacity constraints, or specific individual needs that cannot be met by the nearest institution. Most importantly for our purposes, there is widespread awareness, in the office of the DAP tasked with the assignment, that women-only facilities offer better prison conditions and rehabilitating opportunities.[15]

The assignment therefore can be represented as a multi-stage decision tree:

0 Is the (closest) women-only prison closer to j's residence than the (closest) mixed-gender prison?

1 if **yes**, is j a security risk inmate, or are there other reasons that prompt suspension of the default rule?

- **1.1** if *no*, then assign j to the (closest) women-only prison.
- **1.2** if *yes*, then assign j to a prison different from the closest.

2 if **no**, is j a security risk inmate, or are there other reasons that prompt suspension of the default rule?

- **2.1** if *no*, does the benefit of assigning j to a women-only prison outweigh the loss of assigning her to a prison farther away from her residence?
  - **2.1.1** if ***yes*** then assign j to the (closest) women-only prison.
  - **2.1.2** if ***no*** then assign j to the (closest) mixed-gender prison.
- **2.2** if *yes*, then assign j to a prison different from the closest. This might be a women-only prison, or a mixed-gender one.

At node 1.2 of the decision tree the default rule is suspended, and closeness to j's residence is no longer a factor driving the prison assignment. In principle j could be sent to another women-only prison, but in the data we see that less than 2% of the assignments to a women-only prison involve a prison that is not the closest women-only prison. Also at node 2.2 the default rule is suspended, and the assignment could be to a women-only

[13] *Dispositivo dell'art. 14 Legge sull'ordinamento penitenziario, Titolo I, Capo III.*

[14] As a rule, members of organized crime are kept away from their familiar environment, to disrupt their criminal network, and therefore are not sent to the nearest prison.

[15] The presence of such awareness was established through interviews with DAP officials.

prison, if the latter satisfies the requirements that drive the decision when the default rule is suspended.[16] Whether or not this is the case, however, the comparison between the distances of the two closest types of prison from j's residence is no longer a relevant factor in the decision. In view of these remarks, we slightly simplify the assignment rule by assuming that at node 1.2 the assignment is indeed to a mixed-gender prison. At node 2.2, while we do not specify the trade-offs involved in the assignment decision, we just assume that they do not involve the relative distances of j's residence from the two types of (closest) prisons.

We then formalize the assignment decision as follows.

Let $A(j) \in \{W, M\}$ denote the assignment of j to a women-only (W) or mixed-gender (M) prison

Let $B_{ji}, i \in W, M$ be the perceived benefit of sending a specific inmate j to a women-only or mixed-gender prison, with $B_{jW} > B_{jM}$ for all j, though not necessarily equal for all inmates. Let $D_{ji}, i \in W, M$ be the distance between j's municipality of residence and the (closest) women-only and mixed-gender prison. Finally, let α_j denote the probability that j is either a security risk inmate or there are other reasons that might justify a deviation from the default rule, and let δ_j denote the probability (independent of relative distances D_{ji}) that a women-only prison is assigned in decision node 2.2.

Following the (simplified) decision tree, we then have that the probability of assigning j to a women-only prison is:

$$\begin{aligned} \mathbb{P}(A(j) = W) = \mathbb{1}(D_{jM} - D_{jW} \geq 0)(1 - \alpha_j) + \\ (1 - \mathbb{1}(D_{jM} - D_{jW} \geq 0))[(1 - \alpha_j)\mathbb{P}(D_{jM} - D_{jW} > \omega(B_{jM} - B_{jW})) + \alpha_j \delta_j], \end{aligned} \tag{1}$$

where ω is a positive scaling factor to measure the benefit of assignment to either type of prison in the same units as the distance.

To simplify the notation, let ΔD_j denote the difference $D_{jM} - D_{jW}$ and ΔB_j denote the difference $\omega(B_{jM} - B_{jW})$.

Equation (1) then implies that, as long as $\Delta D_j < 0$, that is, as long as the (closest) mixed-gender prison is closer to j' residence than the (closest) women only prison, the probability that j is assigned to a women-only prison is an increasing function of ΔD_j. Indeed, recalling that ΔB_j is strictly negative, the closer ΔD_j gets to 0 the higher is $\mathbb{P}(\Delta D_j > \Delta B_j)$.

Instead, when $\Delta D_j > 0$, the probability that j is assigned to a women-only prison does not depend on the actual value of ΔD_j.

[16] Given what we just noted about the data, if this were the case it would be almost surely the women-only prison closest to j's residence.

This implies that the probability that j is assigned to a women-only prison is an increasing function of ΔD_j in its negative range and becomes a constant in the positive range.

These two features are important for our empirical strategy.

Most importantly, while ΔB_j (and possibly α_j and δ_j) could reflect selection in the assignment rule, ΔD_j is plausibly independent of any characteristic of j that could be correlated with her recidivism, once we control for a few observables of a geographic nature (more on this point in Section 4.1). Hence ΔD_j is a valid instrument for assignment to a women-only prison.

Second, the fact that for positive values of ΔD_j the assignment probability is independent of the actual value of ΔD_j implies that we can test whether, in that range, the instrument has no effect on recidivism. In other words, we can test whether the instrument affects recidivism only through its effect on the probability of assignment, and not directly, that is, we can test the exclusion restriction, which is in general an untestable assumption.

2.2 Leveraging the Proximity-Based Assignment

Before moving to the empirical specification and to the results of our analysis, it is useful to highlight that the proximity-based assignment rule, which is one of the criteria underlying the allocation rule to the two kinds of prison that we just described, can be used more broadly to construct an empirical strategy to test for the causal effect of a wide range of (binary) prison characteristics and to make inference about the unobserved policy preference (or lack thereof) concerning these characteristics.

To see that this is the case, consider again the multistage decision tree for the assignment of a given inmate to one of two types of prisons, denoted, with a label intentionally kept uninformative, as type 1 ($T1$) and type 2 ($T2$).

If it were the case that the Prison Administration (or, more generally, the authority responsible for the allocation of inmates to available correctional facilities) has a preference for, say, type 1 prisons, then we could derive for the probability of assigning inmate j to $T1$ an equation similar to (1):

$$\mathbb{P}(A(j) = T1) = \mathbb{1}(D_{jT2} - D_{jT1} \geq 0)[(1 - \alpha_j) + \alpha_j \mu_1] \tag{2}$$
$$(1 - \mathbb{1}(D_{jT2} - D_{jT1} \geq 0))[(1 - \alpha_j)\mathbb{P}(D_{jT2} - D_{jT1} > \omega(B_{jT2} - B_{jT1})) + \alpha_j \mu_1],$$

where we amended the decision tree assuming that at nodes 1.2 and 2.2, when the proximity-based assignment rule is suspended, the probability of assignment to a $T1$ prison reflects the share of that kind of prison among all prisons (μ_1) and does not depend on the relative distance ($\Delta D_j = D_{jT2} - D_{jT1}$).[17] The other symbols in the equation are a mutuated by (1) and are easily interpreted.

From (2) we would then conclude, as in Section 2.1, that the difference between distances ΔD_j is a valid instrument for assignment to type 1 prisons. It would also continue to be true that for positive values of ΔD_j the assignment probability is independent of the actual value of ΔD_j, delivering a test for the exclusion restriction.

It might, however, be the case that the Prison Administration does not have a systematic preference for either type of prisons. In this case the decison tree would be simplified, eliminating the node 2.1 (as well as nodes 2.1.1 and 2.1.2), so that the probability of assigning inmate j to $T1$ becomes:

$$\mathbb{P}(A(j) = T1) = \mathbb{1}(D_{jT2} - D_{jT1} \geq 0)(1 - \alpha_j) + \alpha_j \mu_1. \tag{3}$$

In this case the probability of an inmate to be assigned to a $T1$ prison takes the form of a step function, with a lower value ($\alpha_j \mu_1$) in the negative range of ΔD_j, and a higher value ($1 - \alpha_j + \alpha_j \mu_1$) in the positive range.

This would then suggest that a more suitable empirical strategy to assess the causal effect of assignment to $T1$ would be a regression discontinuity design, with the discontinuity taking place at 0.

Interestingly, granted the presence of a preference for proximity in the assignment rule of inmates to prisons, running a regression of the probability of being assigned to $T1$ on ΔD_j would signal, in a revealed preference spirit, whether the Prison Administration also attaches value to $T1$ prisons. If this is not the case, the regression should yield an approximate step function, with a positive discontinuity at 0, while a preference for $T1$ should result in an increasing function over the negative range of Δ_j, and a flat portion over the positive range.[18]

3 Empirical Specification

3.1 Data

The Department of Prison Administration of the Italian Ministry of Justice granted us access to a large amount of confidential information on the universe of female prisoners who spent any time in prison between 2012 and 2022. The information includes 10,222 incarcerations.

[17] Since type 1 and type 2 prisons are generic labels, we cannot invoke, as we did previously, the negligible share of one of the two kind of prisons.

[18] We will revisit this issue in Section 6.

We complement these data with yearly data on the prison population recorded by the Ministry of Justice[19] and with annual surveys on prison conditions for the years 2017, 2018, and 2019, collected in all Italian prisons by Antigone, an Italian NGO.[20]

We measure recidivism, similarly to Mastrobuoni and Terlizzese (2022), as reincarceration within three years from release from prison (we also look at shorter time windows, that is, 1 and 2 years). The data allows us to control for several individual characteristics, like age, marital status, region of residence, region or country of birth, education, sentence length, and sentence status, and the type of crime committed. We can also control for the possible overcrowding of different prisons, at yearly frequency.

Antigone's surveys of prison conditions allow us to describe the main differences between women-only and mixed-gender prisons. Some differences stand out (see Table 1). Women-only prisons house on average many more female inmates, 247 against 60. In mixed-gender prisons, it is considerably less likely that inmates are allowed to freely move within the prison (27.8% versus 82.4%). The other notable differences are that inmates in women-only prisons are more likely to be allowed to work outside of the prison, are more likely to have a woman as prison director (96.9% against 64.0%) and are considerably more likely to have access to hot water, showers, obstetricians, and gynecologists. In women only prisons there is also a lower share of self-harm episodes per year (12.5% against 30.2% in mixed-gender prisons).

It should be noted that the unconditional rate of recidivism is in fact slightly larger among inmates who spent their sentence in a women-only prison, compared to inmates in mixed-gender prisons (about 12% vs. 11.4%). However, women-only prisons tend to be localized in or near large cities much more frequently than mixed-gender ones. Given that recidivism tends to be more prevalent in large cities (e.g., Staton-Tindall et al. (2015)), the near equality of the unconditional rates of recidivism is likely to mask important differences between the two types of prison.

3.2 Identification

We aim to estimate the causal effect on recidivism of serving the same sentence in a women-only prison, instead of a mixed-gender prison. In line with most of the recent literature, we use a linear probability model of 3-year recidivism by inmate j (R_j), depending on whether the sentence was served in a women-only prison, captured by a dummy (W_j), on fixed effects for the region of birth ($\gamma_{b(j)}$), the region of residence ($\tau_{r(j)}$)

[19]We collect yearly statistics from *Statistiche sulla popolazione detenuta*, reports for the years 2012-2022.

[20]The survey conducted in 2019 is the only one with a specific focus on women conditions.

and several controls (X_j):

$$R_j = \beta_0 + \beta_1 W_j + \psi' X_j + \tau_{r(j)} + \gamma_{b(j)} + \eta_j. \quad (4)$$

Given the potential endogeneity of W_j, as argued in the previous section, we exploit the prison administration's decision rule (1), instrumenting the women-only prison dummy W_j using ΔD_j, the difference (in Km) between the (minimal) distances from the residence of inmate j of mixed-gender and women-only prisons. In our main specification, to calculate ΔD_j we use the prison of exit, which is more likely to be the one in which the largest part of the sentence was served, whereas the prison of entry might reflect only a temporary assignment. Nevertheless, most of the times prison of entry and prison of exit coincide. For robustness, we also calculate ΔD_j according to the prison of entry.

The first stage and the reduced form equations are the following:

$$\begin{pmatrix} W_j \\ R_j \end{pmatrix} = \phi + \theta \Delta D_j + \varphi X_j + \lambda_{r(j)} + \xi_{b(j)} + \epsilon_j, \quad (5)$$

where $\phi, \theta, \lambda_{r(j)}, \xi_{b(j)}$ and ϵ_j are column vectors of size 2 and φ is a $2 \times n$ matrix, where n is the number of variables included in the vector X .

Under the assumption that the relative distance from the two types of prison is conditionally exogenous, we can identify the local average treatment effect: $\hat{\beta}_1 = \hat{\theta}_2/\hat{\theta}_1$.

Given that the distances between the municipality of residence and the two types of prison could be correlated with the characteristics of the municipality or with the ease with which the inmate can receive support from the local environment (factors that, in turn, might affect her post-release recidivism), we control for the distance between the inmate's place of residence and the actual prison, for whether the inmate resides in a metropolitan area[21], for some sociodemographic features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions), for region of birth and region of residence fixed effects (the latter denoted $\xi_{b(j)}$ and $\lambda_{r(j)}$, respectively). We also control for the overcrowding rate, the inmate's age, age squared, nationality, educational status, marital status, types of crime committed, sentence status, incarceration length, and the closing year of incarceration.[22]

[21]We classify metropolitan areas those with population exceeding three million inhabitants, including the three largest cities in Italy: Rome, Milan, Naples, Turin, Palermo, Genova.

[22]We calculate the overcrowding rate as the ratio between the number of inmates and the prison's regulatory capacity. Education status is categorized as follows: without schooling, elementary school, lower secondary and higher secondary (including high school and university degrees). Marital status is defined within three categories: married or married in common law, divorced / separated, or widow, and single. We specify the types of crime as drug-related crimes, property crimes, violent crimes, and other crimes. Lastly, we define sentence status as follows: definitive sentence, under appeal, awaiting trial, mixed status, and other statuses.

A distinctive feature of our setting is that we can do better than buttressing the conditional independence assumption by including a large set of controls. Given the prison administration's decision rule (1), we know that the instrument should only be relevant in the range $\Delta D_j < 0$. This can be tested directly. Moreover, past that threshold, the instrument should not affect the probability of assignment to a women-only prison. A significant reduced-form effect past the 0 threshold would imply a violation of the exclusion restriction. Thus, in summary, we test for and estimate the following coefficients for the different samples:

Relevance: $\theta_1 > 0$ when $\Delta D_j < 0$

Decision Rule: $\theta_1 = 0$ when $\Delta D_j \geq 0$

Reduced-form Effect: $\theta_2 < 0$ when $\Delta D_j < 0$

Exclusion Restriction: $\theta_2 = 0$ when $\Delta D_j \geq 0$

Thus, we can test for something that is usually untestable in instrumental variable settings, the exclusion restriction of the instrument. It is worth noticing that in our setup the monotonicity assumption for a LATE interpretation of the 2SLS parameters should hold as well. There is no reason why inmates should become more likely to be sent to a specific prison as the distance from that prison increases.

3.3 Marginal and Average Treatment Effect

As mentioned previously, with heterogeneous treatment effects and a continuous instrument, our Two-Stage Least Squares (2SLS) estimate of equation 4 provides a variance-weighted average of covariate-specific Local Average Treatment Effects (LATEs). The latter measure the causal effect on recidivism of being assigned to a women-only prison for various groups of 'complier' inmates, that is inmates who are assigned to a women-only prison because of the relative distance from their place of residence. The interpretation of the overall 2SLS effect, being an aggregation of LATEs, is a little involved and might hide potentially interesting patterns of selection induced by changes between specific pairs of values of the instrument.

However, with binary endogenous assignment (to a women-only or a mixed-gender prison) and a continuous instrumental variable, we can recover a richer array of treatment effects - the so-called marginal treatment effects (MTEs) - that better characterize the selection induced by the instrument and can be aggregated to obtain the average treatment effect (ATE), something that in general would not be possible starting from the LATE estimates.[23]

Specifically, we can estimate a propensity score, as a function of covariates and of the relative distance (our instrument), to characterize the *observed* inducement into treatment, which in our case is serving the sentence in a women-only prison. The actual assignment then results from balancing out the observed inducement with the *unobserved resistance to treatment*, which captures idiosyncratic (and unobserved by us) motives that might militate against being assigned to a women-only prison. The various LATE estimates (aggregated by the 2SLS procedure) refer to the average effect for compliers who fall in different ranges of the distribution of the unobserved resistance to treatment, while each MTE estimate is the limit as one of these ranges shrinks to a single point. Each MTE estimate then gives the treatment effect for individuals at a given point of the distribution of the unobserved resistance to treatment, in turn identified by a specific value of the propensity score.[24]

Since the percentiles of the propensity score are uniformly distributed, a simple average of the MTEs yields the average treatment effect (ATE), that is the average effect in the inmate population, the policy-relevant parameter if one were to decide to treat the entire inmate population. In Section 5.1, based on this framework, we estimate "optimal" policy relevant treatment effects to identify the ideal location of a new women-only prison.

4 Results

4.1 Balance Tests

We start by looking at whether the individual characteristics of inmates assigned to women-only or mixed-gender prisons differ. Since women-only prisons and their inmates tend to be located in larger cities, with features (e.g., size, density, etc.) that may correlate with crime, we control for such features. Thus, we test the statistical significance of the *conditional* differences among the characteristics of the two groups of prisoners. In other words, we provide support for the assumption of conditional independence of our instrument.

Figure 1, left panel, reports the coefficients of a linear probability model where the dependent variable is a dummy W_j equal to 1 if j is assigned to a women-only prison

[23]MTE were first introduced by Björklund and Moffitt (1987) and Heckman and Vytlacil (1999) and later extended in a series of papers (see, for example, Heckman et al. (2006)). For an introduction to marginal treatment effects see Cornelissen et al. (2016).

[24]Carneiro et al. (2011) has an application of MTE to estimate returns to college education where, similar to our case, distance is used as an instrument.

(0 otherwise), controlling for region of the prison and of the inmate's birth fixed effects, as well as for various characteristics of the municipality of residence (for continuous variables we add a quadratic polynomial): population, population density, a dummy for municipalities with more than 500,000 inhabitants, the share of foreigh born residents and the share with university degree. In line with the potential endogeneity of W_j, we find that several variables display a statistically significant coefficient and an F-test for joint significance of 187, with a zero p-value. In the right panel, we repeat a similar analysis, considering as the dependent variable a dummy equal to 1 if $\Delta D_j < 0$. We see that in this case the observable differences between inmates, depending on whether the relative distance of the two types of prisons from their residence is positive or negative, are almost always statistically insignificant (the joint significance test has a p-value of 0.32, well above the conventional thresholds). The lack of correlation between ΔD_j and inmates' characteristics provides reassurance regarding the conditional exogeneity of our instrument.

Table 2 shows the descriptive statistics that divide inmates according to their relative distance, $\Delta D_j < 0$ and $\Delta D_j \geq 0$. The two samples are generally comparable with some notable exceptions. As mentioned earlier, women with a positive D are more likely resident in metropolitan areas, where women-only prisons are located (22% for $\Delta D_j < 0$; 65% for $\Delta D_j \geq 0$). In turn, the share of Italians is much lower for $\Delta D_j \geq 0$ as metropolitan areas are more likely to attract migrants (73% for $\Delta D_j < 0$; 48% for $\Delta D_j \geq 0$). For this reason, we always control for whether inmates reside in cities with more than 500,000 inhabitants.

Women closer to women-only prisons are also three years younger, 22p.p more likely to be single and 8p.p. more likely to have committed a property crime. The two samples show a marked difference in the three-year recidivism with lower rates for women closer to mixed-gender prisons (10.02% for $\Delta D_j < 0$; 15.14% for $\Delta D_j \geq 0$): this difference might be driven by such imbalances in terms of citizenship, demographics, and type of crime.

4.2 Non-parametric Evidence

Figure 2 shows the fraction of inmates assigned to a women-only prison as a function of ΔD_j, without any controls. We see that the fraction increases with ΔD_j, as long as $\Delta D_j < 0$, while it is broadly constant in the range $\Delta D_j \geq 0$. In plain English, inmates whose residence is only slightly nearer to a mixed-gender prison than to a women-only prison are more likely to be assigned to the latter than inmates whose residence is much closer to a mixed-gender prison than to a women-only one. Once the women-only prison is closer, the probability of being assigned there is no longer significantly affected by the relative distance (in line with the allocation rule described in Section 2.1).

The figure is a graphical representation of the first stage of our Instrumental Variable (IV) strategy. The increasing part, for values of $\Delta D_j < 0$, highlights the relevance of the instrument. The broadly flat part, for values of $\Delta D_j \geq 0$, shows that the instrument does not predict assignment to a women-only prison for inmates whose residence is closer to that kind of prison, in line with the decision rule described in Section 2.1.

In Figure 3, the blue line shows the decreasing relationship between our instrument (in the negative range) and recidivism, again without controls. This is a graphical representation of the reduced form in our IV strategy. The fairly flat green line shown in the figure illustrates the lack of relationship between the instrument and a measure of predicted recidivism. The latter is obtained from a logistic regression model, in which recidivism is projected on all the observables considered in Figure 2.[25] The flat line, implying the absence of a correlation between ΔD_j and (a function of) these observables, confirms that the relationship between the instrument and (actual) recidivism, shown by the blue line, does not capture the effect of other observables. Therefore, it is reassuring that the exogeneity of the instrument is present.

4.3 Instrumental Variable Regressions

Table 3 presents the estimates of equation 5, with the first stage in panel A, the reduced form in panel B and the IV estimate in panel C. The bottom part of the table reports the Kleibergen-Paap statistics (KP F-Stat) for weak identification and the fitted values of recidivism, under the two alternative assumptions that *all* the inmates are either in a mixed-gender ($\hat{R}_M$) or in a women-only prison ($\hat{R}_W$), leaving all other covariates unchanged. In the first 4 columns, the estimates are restricted to the sample of inmates whose residence is closer to a mixed-gender prison than to a women-only one ($\Delta D_j < 0$), in the following 4 columns the sample only includes inmates whose residence is closer to a women-only prison ($\Delta D_j \geq 0$).

In column 1 we include no controls nor fixed effects, with the exception of the dummy indicating whether or not the residence of the inmate is within a metropolitan area.[26] Hence the coefficient of interest (the effect on recidivism of being assigned to a women-only prison; β_1 in the notation of equation 4) is identified by the variability that results from all possible reciprocal positions of the inmates residence, the (closest) mixed-gender prison and the (closest) women-only prison, provided that we only compare inmates whose residence is equally within (or equally outside) a metropolitan area (though not necessarily the same). We see that both the first stage and the reduced form are highly

[25] Appendix Figure A1 shows the high correlation between recidivism and predicted recidivism.

[26] This dummy will always be included in all the specifications discussed in this and in later Sections.

significant, confirming the relevance of the instrument, with a large value of KP F-Stat, and the presence of a reduced-form effect (in the notation of equation 5, $\theta_1 > 0$ and $\theta_2 < 0$ when $\Delta D_j < 0$). The overall effect is about -8p.p. Hence, the fitted value of recidivism would drop from 13.8%, if all inmates were housed in mixed-gender prisons, to 5.9%, if they were all moved to women-only prisons.

In column 2 we include region of birth and region of residence fixed effects. Including the latter greatly restricts the variability of the instrument used to identify the causal effect. In particular, since different regions might be more or less conducive to recidivism,[27] and, at the same time, might be differentially endowed with women-only prisons,[28] comparing inmates who live in the same region allows us to clean the effect of being assigned to a women-only prison from the possible (positive) correlation between recidivism and presence of women-only prisons. Since this correlation would partially offset the pure effect of the assignment, we see that the latter increases substantially (in absolute value), with an estimated value of -16.1p.p. In this case, therefore, the fitted value of recidivism would drop from 17.7%, if all inmates were housed in mixed-gender prisons, to 1.6%, if they were all moved to women-only prisons.

In columns 3 and 4 we also include the controls listed in Section 3.2, so we further restrict the variability identifying the coefficient of interest, as we compare inmates who differ in terms of the relative distance to the two kinds of prisons, live in the same region, and also have the same values for all the included controls (in column 4 we add the quadratic version of the continuous controls). Both the first stage and the reduced form estimates remain significant, with little change in value, and the overall effect becomes slightly less negative, to about -14p.p.

As mentioned, we can directly test the exclusion restriction, namely the requirement that the instrument affects recidivism only through its effect on prison assignment. Columns 5 to 8 replicate the same specifications of columns 1 to 4 on the sample of inmates whose residence is closer to a women-only prison ($\Delta D_j \geq 0$). The assignment rule described in Section 2.1 implies that positive values of the variable ΔD_j should have no effect on the prison assignment. Therefore, under the validity of the exclusion restriction, positive values of the variable ΔD_j should also have no effect on recidivism. Hence, in columns 5 to 8, we should observe both an insignificant first stage and an insignificant reduced form. This is precisely what Table 3 shows.

[27] For example, regions might differ for the presence of organized crime or for labor opportunities available to released inmates.

[28] For example, it might be the case that women-only prisons were created precisely in those regions where there is more recidivism.

4.4 Robustness Tests

As mentioned before, we compute the instrument ΔD_j on the basis of the prison of exit. In Table A1 we verify that our results are robust to this choice by computing the instrument on the basis of the prison of entry. The results are very similar to the ones in Table 3, with the range of IV estimates from 7 to 15p.p.

In Table A2 we compute recidivism as re-incarceration within a shorter window, namely 1-year and 2-year after release. We show that the effect of spending the sentence in a women-only prison is already apparent in the shorter time window, with the IV estimate ranging between 6 and 13 percentage points.

A further robustness check on the definition of recidivism is presented in Table A3. Instead of including all re-incarcerations after release, irrespective of whether the latter occurred after a definitive sentence,[29] we define recidivism as reincarceration after release from a definitive sentence. While this reduces the sample size and yields somewhat less precise estimates, the effect of assignment to a women-only prison are broadly similar to those observed in the main specification.

Finally, we consider two dimensions of potential heterogeneity in our results: foreign status and the type of crime. Our sample includes foreign inmates, whose recidivism might respond differently to the prison assignment. Table A4 replicates the analysis on the sample that only includes Italian inmates. The IV estimates are somewhat larger (in absolute value) than those in Table 3, particularly in the more restricted specifications, and remain highly significant.[30] Table A5 replicates the analysis distinguishing between violent and property crimes and shows that for both types of crime the assignment to a women-only prison reduces recidivism. Depending on the specification, the effect is somewhat stronger for one or the other of the two types of crime, and is in the same ballpark of what found for the entire sample.

4.5 Results for Marginal and Average Treatment Effects

We estimate the propensity to be assigned to a women-only prison using a probit model. The controls are the same used in Table 3, although we get similar results when we do not use regional fixed effects. Figure A4 shows the support of the histogram of the propensity score for women-only (treated) and mixed-gender (control) prisons and highlights two important facts: the support in the two samples is common and covers the entire range $[0, 1]$. These imply that we can use the semiparametric local instrumental variables

[29] The Italian system has two levels of appeal, but a condemned inmate can be in prison while waiting for one of the appeals or because she decided not to appeal.

[30] We do not include a separate test for foreign inmates due to the small sample size.

MTE specification (see Heckman and Vytlacil, 2001a). This allows us to compare the semiparametric and more data-intensive model to the more parsimonious parametric one.

Figure 4 shows that the semiparametric local linear as well as the linear MTE curves are slightly upward sloping, which means that inmates with a larger unobserved resistance to end up in a women-only prison show smaller reductions in recidivism.

Inmates are thus selected on the basis of unobservables to maximize treatment effects. However, the slope is nearly flat and Table 4 shows that ATEs are fairly close to the main local average treatment effects estimated in Table 3. This means, importantly, that scaling up the treatment to the entire prison population, thus increasing the number of women-only prisons by a factor of about 4 (right now about one-fifth of women are housed in women-only facilities), would drastically reduce recidivism.

5 Two Policy Experiments

In this section, we present two simple policy experiments, aimed at leveraging the results obtained on the effect on recidivism of women-only assignment to explore possible targeted reorganizations of the current Italian prison system. The first experiment takes advantage of the MTEs estimated above and involves the construction of a single, new women-only prison, strategically located to serve areas with high concentrations of incarcerated women who, in addition, have larger (in absolute value) MTE. The second experiment explores the possibility to repurpose, within a given region, some of the existing mixed-gender prisons to cater exclusively for women, by reallocating the current male population. This approach would transform selected mixed-gender prisons into women-only facilities.

5.1 Optimal Policy Relevant Treatment Effects

Policy makers might want to know in which municipality, out of the 7,896 existing in Italy, a new women-only prison should be built to achieve the maximal reduction in women recidivism. For each municipality, we simulate the opening of one new women-only prison (the policy) and estimate the corresponding Policy Relevant Treatment Effects (PRTEs), that is, the marginal treatment effects for those inmates whose probability of ending up in a women-only prison changes in response to the policy (see Heckman and Vytlacil, 2001b). The simulations are based on the entire 9 years of data, and the corresponding distribution of inmates across municipalities.[31] This allows us to identify the optimal

[31] We are implicitly assuming that such distribution does not change much over time, an assumption which is supported by the data.

location ℓ of an additional new women-only prison, as the one that minimizes overall predicted recidivism (evaluated at the average value of the controls X):

$$\min_{\ell} E(\widehat{R}_i^{\ell} - \widehat{R}_i | X = \overline{x}) = \min_{\ell} \int_0^1 MTE(\overline{x}, u_D)\omega^{\ell}(\overline{x}, u_D) du_D,$$

where the weights are $\omega^{\ell}(\overline{x}, u_{iD}) = F_{P|\overline{X}}(u_{iD}|\overline{x}) - F_{P^{\ell}|\overline{X}}(u_{iD}|\overline{x})$, with F_P and $F_{P^{\ell}}$ denoting the distribution function of the unobserved resistance to the treatment, conditional on the *status quo* and the addition of a new women-only prison in location ℓ, respectively. In words, the weights reflect the change in the distribution of the unobserved resistance to end up in a women-only prison as the propensity scores change when a prison is build in municipality ℓ.[32] Notice that opening a new women-only prison can only increase the propensity scores, which implies that all weights are larger than zero.[33]

Figure 5 shows the distribution of the PRTEs in the left panel and the prison size requirement (the change in the propensity score times the average yearly number of prison inmates) in the right panel. Based on the current distribution of women-only prisons (Rome, Venice, Trani and Naples), the largest demand for a new women-only prison is in the North-West, in the municipality of Zinasco, province of Pavia, 34 km south of Milan, 100 km East of Turin, and 75 km North of Genoa. The prison in the optimal location would accomodate around 250 women and lead to a reduction in recidivism of about 30 inmates each year (250 times the average PRTE, -0.12). Given an estimate of the prison cost per inmate of about 50,000 euro (see Barbarino and Mastrobuoni, 2014), this would lead each year to about 1.5 million euros of savings.

5.2 Re-allocation to Existing Prisons

A bolder policy change would ban mixed-gender prison altogether. Here we propose a way to achieve such change without building new prisons.

The official prison capacity for women inmates in Italy, besides the four existing women-only prisons, is of almost 1600 places, and is present in almost all the Italian regions. Setting aside possible technical difficulties in repurposing existing buildings, here we conduct the following thought experiment: within each region (except the two smaller regions which have no official capacity for women), we imagine to repurpose one or more of the existing mixed-gender prisons, transforming them into women-only facilities, so as to create enough places to host all the official capacity for women currently housed

[32] In line with the literature, we are assuming policy invariance, meaning that the MTEs do not depend on ℓ, thus do not change with the policy (see Heckman and Vytlacil, 2007).

[33] In line with the evidence on the first stage, we set propensity scores when the difference in distance is below -110 km to zero.

in mixed-gender prisons. In this way, all the women inmates envisaged in the official capacity of the Italian prison system could be housed in women-only prisons.

Clearly, it is only by chance that in a region there is one prison that has (or several ones that in total have) a number of places exactly equal to the total number of places for women inmates in the region, so that the women reallocated would free just enough places to house the males that were originally in the repurposed prison.[34] Nevertheless we verified that in each region the reallocation can be done in such a way that the excess number of places envisaged for male inmates almost never exceeds 3 percent of the regional residual official prison capacity for males.[35] We believe that, given the limited size of the deficit, and assuming that there could be some reorganization and rationalization of the physical space, the reallocation could be easily accommodated.

Having checked that, at least on the basis of the current distribution of the official prison capacity, the Italian prison system could become a women-only one, we can easily compute the reduction in recidivism that this would entail, given our estimates. The shift to a women-only prison would reduce the yearly number of recidivating women by a minimum of 126 to a maximum of 256 (corresponding to the range of our estimates of the effect on recidivism of women-only prison).

6 Mechanisms

Women-only prisons differ from mixed-gender ones along several dimensions (as documented in Table 1). They typically offer enhanced healthcare services, improved living areas, and a more comprehensive array of educational and vocational opportunities for inmates. We are considering, in other words, a case of bundled treatment, and it is therefore difficult to single out one (or more) of these aspects as being the main one(s) responsible for the effects on recidivism that our analysis identifies. We try to tackle this difficulty in two ways. First, somewhat indirectly, by looking at factors that might enable, or prevent, the design and organization of facilities with these different bundles of aspects. Secondly, arguably more directly, we select some features that we conjecture might be drivers of our results and we repeat our analysis on the effect of two kinds of prisons on recidivism, but instead of contrasting women-only and mixed-gender prisons, we use factor analysis to repeatedly split the prisons into two groups, according to those features. The idea is to verify whether one (or more) of these features, in and of themselves, and irrespective of whether the prison is a women-only or a mixed-gender one, are

[34] In the current regional distribution of prison capacity, this coincidence only happens once.

[35] In fact, in most cases the male deficit is smaller than 1 percent. Only in one case, in the sparsely populated region of Sardinia, it reaches 11 percent.

associated with a reduction in recidivism.

As to the first approach, one plausible conjecture is that tailoring prison structures to better suit the specific needs of female inmates is both a more pressing concern and easier to implement when women represent a large enough share of the population of inmates housed in a given facility.[36]

To test this conjecture, in Table A6 we compute again the effect on recidivism of being assigned to a women-only prison (as in Table 3) but, in columns 1 and 2, respectively, we restrict the control group to mixed-gender prisons with a relatively high, and relatively low, proportion of women inmates (above and below the median of the distribution). Consistently with the conjecture, the effect on recidivism of the assignment to women-only prisons is more than 3 times larger, in absolute value (although not precisely estimated) when the control group only includes prisons with relatively fewer women.[37] Similarly, in columns 3 and 4 we consider the possible role of absolute, instead of relative, size. In column 3 the control group only includes mixed-gender prisons with relatively larger (above the median) female sections, while in column 4 it includes only mixed-gender prisons in which the size of the female section is below the median. Also in this case, the estimated coefficient is about 2 times larger, in absolute value, when the control group is the one with smaller sized female sections.

In columns 5 and 6, we consider another factor, not necessarily alternative, that might facilitate (or hinder) the organization of correctional facilities better suited to the needs of women inmates: the gender of the prison director. The plausible conjecture, in this case, is that a woman director is more attuned to other women needs. In column 5, we use as a control group only mixed-gender prisons with a male director, while in column 6, we focus on mixed-gender prison with a female director. Again, the results lend support to the conjecture. The effect on recidivism of being assigned to a women-only prison is more than 2 times stronger when the control group only includes mixed-gender prisons directed by a men. This finding echoes research in political economy highlighting how the presence of women leaders can enhance the welfare of the women population (Chattopadhyay and Duflo, 2004; Pande and Ford, 2009; Bochenkova et al., 2023). However, it is important to note that this result should not immediately advocate for replacing men directors with women ones, as mixed-gender prisons predominantly house male inmates, and we have so far no evidence of the potential impacts of having a woman director on the male population.

[36]According to a report from the Italian Ministry of Interior (Palmisano, 2015), the limited number of women inmates in mixed-gender facilities often leads to neglect and a lack of engagement in activities tailored to their needs, posing challenges for implementing targeted interventions.

[37]For the sake of space, we only report the most restricted specification with all the controls and the fixed effects. The appropriate comparison, therefore, is with column 4 of Table 3.

Moving now to our second approach, we conjecture that the availability of working facilities and opportunities to carry out work outside the prison walls or inside for external firms, as well as the presence and quality of sanitation and health services, might be features that facilitate a smoother return to a normal life after serving the sentence, and therefore reduce recidivism. Based on previous research (see Mastrobuoni and Terlizzese (2022)) and results just reported, we also attribute a similar potential role to social activities withing the prisons, like the opening of prison cells during the day (in excess to the minimum required by law), and to the female gender of the prison director.

Accordingly, we construct four binary classifications of the universe of Italian prisons: based on work facilities and external work (denoted *Work*), on sanitation and health services (denoted *Sanitation*), on the social activities (denoted *Social*), on whether the prison director is a woman (denoted *Woman director*). We assign prison to be work-prone, sanitation/prone and social-prone based on a series of observable characteristics, using three separate factor analyses. We define proneness when the first factor is above the median.

It should be stressed that we observe the characteristics of different prisons that host female inmates only at a given point in time, 2019, while we would ideally need to measure them as they prevailed during the presence in the facilities of the various inmates in our sample. This is likely to introduce a measurement error that weakens the statistical significance of our attempt to identify the mechanisms.

Figure A5 show that, for each of these four binary classes, women-only prisons are more likely to present the characteristic(s) that define the class.

For each of these four splits we compute, as in our previous analysis and in the spirit of the generalization presented in Section 2.2, the distances from the residence of each female inmate to the closest prison belonging to each of the two classes identified by the split, and we take the difference between these two distances. We label classes in such a way that a negative difference means that the (closest) prison in the class that we conjecture to be "better," that is more conducive to a reduced recidivism, is farther away for the inmate's residence than the (closest) prison in the "worse" class. We then use this difference as an instrument for the effect of the set of features that identify the prison class on recidivism.

Figure A6 shows, for each of the four binary classes, the first stage and the reduced form. The first stage gives the fraction of inmates assigned to the "better" prison class, for various values of the distances difference. The reduced form gives the corresponding fraction of recidivating inmates.

As to the first stage, given the underlying preference by the prison administration for assigning the inmate to the prison closest to her residence, and according to the analysis presented in Section 2.2, we see two possibilities. If the prison administration has no strong preference for the features that define a given class, we should observe a fairly flat pattern, at a low level, for negative differences, and again a fairly flat pattern, at an higher level, for positive differences, as in equation (3). This is because, absent other considerations, inmates would tend not to be assigned to the "better" class when the latter is farther away form their residence, while would predominantly be assigned to it when it is closer. There would therefore be a sizeable jump at zero. The other possibility is that the prison administration trades off the closeness to residence with some desirable features of the class (as in our earlier analysis of mixed-gender vs. female-only prisons). In this case, we should observe an increasing pattern to the left of zero and a fairly flat pattern to the right, as in equation (2). Both possibilities are likely to imply a significant first stage, even though the first would suggest a regression discontinuity approach as more appropriate, since away from zero the instrument should have little relevance.

The first stages shown in Figure A6 are all statistically significant. They tend to be of the second type, without jumps. The black colored data point are those which correspond to the range of relevance of the instrument, i.e. those for which a change in the value of the distances difference is associated to a change of the fraction of inmates associated to the "better" class.

Moving to the reduced form, we see that in the range of relevance of the instrument, there is some evidence of a reduction of recidivism only for the class *Work*. Overall, though, there is no single mechanism that can explain the women-only result. This is confirmed in Table A7 where we explore the effect of those potential mechanisms on recidivism. None of the mechanisms considered—such as having a woman director, work opportunities while in prison, sanitation services, and social aspects—appear on their own to explain the reduction in recidivism, as none of their coefficients are significantly different from zero.

7 Conclusions

Despite a nearly 60% increase in the global population of incarcerated women over the past two decades, the issues surrounding women's incarceration remain largely neglected. In particular, little is known about the possible effects of serving a sentence in a separate section within prisons that mostly house male inmates, as is the case in 143 countries, as opposed to serving the same sentence in a dedicated, women-only prison, as is the case in 79 countries.

In this study, we show that, once we correct for the possible selection and other confounding factors, serving a sentence in a women-only prison, rather than in a mixed-gender one, substantially reduces recidivism in the three years after release.

Our results are based on Italian data, where both women-only and mixed-gender prisons coexist and where the institutional details of the process allocating women convict to prisons allow us to mimic a quasi-random assignment, and thus identify the causal effect on recidivism of the two types of prison.

Our empirical approach—leveraging a proximity-based assignment rule aligned with international correctional standards—offers broader applicability across countries and can be used to identify the causal impact of various prison characteristics on recidivism and other correctional outcomes, beyond gender composition. This framework opens a promising avenue for future research in the field of prison studies.

Women-only prisons display better features along several dimensions, including health, social and work services. While it is difficult to single out one of these dimensions (or a combination thereof) as being the main responsible for our results, we show that both the number (in relative or absolute terms) of women inmates within a given facility, and the gender of the director, are relevant factors affecting the difference in recidivism that we estimate. This suggests that the design and organization of correctional facilities customized around women needs and fostering rehabilitation initiatives specifically targeted at women inmates might require a minimum scale and an appropriately attuned sensibility. A more in-depth analysis of the mechanisms underlying the causal effect identified in this study, as well as the collection of more accurate, time-varying data on the characteristics of the various correctional facilities, remain important topics for future research.

Our results are relevant for governments and international organizations interested in designing policies to reduce crime with a specific focus on women's incarceration. With this purpose, we also conduct two simple policy experiments to show how to leverage the results of the analysis to guide the reorganization of a prison system.

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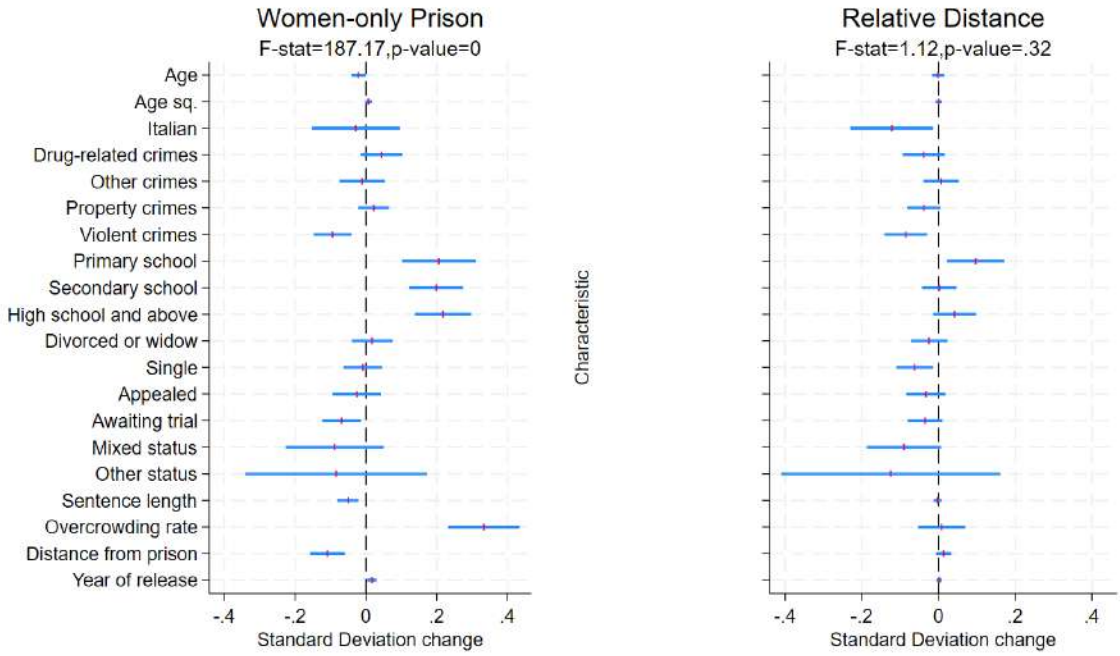
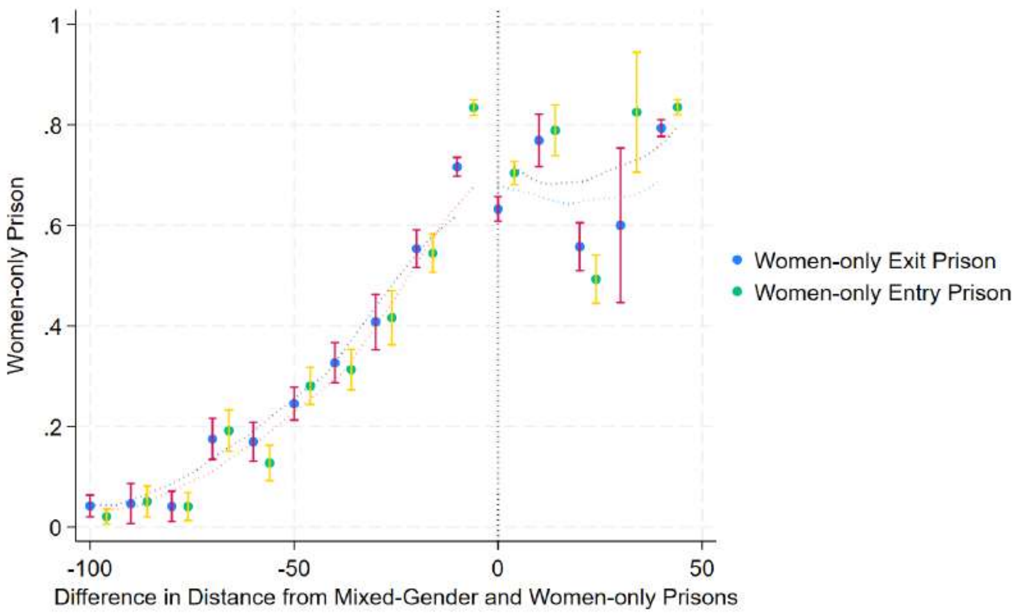
8 Figures and Tables

Figure 1: Balance across prisons and relative distance



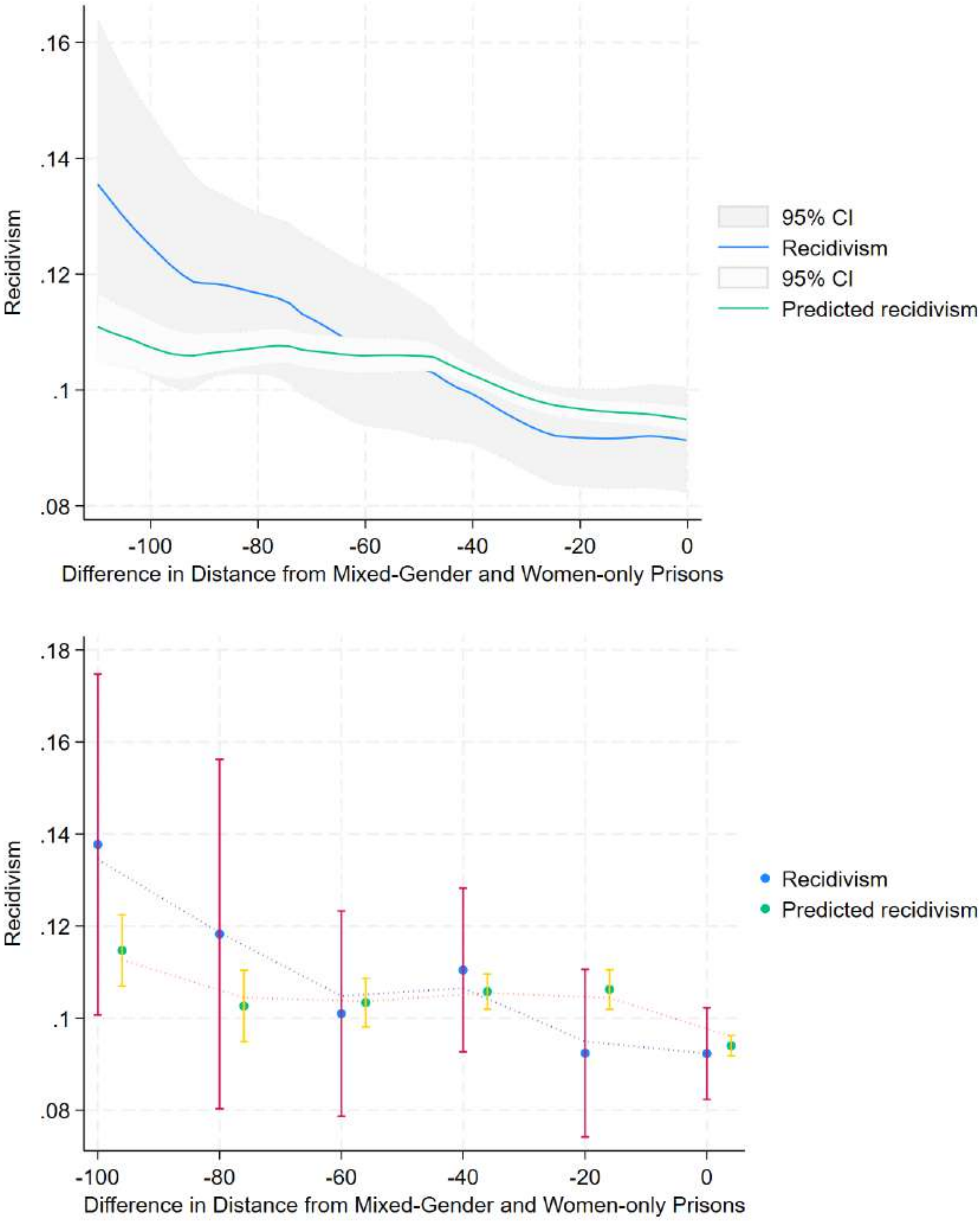
Notes - The figure reports the coefficients of a linear probability model and the corresponding 95% confidence intervals, controlling for region of the prison and of the inmate's birth fixed effects, and various controls for the municipality of residence and their square when continuous: population, population density, a dummy for municipalities with more than 500,000 inhabitants, share of foreigh born, and share with university degree. In the left panel, the dependent variable is the dummy *Women-only Prisons*, while in the right panel, it is the *Prison relative distance*. For both specifications, the joint significance test is reported.

Figure 2: Women-only Prison and difference in distance: First stage



Notes - The figure shows the estimated probability to be assigned to a women-only prison of entry or exit and the corresponding 95% confidence intervals. Distance is divided into groups of 10 km each.

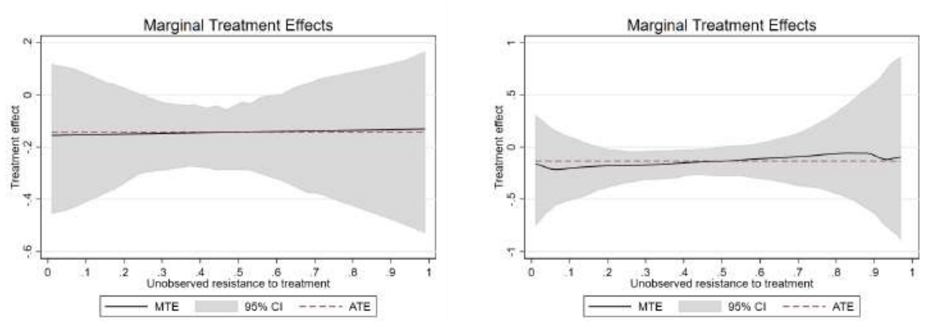
Figure 3: Difference in distance and recidivism (or predicted residual recidivism.)



Notes - The figure shows the recidivism rate and the predicted recidivism rate (and the corresponding 95% confidence intervals) against the relative distance between the place of residence of inmates and the two types of prison (mixed-gender vs. women-only). The upper panel plots the local linear regression, while in the lower panel averages are computed every 20 km.

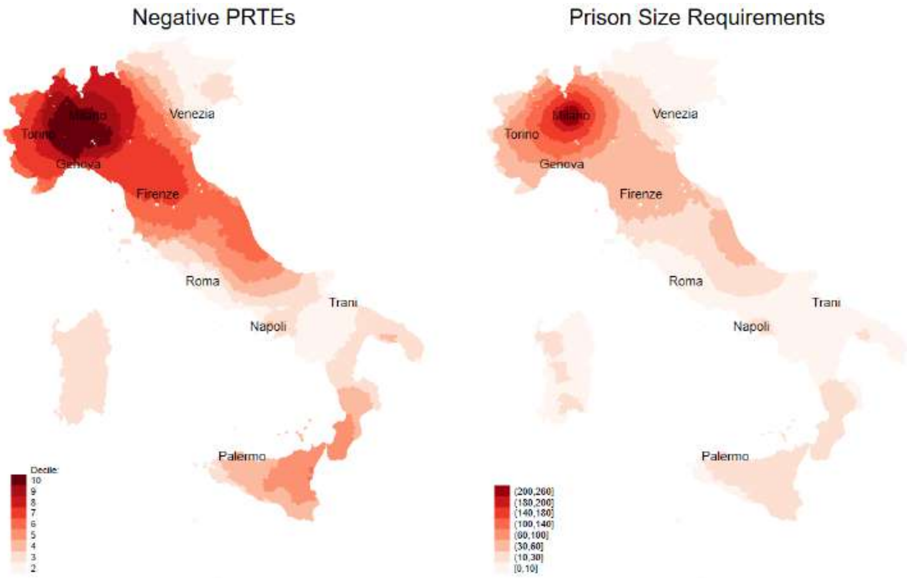
Figure 4: Marginal Treatment Effects

Linear Semi-parametric



Notes - The Figure shows the MTE curves and the Average Treatment Effects (ATE) for the semiparametric and the linear specification. The propensity score is estimated using a probit model (see Figure A4 for the common support). The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The controls are the same ones used in Column 3 of Table 3. The semiparametric figure uses the Epanechnikov kernel with a bandwith of the local polynomial smooth for recidivism of 0.1. Standard errors are estimated using 200 bootstrap replications.

Figure 5: Policy Relevant Treatment Effects



Notes - The maps shows the deciles of the absolute value of PRTEs (large decile indicate larger reductions in recidivism) and of the prison size requirements (the changes in the propensity score times the average number of yearly inmates). The PRTE are based on the linear specification of the MTEs (see Figure 4). The propensity score is estimated using a probit model (see Figure A4 for the common support). The controls are the same ones used in Table 3.

Table 1: Women-only vs Mixed-gender Prisons

	Women-only	Mixed	Difference	Std. Err.
Health				
Heating	0.934	0.896	0.038	0.007
Hot Water	0.874	0.387	0.488	0.009
Separate WC	0.714	0.939	-0.225	0.010
Shower	0.539	0.325	0.214	0.012
Medical Doctor	0.883	0.900	-0.017	0.008
Gynecologist	0.941	0.794	0.146	0.007
Obstetrician	0.411	0.362	0.048	0.012
Social Spaces				
School Spaces	1.000	0.987	0.013	0.001
Working Spaces	1.000	0.838	0.162	0.004
Non-catholic Religious Spaces	0.288	0.217	0.071	0.011
Gym	0.657	0.642	0.015	0.012
Sports Facilities	0.756	0.653	0.102	0.011
Hours Spent Outside the Cell	5.851	4.089	1.763	0.030
Freedom of Movement in Prison	0.824	0.278	0.547	0.010
Remote Meetings	0.611	0.348	0.263	0.015
Web Access	0.199	0.144	0.054	0.009
Work & Other				
Share Working Women Inside	0.272	0.345	-0.073	0.004
Share Working Women Outside	0.051	0.036	0.015	0.001
Share Training Women	0.127	0.095	0.032	0.004
Share Woman in School	0.287	0.238	0.049	0.004
Number of Women	247.481	59.830	187.651	2.205
Prison Occupancy Share	0.835	0.993	-0.158	0.008
Share of Foreigners	0.351	0.309	0.042	0.004
Share on Parole	0.016	0.011	0.004	0.000
Share of Disciplinary Measures	0.097	0.090	0.006	0.003
Self-Harm	0.125	0.302	-0.177	0.006
Female Director	0.969	0.640	0.328	0.007
%Positive description	0.364	0.328	0.037	0.003

Notes - Prison population-weighted mean differences between the two types of prisons. Data come from the Antigone surveys. *Positive description* accounts for the fraction of positive words relative to the total number of positive and negative words used by Antigone's representatives to describe prison conditions.

Table 2: Summary Statistics

Sample	Full		$\Delta D_i < 0$		$\Delta D_i \geq 0$	
	Mean	SD	Mean	SD	Mean	SD
Recidivates	11.77	32.22	10.02	30.03	15.14	35.84
Women-only (Exit)	0.57	0.50	0.48	0.50	0.75	0.43
Relative distance (Entry)	-10.51	43.51	-35.38	30.25	37.39	17.06
Relative distance (Exit)	-9.94	42.67	-34.51	29.13	37.39	17.06
Year of release	2015.23	2.54	2015.25	2.55	2015.19	2.51
Age (10 yrs.)	39.08	23.13	40.05	27.09	37.23	12.13
Italian	0.64	0.48	0.73	0.45	0.48	0.50
Drug-related crimes	0.38	0.48	0.40	0.49	0.33	0.47
Other crimes	0.13	0.34	0.13	0.34	0.13	0.33
Property crimes	0.41	0.49	0.38	0.49	0.46	0.50
Violent crimes	0.33	0.47	0.33	0.47	0.33	0.47
Metropolitan area	0.37	0.48	0.22	0.41	0.65	0.48
Primary school	0.16	0.37	0.18	0.39	0.11	0.32
Secondary school	0.33	0.47	0.34	0.47	0.32	0.47
High school and above	0.18	0.38	0.17	0.37	0.19	0.39
Divorced or Widow	0.16	0.37	0.18	0.38	0.12	0.33
Single	0.45	0.50	0.37	0.48	0.59	0.49
Distance from prison	57.94	111.72	60.55	107.00	52.91	120.15
Appealed	0.13	0.34	0.13	0.34	0.14	0.35
Awaiting trial	0.41	0.49	0.44	0.50	0.37	0.48
Mixed status	0.03	0.17	0.03	0.17	0.03	0.18
Sentence	1.34	1.93	1.43	2.00	1.19	1.78
Other status	0.00	0.06	0.00	0.06	0.00	0.05
Overcrowding rate	1.37	0.55	1.40	0.62	1.32	0.38
Population (/10k)	75.94	104.16	25.78	37.80	172.56	121.72
Share of Foreign Born (in %)	6.06	3.77	4.91	3.84	8.27	2.40
Share of College Education (in %)	12.11	5.06	10.39	3.94	15.43	5.34
Population Density	2.44	2.74	2.89	3.25	1.58	0.74
Observations	10130		6668		3462	

Notes - This table reports the summary statistics.

Table 3: Effect of Women-only Prison on Recidivism.

	$\Delta D_i < 0$				$\Delta D_i \geq 0$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: First Stage - Women-only (Exit)								
Relative distance (Exit)	0.007***	0.005***	0.004***	0.004***	-0.004	-0.003	-0.006	-0.005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)	(0.004)	(0.003)
Mean women-only	0.479				0.747			
Panel B: Reduced Form - Recidivates								
Relative distance (Exit)	-0.056***	-0.075***	0.0062***	-0.062***	-0.001	-0.136	-0.053	-0.051
	(0.019)	(0.021)	(0.019)	(0.019)	(0.122)	(0.138)	(0.116)	(0.118)
Mean recidivism (%)	10.02				15.14			
Panel C: IV-Recidivates								
Women-only (Exit)	-7.955***	-16.084***	-14.327***	-14.117***				
	(2.922)	(4.823)	(4.838)	(4.802)				
Region of birth FEs		✓	✓	✓		✓	✓	✓
Region of resid. FEs		✓	✓	✓		✓	✓	✓
Controls			✓	✓			✓	✓
Controls (quadratic)				✓				✓
Observations	6,668				3,462			
KP F-Stat	186.1	56.15	60.45	71.29				
$\widehat{R}_M$ (%)	13.83	17.72	16.88	16.78				
$\widehat{R}_F$ (%)	5.871	1.633	2.550	2.659				

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. Columns 1-4 report results for $\Delta D_i < 0$, while columns 5-8 for $\Delta D_i \geq 0$. We report the Kleibergen-Paap for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * p< 0.10, ** p< 0.05, *** p< 0.01.

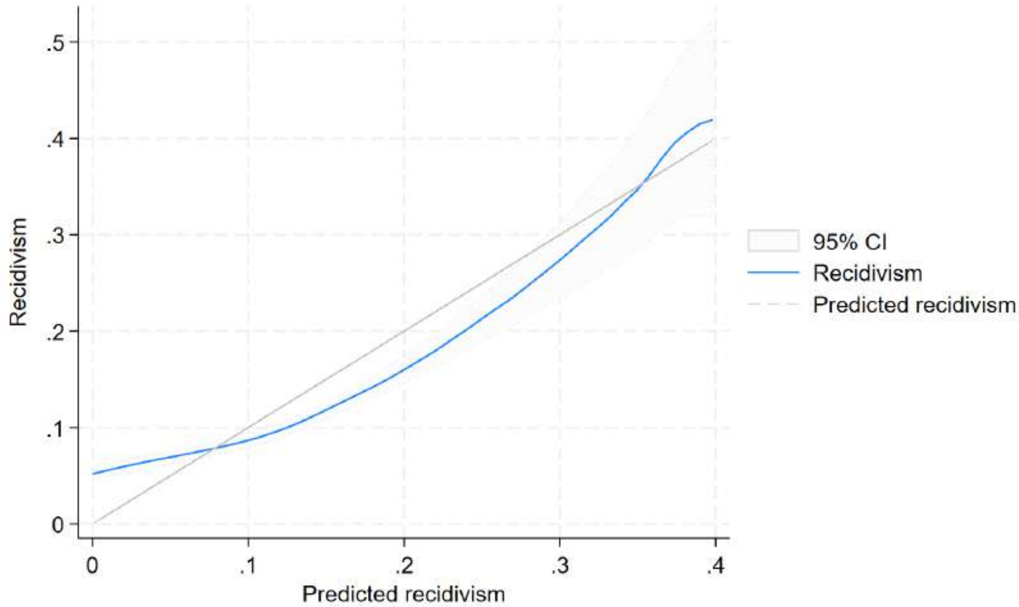
Table 4: Marginal Treatment Effects

	(1)	(2)	(3)
ATE	-0.155*	-0.120*	-0.121
	(0.0796)	(0.0727)	(0.0974)
Polynomial	3	1	-
Semiparametric			$\surd$
Observations	6,673	6,673	6,673

Notes - The Table shows Average Treatment Effects (ATE) computed using Marginal Treatment Effects estimated with parametric and sempiparametric Local Instrumental Variable specifications. The propensity score is estimated using a probit model (see Figure A4 for the common support). The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The controls are same ones used in Column 3 of Table 3. Standard errors are estimated using 200 bootstrap replications.

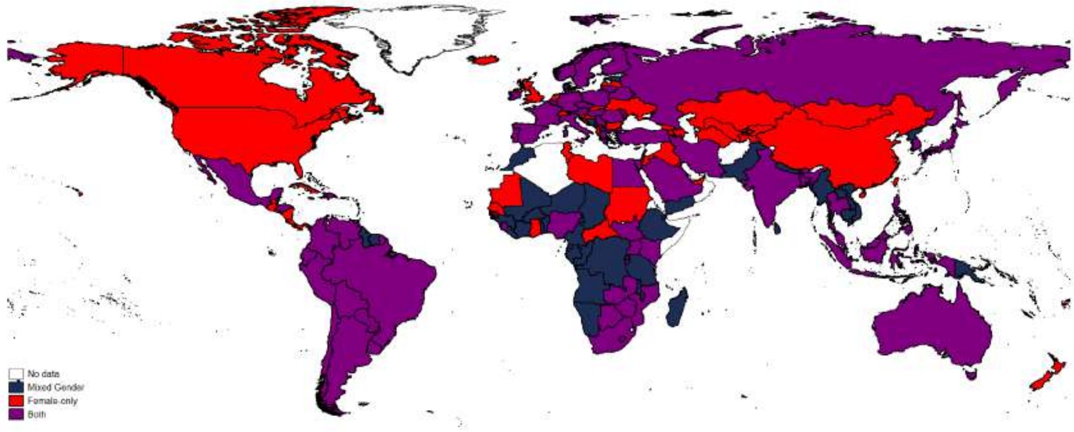
A Appendix

Figure A1: Predicted Recidivism



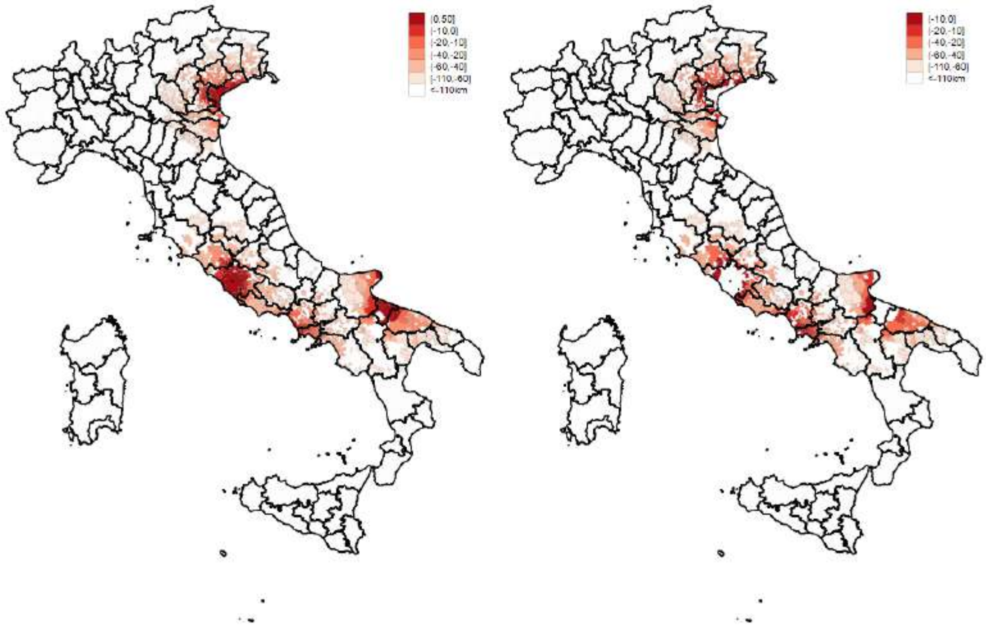
Notes - The figure plots local linear regressions for recidivism against predicted recidivism.

Figure A2: Types of Prisons Across the World



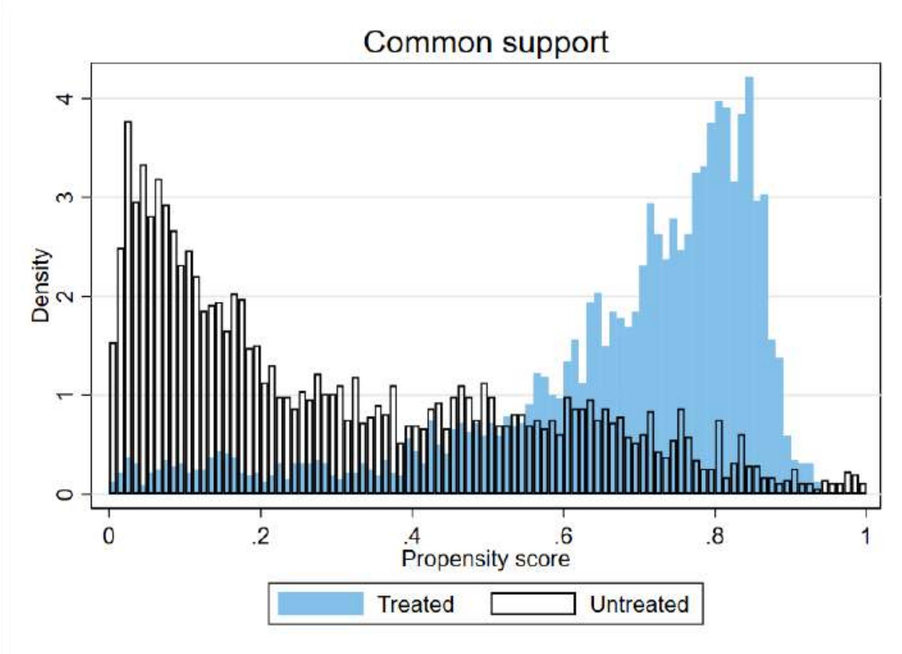
Notes

Figure A3: Difference in Distance from the Nearest Mixed-gender and Women-Only Prison



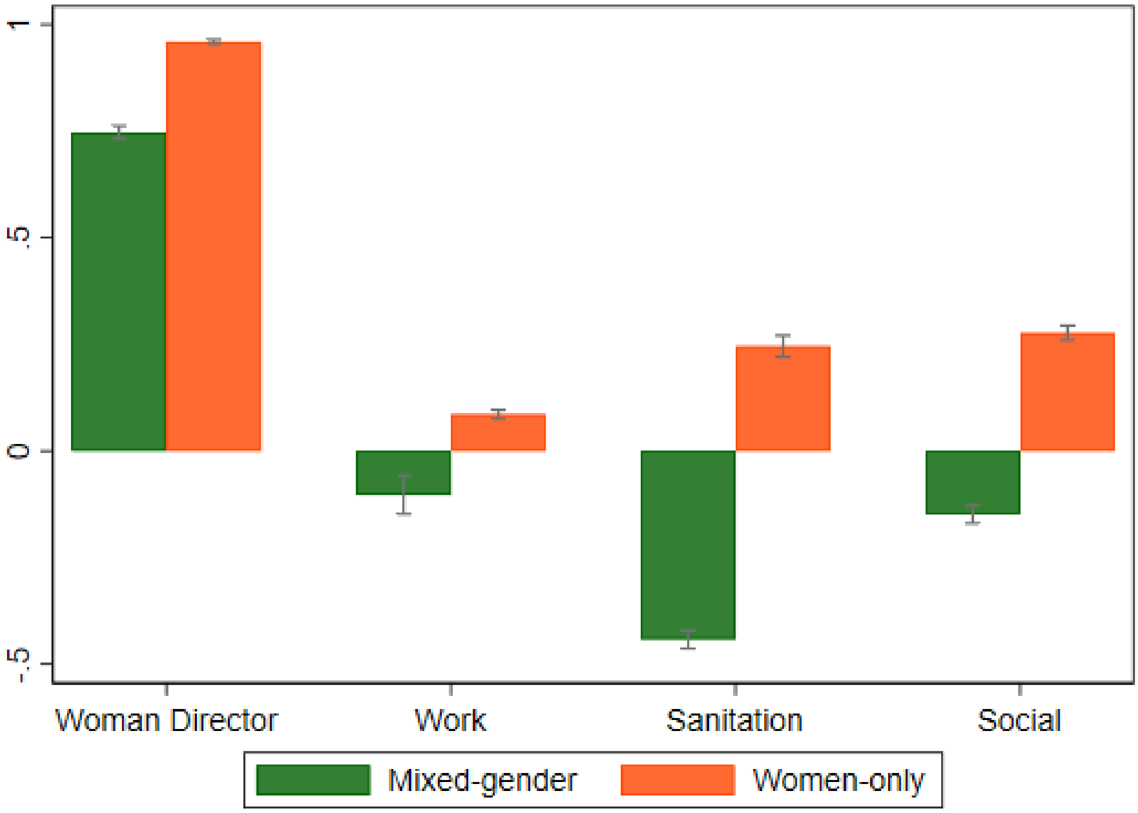
Notes - The figure plots the difference in distance (in km) between the inmate's municipality of residence and the nearest mixed-gender and women-only prison. The left map shows all distances, while the right one focuses on negative differences, where the mixed-gender one is closer. White refers to inmates housed in prison with a relative distance greater than 110 km.

Figure A4: Propensity Score



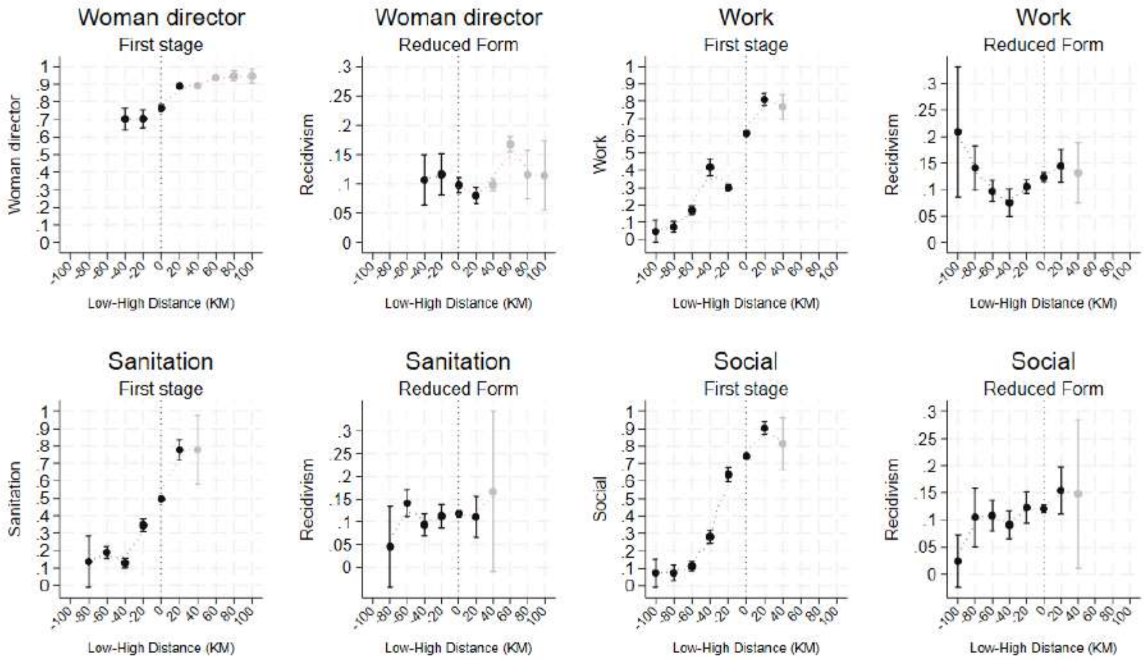
Notes - The figures shows the histograms of the propensity score for inmates sent to the women-only prisons (treated) and mixed-gender prisons (untreated). The propensity score is estimated with a probit model that contain the variables included in column 3 of Table 3.

Figure A5: Mechanisms by Type of Prison



Notes - The figure shows the average characteristic by type of prison, as well as the corresponding 95% confidence intervals. Prisons are classified based on the following characteristics (treatments): whether the director is a woman, work facilities and external work, sanitation and health services, and whether prison cells are open during the day.

Figure A6: Potential Mechanisms



Notes - The figure shows the likelihood of treatment (left) and the treatment effects on recidivism (right), as well as the corresponding 95% confidence intervals, against the relative distance between the place of residence of inmates and the two types of prison. Prisons are classified based on the following characteristics (treatments): whether the director is a woman, work facilities and external work, sanitation and health services, and whether prison cells are open during the day.

Table A1: Effect of Women-only Prison on Recidivism (entry).

	$\Delta D_i < 0$		
	(1)	(2)	(3)
	Panel A: First Stage - Women-only (Entry)		
Relative distance (Entry)	0.008***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)
Mean women-only		0.479	
	Panel B: Reduced Form - Recidivates		
Relative distance (Entry)	-0.053***	-0.074***	-0.059***
	(0.018)	(0.021)	(0.019)
Mean recidivism (in %)		10.02	
	Panel C: IV- Recidivates		
Women-only (Entry)	-6.680***	-14.502***	-13.373***
	(2.424)	(4.534)	(4.799)
Region of birth FEs		✓	✓
Region of resid. FEs		✓	✓
Controls			✓
Observations		6,668	
KP F-Stat	182.3	43.10	59.12
$\widehat{R}_M$ (in %)	13.51	17.59	17
$\widehat{R}_F$ (in %)	6.825	3.087	3.626

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the entry prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * p< 0.10, ** p< 0.05, *** p< 0.01.

Table A2: Effect of Women-only Prison on Recidivism.

	Recidivism					
	1 year		2 years		3 years	
	Panel A - Reduced Form					
Relative distance (Exit)	-0.050***	-0.058***	-0.044**	-0.054***	-0.056***	-0.062***
	(0.016)	(0.018)	(0.017)	(0.018)	(0.019)	(0.019)
Mean recidivism (in %)	6.479		8.623		10.02	
	Panel B - IV					
Women-only (Exit)	-7.081***	-13.071***	-6.331**	-12.357***	-7.955***	-14.117***
	(2.490)	(4.224)	(2.606)	(4.430)	(2.922)	(4.802)
Observations	6668					
KP F-Stat	186.1	71.29	186.1	71.29	186.1	71.29
$\widehat{R}_M$ (in %)	9.868	12.74	11.65	14.54	13.83	16.78
$\widehat{R}_F$ (in %)	2.788	-0.335	5.323	2.182	5.871	2.659
Region of birth FEs		✓		✓		✓
Region of resid. FEs		✓		✓		✓
Controls		✓		✓		✓

Notes - The dependent variable is whether the inmates recidivades within either 1, 2 or 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * p< 0.10, ** p< 0.05, *** p< 0.01.

Table A3: Effect of Women-only prison on recidivism (final sentence).

	(1)	(2)	(3)
Women-only (Exit)	-4.331	-13.154***	-11.362**
	(3.757)	(4.796)	(4.975)
Observations	2,668	2,668	2,668
KP F-Stat	203.8	83.14	90.20
$\widehat{R}_M$ (in %)	11.21	15.41	14.56
$\widehat{R}_F$ (in %)	6.878	2.258	3.196
Region of birth FEs		✓	✓
Region of resid. FEs		✓	✓
Controls			✓

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * p< 0.10, ** p< 0.05, *** p< 0.01.

Table A4: Effect of Women-only prison on Recidivism (Italians).

	(1)	(2)	(3)
Women-only (Exit)	-10.617***	-22.487***	-21.554***
	(2.955)	(4.771)	(6.039)
Observations	4,842	4,842	4,842
KP F-Stat	235.5	62.54	50.70
$\widehat{R}_M$ (in %)	15.96	21.98	21.51
$\widehat{R}_F$ (in %)	5.345	-0.502	-0.0425
Region of birth FEs		✓	✓
Region of resid. FEs		✓	✓
Controls			✓

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$.

Table A5: Effect of Women-only Prison on Recidivism by Type of Crime.

	Property Crimes		Violent Crimes	
	(1)	(2)	(3)	(4)
	Panel A: First Stage- Women-only (Exit)			
Relative distance (Exit)	0.007***	0.004***	0.006***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Mean women-only	0.499		0.420	
	Panel B: Reduced Form- Recidivates			
Relative distance (Exit)	-0.060**	-0.081***	-0.071***	-0.061**
	(0.022)	(0.021)	(0.026)	(0.032)
Mean recidivism (in %)	10.15		10.40	
	Panel C: IV- Recidivates			
Women-only (Exit)	-8.597***	-19.388***	-11.542**	-15.168**
	(3.324)	(5.901)	(4.512)	(8.399)
Observations	4,976		2,173	
Controls		✓		✓
Region of birth FEs		✓		✓
Region of resid. FEs		✓		✓
KP F-Stat	168.9	54.96	141.8	45.20
$\widehat{R}_M$ (in %)	14.44	19.82	15.24	16.77
$\widehat{R}_F$ (in %)	5.842	0.435	3.702	1.598

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * p< 0.10, ** p< 0.05, *** p< 0.01.

Table A6: Effect of Women-only prison on recidivism: restrict on control group characteristics.

	(1)	(2)	(3)	(4)	(5)	(6)
Women-only (Exit)	-7.142*	-26.173	-9.815**	-17.143	-14.168**	-6.101
	(3.954)	(15.962)	(4.522)	(11.443)	(5.747)	(6.088)
Observations	5,020	4,840	4,975	4,885	5,858	4,002
KP F-Stat	181.4	8.432	134.6	13.37	46.14	71.71
Mean recidivism	10.26	9.587	10.13	9.724	10.11	9.670
Control group	> median female share	< median female share	> median size	< median size	male director	female director
Controls	✓	✓	✓	✓	✓	✓
Region of birth FEs	✓	✓	✓	✓	✓	✓
Region of resid. FEs	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *Women-only,* is a dummy equal to one for inmates in one of the four women-only prisons. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons (Mixed-gender vs. Women-only). The measures are calculated according to the exit prison. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density - and their quadradic versions). Municipality of residence clustered standard errors in parentheses. * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$.

Table A7: Effect of Potential Mechanisms on Recidivism.

	(1)	(2)	(3)	(4)
Women director	0.121			
	(0.108)			
Work		-0.012		
		(0.047)		
Sanitation			-0.021	
			(0.037)	
Social				0.151
				(0.115)
Observations	6,606	6,570	5,770	6,668
KP F-Stat	27.60	31.68	48.91	12.78

Notes - The dependent variable is whether the inmates recidivades within 3 years. The endogenous variable, *whether the director is a woman, work facilities and external work, sanitation and health services, and social aspects* are dummy equal to one for inmates above the median for each respective category or for prisons with a female director. The instrumental variable, *Prisons Relative distance* is the difference in the distance in km between the municipality of residence of the inmate and the nearest two types of prisons, i.e. below/above the median of each category or with/without a woman director. We report the Kleibergen-Paap F statistic for weak identification. Controls include age, age squared, nationality, education status, family status, types of crime, sentence status, incarceration length, closing year of incarceration, metropolitan area, true distance, overcrowding, as well as features of the inmate's residence (size of the population, share of foreign born, share of college education and population density – and their quadratic versions). Municipality of residence clustered standard errors in parentheses. * $p< 0.10$, ** $p< 0.05$, *** $p< 0.01$.