Art of Modeling Covered the Facts of Data:

Uncovering an artifact of the change in reporting system of crimes against women in India

Kathryn Andrews, Elina Pradhan, Maria Steenland

Harvard School of Public Health

GOV 2001

May 5 2014

Abstract

Does female representation in legislature result in more crimes against women? Iyer et al. (2012) asserts a positive causal link between Indian state-level policy implementation mandating $\frac{1}{3}$ of legislative seats to women (claiming exogeneity of this relationship) and reported crimes against women with some supporting evidence to show that the incidence of crime remains unchanged. We show that the increases in reporting do not correspond with implementation of the reservation policy; rather, they coincide with the year in which crime data was reclassified to introduce more categories of crimes against women. When restricting the dataset to the years in which total crimes against women were consistently aggregated, we find that the reservation policy is not significantly associated with crime reporting. Further, we claim that the delay in implementing the reservation policy was not exogenous, and show, with limited power, that the year of implementation is associated with progressivity of the state.

1 Introduction

Though women's education level and political participation have increased dramatically in the last half century, around the world, women remain underrepresented in political leadership. The Convention on Elimination of all forms of Discrimination Against Women (CEDAW) was adopted by the 1979 United Nations General Assembly with the intent of defining discrimination against women and establishing legal obligations for states to end such discriminations (UN, 1979). In line with CEDAW and to specifically address disparities in gender representation in political leadership, many countries have enacted legislation that sets a quota on the proportion of women in legislative bodies. Despite this, women's representation in legislative bodies has increased very little in the last decade. Globally, in 1995 women had attained around 12% of seats in national parliaments and this proportion grew to only 17% by 2007 (UN DESA 2012). As of 2012, a total of 98 countries have a quota system in place and of the 32 countries in which women's representation is at least 30%, 26 countries have instituted a quota (CWD 2010). A 2011 review of studies that assessed the effect of women's political representation quotas found that female leadership influences policy outcomes (Pande 2011).

In accordance with CEDAW, India established the National Commission for Women in 1992 and introduced the 73rd constitutional amendment in 1993 that required states to set up a three-level system of local government consisting of village, intermediate, and district levels. The 73rd amendment also stipulated that one third of seats in local legislatures must be reserved for women. In addition, the amendment set quotas for the representation of lower castes and tribes based on their representation in the population. One study that specifically focused on two Indian states, West Bengal and Rajasthan, assessed the effect of female reservation policy implementation and found that in villages where the reservation policy had been implemented, the council invested more money in public works projects preferred by women (J-PAL 2006). This finding demonstrates that increasing the proportion of women in

legislative councils can change the way funding is allocated and more fundamentally, provide an avenue through which women's priorities can be included in local decision-making and policy outcomes.

Throughout the 1990s and the 2000s, as reported in the interim reports to the UN Committee on CEDAW on progress in implementing the convention (GoI 1999 and 2005), the government of India has taken several institutional and constitutional measures to reduce discrimination against women. For instance, in 1995, in an effort to further strengthen women's rights by measuring the incidence of violence against women in greater detail, the National Crime Records Bureau (NCRB) in India began classification of crimes into detailed categories of dowry death, molestation, sexual harassment, and cruelty by husband and/or his relatives (NCRB 1995).

"The Power of Political Voice: Women's Political Representation and Crime in India" by Iyer et al. (2012) focuses on the 1993 amendment to the Indian constitution which required that 33% of seats in local councils be reserved for women. The date of state-level implementation of the national policy varied. In some cases, states waited for incumbent terms to expire before holding new elections while other states had already implemented policies that conformed to the new law's requirement before the national law was passed. Finally, some states filed lawsuits to protest aspects of the amendment or delayed the elections that would require women's reservation due to budgetary constraints. Iyer et al. (2012) makes the claim that much of this variation in year of state-level implementation can be assumed to be exogenous and exploit this assumed randomness to analyse the effect of women's reservation implementation at the state level on reported crimes against women, their main outcome of interest. Iyer et al. (2012) finds that policy implementation was associated with an increase in rate of reported total crimes against women. Using robustness checks that (1) showed that the policy did not affect other types of crimes (including kidnapping of men and boys and

crimes against public order) and (2) did not change the actual incidence of crimes against women, Iyer et al. (2012) asserts that the change in the number of crimes against women is a result of women feeling empowered to report crimes rather than a backlash against the policy. This finding has important implications for the impact of reservation legislation on crimes and women's empowerment worldwide.

Given the importance of the finding in Iyer et al. (2012), we believe that the analysis deserves additional scrutiny. We are unconvinced by the paper's assertion that the relationship between state-level implementation of the reservation rule and rate of reported crimes against women is exogenous. By assuming exogeneity, Iyer et al. (2012) is assuming that the association between crimes and year of reservation is not confounded by other factors that impact both simultaneously. The sheer magnitude of the differences in year of implementation of reservation by state is a clear first source of suspicion. By the time the 1993 national amendment was passed, some states had already implemented the policy (with one state being so enthusiastic so as to implement it in 1987; a full 6 years earlier) while others stalled implementation for a decade or more after (as late as 2006). We hypothesize that these differences between states in year of implementation are driven by differences in the states' progressiveness generally and towards women. Specifically, that more progressive states (i.e. with higher education, and/or more progressive views on women's rights and roles) will be more likely to implement the reservation rule easily without delay at the next election. We also believe that more progressive states will be more likely to have an environment that allows women to feel empowered to report crimes when they occur. Thus, the relationship observed between crime rate and year of reservation may in fact be due to outside factors.

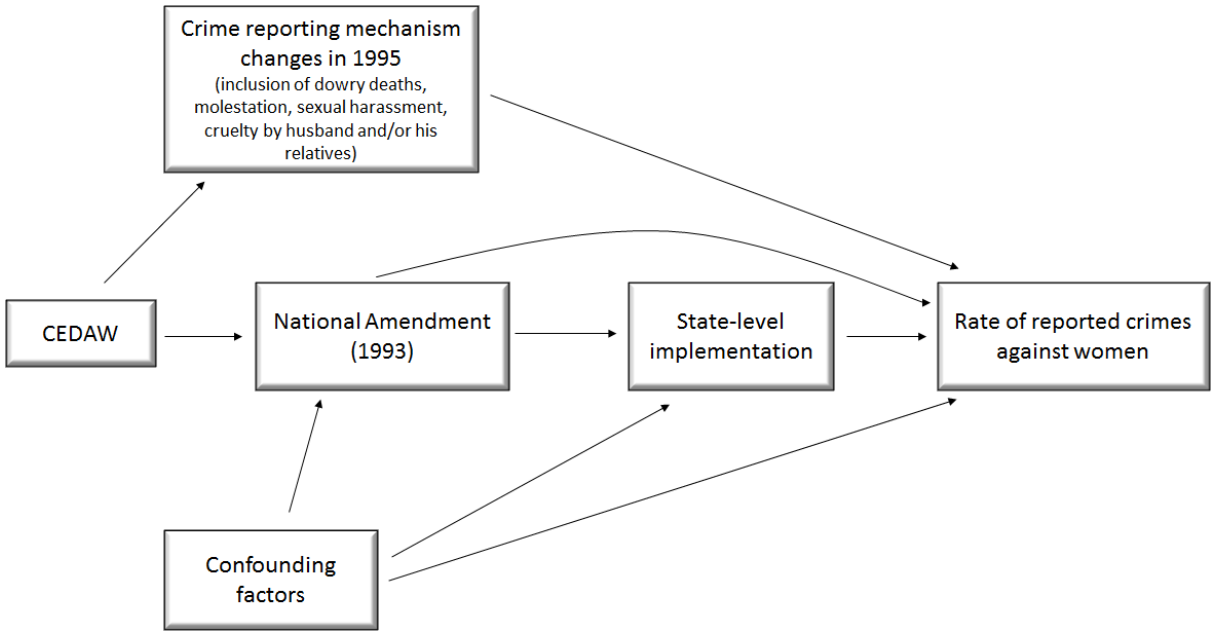
A causal interpretation of the findings in Iyer et al. (2012) relies on the assumption of exogeneity and if the year of implementation is not exogenous with respect to the rate of crimes against women, the study does not indicate that merely increasing the proportion of

women in local legislatures increases the reporting of crimes against women. Thus, if the exogeneity assumption is violated, the value to policymakers of the finding in Iyer et al. (2012) is considerably decreased.

2 Theoretical Framework

We propose a theoretical framework to conceptualize the proposed causal relationships of interest in this analysis. While Iyer et al. (2012) suggests an endogeneity-free relationship between state-level implementation of the reservation rule and the rate of reported crimes against women, we propose a more complex web of causality, and use it as the basis for our concerns about the exogeneity of the relationship of interest.

Figure 1: Theoretical framework



Note: The framework illustrates the relationship between CEDAW, changes in crime reporting, the national amendment on women's reservation, state-level implementation of this amendment, and rate of reported crimes against women (the main outcome of interest)

Figure 1 shows the theoretical framework. We propose that CEDAW had an impact on both the ratification of the 1993 national amendment to require reservation of senate seats

for women and the crime reporting mechanism changes in 1995 (whereby the categories of dowry deaths, molestation, sexual harassment, and cruelty by husband or his relatives were added to national crime records). The change in classification of crimes reported, in turn, led to an increase in the aggregate number of reported crimes against women.

The national amendment required state-level implementation of the reservation rule, but we believe that confounding factors (such as level of progressivity - or more specifically, women's decision-making and educational attainment, women's elevated status, female bodily autonomy, social and cultural history and traditions with respect to women, etc.) impacted the time it took different states to implement the rule. These confounding factors also impacted India's readiness to ratify the national amendment in 1993, and both actual crimes against women and women's comfort and empowerment to report these crimes. The arrow between state-level implementation and rate of reported crimes against women, representing the magnitude and direction of this relationship, was the main question of interest for this analysis.

3 Objective

The first aim of this analysis was to explore the available data on crimes against women in-depth in order to identify trends and anomalies in the data at the state level. The second aim was to determine whether the year of policy implementation was exogenous; to do so, we assessed whether measures of progressiveness such as women's education level, female to male ratio, and proportion of the population that is rural predict the year of policy implementation.

4 Data

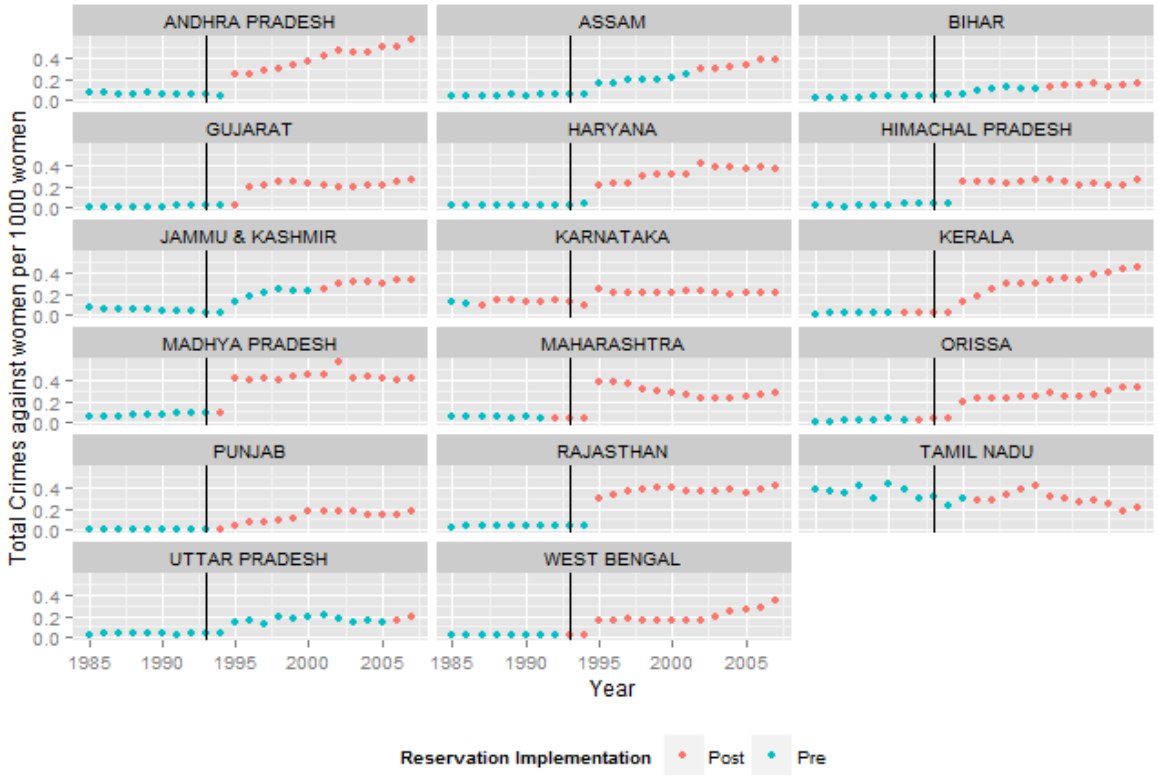
The data used for this analysis were available to us via the *American Economic Journal (AEJ)* public data repository for the article by Iyer et al. (2012). The bulk of the data originated from the National Bureau of Crime Reporting in India, from which data on a variety of types of reported crimes (i.e. rapes, kidnappings, murders, crimes against public order) from 1985 through 2007 from each of 17 states in India were included. As part of the main dataset from Iyer et al. (2012), data on state- and year-level covariates such as women's education level, female to male ratio, and proportion of state population employed as farmers were also included (data originating from censuses, Central Statistical Organization, etc.). Additional National Bureau of Crime Reporting data where more granular crime categories were available (dowry deaths, molestation, sexual harassment, cruelty against women by husband and/or his family, importation of girls, etc.) from 1991 to 2003 were kindly provided by the authors (Personal communication with Lakshmi Iyer 2014). All analyses were conducted using R statistical software version 3.0.3 (The R Foundation for Statistical Computing 2014).

5 Analysis

5.1 The increases in reported crimes against women are not consistent with the timing of reservation implementation across states

To better understand how the effect of the policy may have varied by state, we plotted the rate of reported crimes against women, rapes, and kidnappings of women and girls by state from 1985 through 2007 (Figures 2-4). For each state, we denoted the year of policy implementation in the figure to visualize whether the implementation corresponded with changes in crime reporting rates.

Figure 2: Total crimes against women per 1000 women across states in India, 1985-2007

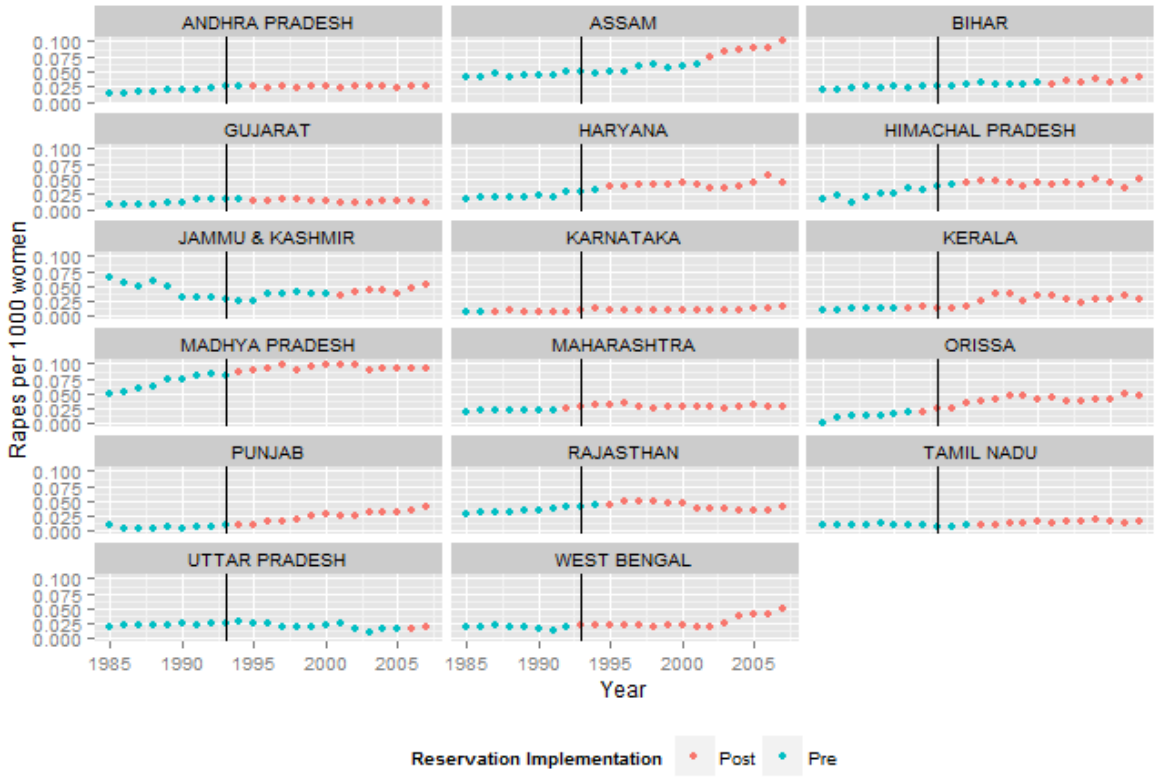


Note: Blue points indicate years prior to implementation of reservation rule at state-level, and red points indicate the first year of reservation and all years subsequent. Vertical line at 1993 denotes the year of ratification of the national amendment. Almost all states show a surprising spike in 1995, which does not usually correspond to either the national amendment ratification or the state-level implementation.

We find that the increases in crimes against women per capita do not correspond with the implementation of reservation policy in different states. Figure 2 shows that the relationship between year of implementation and changes in total reported crimes against women per 1000 women was heterogenous across states, and that the jumps in crimes per capita do not consistently follow reservation policy implementation. For example, the state of Maharasthra implemented the reservation policy in 1992, but the reported crimes against women do not change until 1995. In contrast, in the state of Jammu & Kashmir, increases in reported crimes precede policy implementation by 7 years. In fact, the increases in crime seem to be occurring around 1995 across almost all states. These changes suggest that the state-level

policy implementation is not the primary mechanism through which total reported crimes against women are increasing. The magnitude of the stark change in crime reporting rate from 1994 to 1995 is suggestive of an administrative change in the way crime data are collected or categorized.

Figure 3: Rapes per 1000 women across states in India, 1985-2007

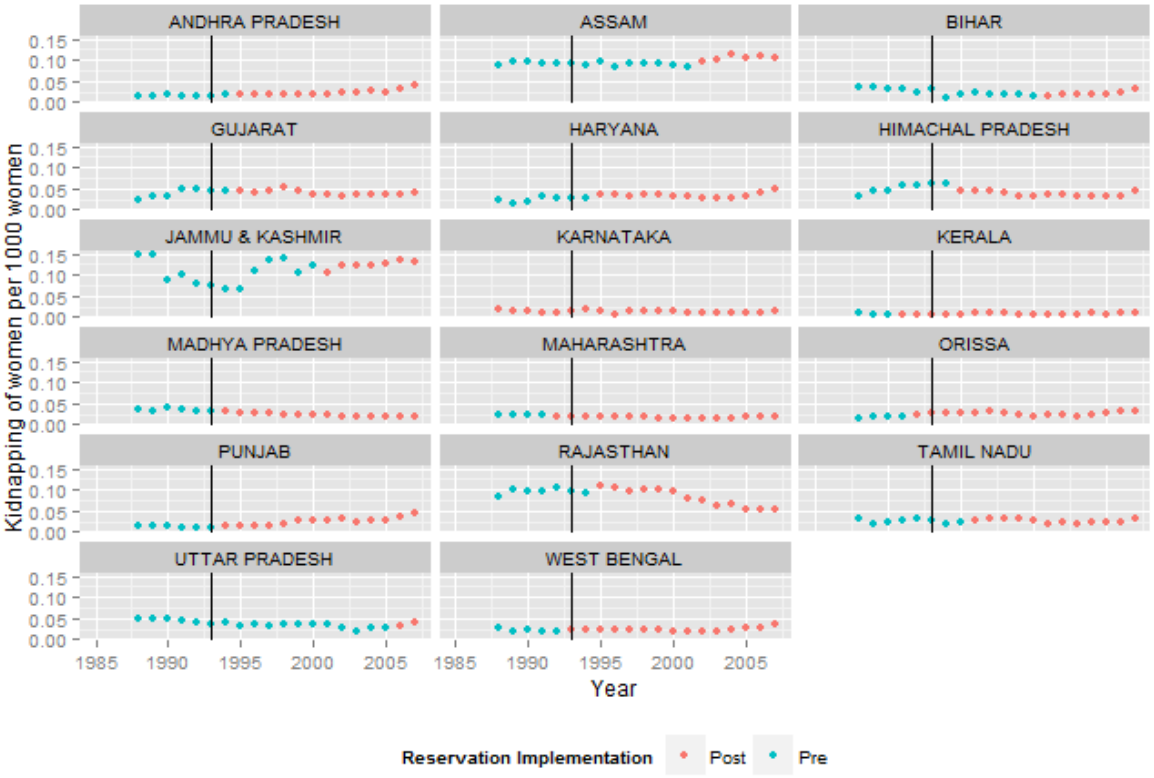


Note: Blue points indicate years prior to implementation of reservation rule at state-level, and red points indicate the first year of reservation and all years subsequent. Vertical line at 1993 denotes the year of ratification of the national amendment. Unlike the trend of total crimes against women, there do not appear to be any uniform jumps in rate of reporting of rapes.

Although the rate of total reported crimes against women appears to be rising, and in many states increases suddenly in 1995, we do not see similar increases in reported rapes per 1000 women (Figure 3), or reported kidnapping of women and girls per 1000 women (Figure 4). Conceptually, this is surprising; if the women's reservation policy makes women feel more

empowered to report crimes against them, why would we expect to see big changes in total reported crimes against women and not see changes in two important types of crimes against women, rapes and kidnapping? Comparison of Figure 2 to Figures 3 and 4 indicates that the increases in rate of total crimes against women is likely due to increases in another category of crime against women not reported in the dataset provided on the *AEJ* website.

Figure 4: Kidnapping of women per 1000 women across states in India, 1985-2007

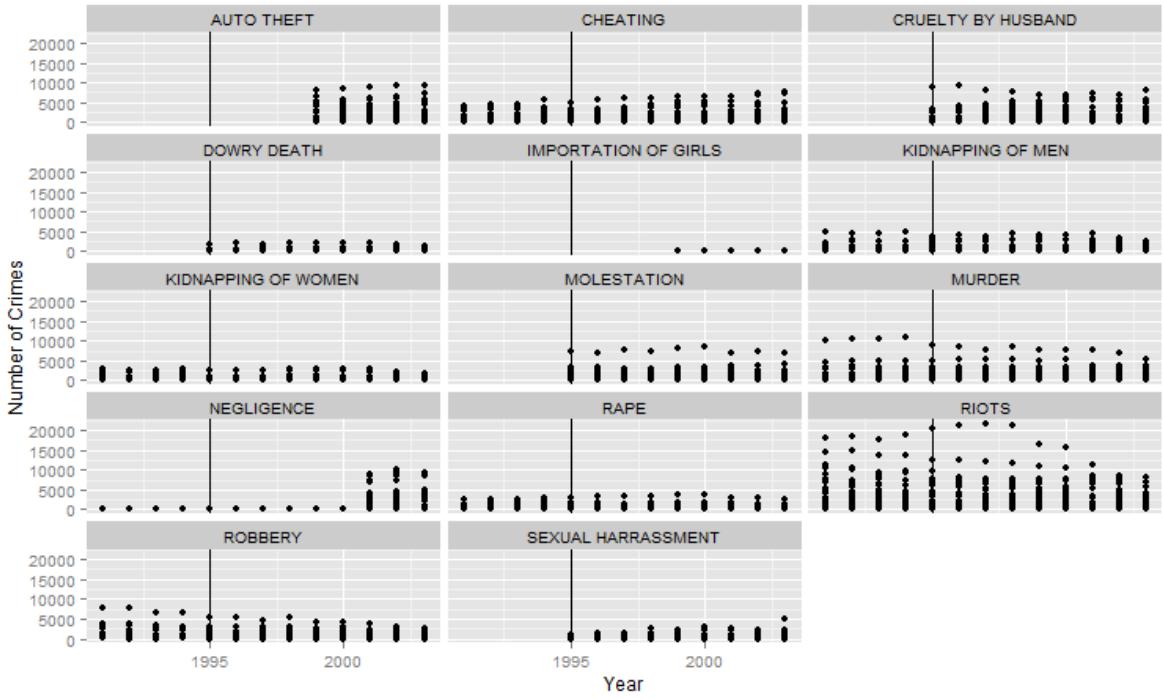


Note: Blue points indicate years prior to implementation of reservation rule at state-level, and red points indicate the first year of reservation and all years subsequent. Vertical line at 1993 denotes the year of ratification of the national amendment. Unlike the trend of total crimes against women, and similar to the trend seen for rapes, there do not appear to be any uniform jumps in rate of reporting of kidnapping of women.

5.2 Abrupt increases in reported crimes against women are likely because of altered classification of crimes committed against women

The identification of these surprising state-level trends led us to analyse the crime data with more granular categorizations to determine whether the changes in trends in total crimes against women were associated with the inclusion of new categories of crimes. We plotted these data over time by category of crime in Figure 5.

Figure 5: Crimes by select categories across states in India, 1991-2003



Note: Vertical line at 1995 denotes year of altered classification of crimes against women. Figure shows that kidnapping of women and rape classifications (and other crimes not specifically associated with women) existed pre- and post-1995, but that new separate reporting of cruelty by husband and/or his relatives, molestation, dowry death, and sexual harassment occurred in 1995 and after.

These plots indicate that the spike in total crimes against women in 1995 may be an artifact of the inclusion of new crime categories in 1995 and henceforth. In 1995, the National Bureau

of Crime Reporting began providing data on dowry deaths, molestation, sexual harassment, and cruelty by husband and/or his relatives separately from other aggregated crime types (NCRB, 1997). Figure 5 shows that these four categories of crimes were null prior to 1995 and large in 1995 and forward. When summing across categories of crimes against women over time, total crimes against women likely only include rape and kidnapping pre-1995, and rape, kidnapping, dowry deaths, sexual harassment, cruelty, and molestation in 1995 and onward. Thus, the increase in rate of total reported crimes against women seen in Iyer et al. (2012) is likely due to the inclusion of new categories of data, rather than the result of a real increase in reporting.

5.3 Reservation policy is not associated with changes in reported crimes in data without bias due to inconsistent aggregation

Since the total crimes against women were not aggregated using consistent classifications/ categories of crime before 1995 and in 1995 and after, we restricted the dataset to only include data from 1995 and after from states in which the policy was delayed until at least 1995. Using this restricted dataset, we analysed the data using the same methods used in Iyer et al. (2012) to generate the main finding of an increase in reported crimes against women after state-level policy implementation. We replicated the main regression of the paper, the model from column 1 of the Iyer et al. (2012) Table 3 which presented results from a linear model regressing log-transformed total crimes against women (per 1000 women) on a dummy variable coded as 1 for every year after the year of state policy implementation. This model included state and year fixed effects and standard errors were clustered at the state level. We also performed a second regression using the most conservative model used by Iyer et al. (2012) to assess the robustness of their main finding. This model regressed log-transformed total crimes against women (per 1000 women) on the reservation implementation dummy, control covariates (female to male ratio, fraction rural, fraction in farming, woman chief minister dummy, per capita Gross State Domestic Product, and number of police personnel

per 1000 population), state-specific time trends in addition to state and year fixed effects. Standard errors were again clustered at the state level.

Table 1: Women's political representation and crimes against women

	No controls	Control for state-specific time trends + other controls
	(1)	(2)
Panel A: Data after 1994 from states that implemented the reservation policy after 1994		
Total crimes against women per 1000 women [SE]	0.208 [0.111]	-0.045 [0.109]
R^2	0.76	0.88
Observations	130	130
Panel B: Data used in Iyer et al. (2012)		
Total crimes against women per 1000 women [SE]	0.365* [0.19]	0.229** [0.084]
R^2	0.85	0.95
Observations	391	391

Note: *p<0.1; **p<0.05; ***p<0.01

In this restricted regression, we find that the reservation policy is no longer a significant predictor of the changes in reported crimes against women. Table 1 Panel A shows that the coefficient on reservation policy implementation is 0.208 and is no longer significant (compared to the result from Iyer et al, which is reproduced in our Table 1 Panel B) in a model containing the policy indicator and state and year fixed effects. Furthermore, in a model that contains covariates and well as state- and year-specific fixed effects, the coefficient becomes negative (-0.045) and is not statistically significant. This result is visible in Table 1 Panel A, and compared to the findings from the model in Iyer et al. (2012) in Table 1 Panel B. Although we hypothesize that the impact of the reservation policy at the state-level is no longer apparent because we are removing the effect of the new categories of data, it is also important to consider that because we are restricting the data to 1995 and after, the sample

size for the regression is approximately one third the size of the sample used in the model by Iyer et al. (2012), and our smaller sample gives us less power to detect an effect.

5.4 Female to male ratio predicts time to implementation of reservation rule, suggesting endogeneity

In order to evaluate the exogeneity of year of state-level implementation of women's reservation and rate of crimes against women, we ran a duration model to determine whether the progressivity of a state predicts the time until the implementation of reservation. We used survival analysis with a weibull distribution, and measured progressivity of the state by the available variables of per capita Gross State Domestic Product (GDP), female to male ratio, total fraction literate, fraction of women literate, and fraction rural. We used the value of each covariate of interest from 1985 to predict the year of reservation policy implementation.

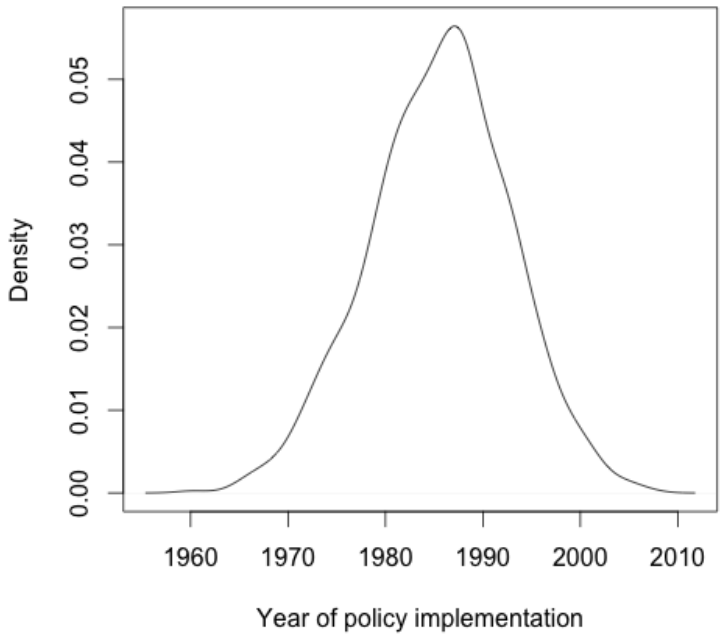
Table 2 shows the results of the duration model. All of the coefficients on the covariates were small. Only the effect of female to male ratio was significant: an increase in female to male ratio is associated with an earlier year of policy implementation. In India, in some states, the sex ratio differs from what would be expected absent discrimination against women due to sex selective abortions and poor treatment of women and girls. A higher female to male ratio is an indicator of states that have more progressive attitudes towards women and greater gender equality. Therefore, this finding indicates that more progressive states were more likely to implement the reservation policy earlier. It should be noted that the sample size in the analysis was only 17 (one observation per state), therefore this analysis has limited power to detect an effect. Though the other coefficients were not statistically significant, they were in the direction that we would expect if more progressive states implemented the policy earlier. For instance, a higher GDP and higher literacy were associated with an earlier year of policy implementation.

Table 2: Duration model predicting time to state level implementation of the national reservation policy

	Dependent variable:
	Year the Reservation Policy was Implemented
GDP per capita [SE]	−0.002
	[0.001]
Female-male ratio [SE]	−0.033**
	[0.014]
Literacy [SE]	−0.009
	[0.033]
Women's literacy [SE]	0.009
	[0.029]
Percent rural [SE]	0.006
	[0.006]
Constant [SE]	7.628***
	[0.016]
Observations	17
Log Likelihood	−44.935
χ^2	14.494** (df = 5)
Note:	*p<0.1; **p<0.05; ***p<0.01

To improve the interpretability of the results of our duration model, using Zelig Statistical Software (Kosuke et al 2007), we simulated the predicted year of reservation implementation for an average state with an equal ratio of females to males in the population (i.e. female to male ratio equal to 1). As shown in Figure 6, the mean predicted year of policy implementation for such a state was 1985.5 (95% CI: 1971.0, 1998.9). This indicates that all else equal, in a more progressive state (as defined by equal female to male ratio), we would expect women's reservation policy implementation to occur around mid-year 1985.

Figure 6: Predicted year of policy implementation for a state with female-male ratio of 1



Note: The figure shows distribution of predicted year of women's reservation implementation in a state with equal populations of men and women. The x-axis is the predicted year of policy implementation, and the y-axis is the correponding density of the particular year in the predicted variable.

6 Discussion

After examining the rate of reported total crimes against women by year in each state we found that sharp jumps occur in many states around 1995 rather than in the year of reservation policy implementation. These large and abrupt increases coincide with the availability of new categories of crimes against women. The dataset used in Iyer et al. (2012) contained no data for these categories before 1995. It is likely that the inclusion of these categories led to the jump in rate of total reported crimes against women and the resulting estimated impact of the policy.

Using data from 1995 and after in states that implemented the reservation policy after 1995, we find no effect of the reservation policy on total reported crimes against women. In doing so we have eliminated the biasing effect of changes in crime categorization seen in the Iyer

et al. (2012) model. While this result contradicts the findings by Iyer et al. (2012), it is crucial to note that this restricted analysis has important limitations.

First, removing states where the policy was implemented before 1995 reduces the number of included states from 17 to 10 and it is possible that the result would have been different had we been able to include all state years. Second, we identify but do not address a violation of the theory of causality in Iyer et al (2012). In order to make causal inferences, the probability that states receive the treatment (in this case, the policy implementation) must be greater than 0 (and less than 1), which is violated given that once the reservation implementation takes place, each subsequent observation has 0 probability of not having the treatment (i.e. the reservation dummy in the regression becomes a 1 and has no probability of ever being a 0 again). To eliminate this violation of the theory of causality, the analysis in Iyer et al (2012) would have to have 17 observations (one for each state), not 391, and we would include only 10 observations in our restricted analysis, instead of 130.

Finally, our analysis identified the more fundamental issue that the year of policy implementation may not have been exogenous. Examining this possibility using a duration model to predict year of policy implementation, we find that female to male ratio, a metric of gender equality, predicts the time to state-level implementation of the national policy. These results suggest that the relationship between the dependent variable and the independent variable of interest may be due to omitted variables that are associated with both the year of implementation and reported crimes. This analysis also has limitations, including that 17 observations is an extremely small sample size from which to draw inference and make predictions.

7 Conclusion

Our study finds no indication that the implementation of a women's reservation policy is associated with increased reporting of total crimes against women. Supported by the finding in Iyer et al (2012) that actual crimes have not increased, this provides encouraging evidence that women's reservation rules may be implemented without the threat of increased crimes against women as a backlash.

8 References

Abdul Latif Jameel Poverty Action Lab. 2006."Aint No Stopping Us Now–Women As Policy Makers." Cambridge, MA. *MIT Department of Economics* `http://www.povertyactionlab.org/publication/women-policy-makers`.

Center for Women and Democracy. 2012. "Quotas in Parliamentary Elections". Seattle, WA: *Center for Women and Democracy.*

Government of India. 1999. "Consideration of reports submitted by States parties under article 18 of the Convention on the Elimination of All Forms of Discrimination against Women: Initial Reports of States Parties (India)." *Presented at 22nd session of UN GA (2000). Committee on the Elimination of Discrimination Against Women (CEDAW).*

Government of India. 2005. "Consideration of reports submitted by States parties under article 18 of the Convention on the Elimination of All Forms of Discrimination against Women: Combined second and third periodic reports of States parties (India)." *Presented at 37th session of UN GA (2007). Committee on the Elimination of Discrimination Against Women (CEDAW).*

Kosuke Imai, Gary King, and Oliva Lau. 2007. "Weibull: Weibull Regression for Duration Dependent Variables in Kosuke Imai, Gary King, and Olivia Lau, "Zelig: Everyones Statistical Software," `http://gking.harvard.edu/zelig`.

Iyer, Lakshmi, Anandi Mani, Prachi Mishra, and Petia Topalova. 2012. "The Power of Political Voice: Womenś Political Representation and Crime in India." American Economic Journal: Applied Economics, 4(4): 165-93. Data available from `https://www.aeaweb.org/articles.php?doi=10.1257/app.4.4.165.`.

Iyer, Lakshmi. Personal communication, April 29, 2014.

National Crime Records Bureau (NCRB), Ministry of Home Affairs, Government of India. 1997. "Crime in India: 1995 Statistics." http://ncrb.nic.in/ciiprevious/Data/CII1995/home.htm.

Pande, Rohini, Deanna Ford. 2011. "Gender Quotas and Female Leadership: A Review." *Washington, DC: World Bank. World Bank.* https://openknowledge.worldbank.org/handle/10986/9120.

R. The R Foundation for Statistical Computing. 2014. Platform: x86—64-w64-mingw32\x64 (64-bit). Available from http://www.r-project.org/.

United Nations Department of Economic and Social Affairs. 2010. "The World's Women 2010 Trends and Statistics." New York, NY.

UN General Assembly. 1979. "The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)." *GA Res 180.*