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and Gender Wage Gap

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# Sexual Violence: A Model of Occupational Choice and Gender Wage Gap

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## Abstract

Surge in sexual violence in India is a public concern in the recent times. I present the stylized facts regarding rapes in India over time and contrast them to global data. Incidence of rape is positively associated with per capita income of that country and to female participation in the labour force. The documented empirical facts may not be representative of the reality because of many unreported incidences. Even though, we accept the empirical facts on its face value, these facts may not represent general rise in crime levels but a shift in occupational choice for women who are increasingly into non-traditional roles. I build a theoretical model where a woman has the choice to work in non-traditional sector as opposed to a traditional one. The model predicts that the gender gap in wages will reduce with technological progress but the sexual assault will register a rise. This will result in intensification in public demand for infrastructure that makes woman safe in their non-traditional role.

**Key words:** Economics of Crime, Economics of Gender, Gender Gap, Crime against Women, Technological revolution.

**JEL Classifications:** J16, J62, O33.

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# 1 Introduction

Sexual violence and safety of women at public places is a concern for many developing countries. As an example, I cite the case of India where the issue came to prominence in public opinion from one nerve-wrecking atrocity (The Economist, 2013) of sexual crime and sexual violence that pulverized the nation. In the wake of this incidence, public protest forced the lawmakers amend the existing law which was rechristened as the Criminal Law (Amendment) Act, 2013 and toughen penalties for crime against women. This break-out of public opinion and subsequent amendment of law in 2013 is not an isolated one-time phenomenon but rather a continuous process (See Appendix A). Apart from India, public opinion is concerned about the women's security and safe public spaces in many developing countries such as Ecuador, Egypt, Rwanda, Brazil, Costa Rica, Philippines (UN Women: United Nations Entity for Gender Equality and Empowerment of Women, 2014).

Relevant statistics told no different story when I looked into rape to illustrate the more general case of rise in sexual crime and sexual violence over time. However, there is the usual problem of under-reporting of rapes that makes statistics quite unreliable to have a complete unbiased picture of the reality. There are two aspects of conventional wisdom associated with this under-reporting. One, comparatively more under-reporting is reported in developing countries over the developed countries. Two, number of under-reporting is possibly changing over time with more reporting now than before. This looks plausible when I note a higher reported rate of rape, on average, for developed countries compared to their developing counterparts including India. Moreover, the incidence of rape has also increased over time, for India.

The contribution of this article is twofold. First, I document a comparative analysis of rapes, statistics wise, across various countries and over time in India, drawing from various sources. I argue that although the extent of under-reporting makes it impossible to predict on the basis of available statistics, it may not be the case that the actual country-level comparisons can be completely reversed on account of under-reporting. I articulate the case in Section 2. If our argument of unreliability of statistical data based prediction

holds, then it immediately follows that a suitable modelling is the only way of analysing the situation. Therefore, as the second part of this work, I present an economic model that analyses the causes and consequence of rise in sexual crime.

Besides the rise in sexual violence (violence against women), there are other changes in the society during last few decades regarding gender specific disparities. Many of them can be identified as an outcome of technological change in society. Such an approach not only resolve the drop in fertility (Greenwood et al., 2005a) and woman’s increasing participation (Greenwood et al., 2005b) in the labour market as a consequence of technological revolution, but also explain many changes in social mores. For example, Fernández-Villaverde et al. (2014) discusses how pre-marital sex from once being frowned upon has become a common practice in Western societies. They have identified the improvement in contraceptives as the underlying cause for this shift in attitude. In my model, women choose to work in

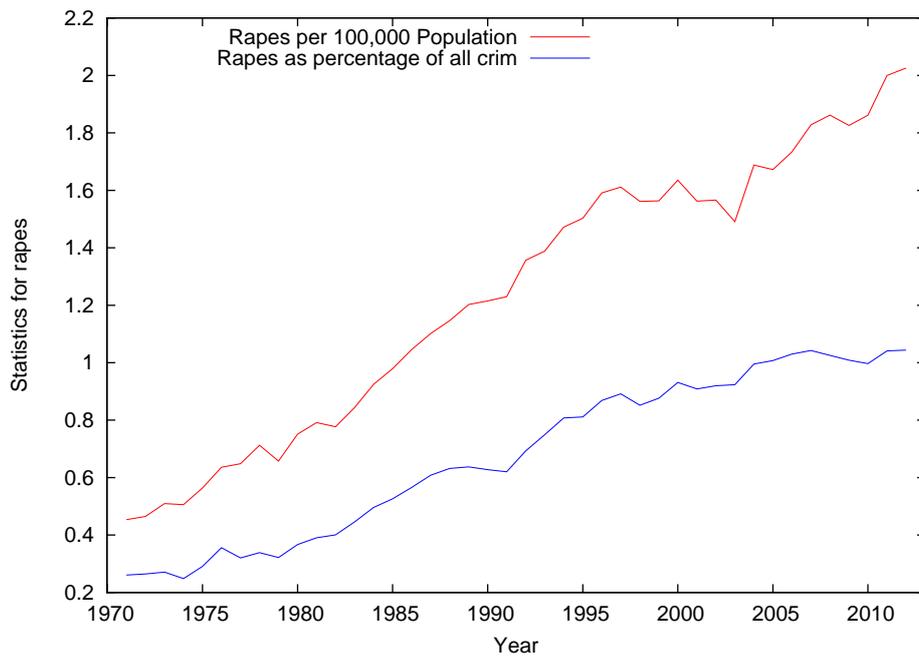


Figure 1: Numbers of rapes per 100,000 population of India as well as rapes as percentage of total number of Indian Penal Code crimes is plotted against time.

the Traditional Sector or in the Non-traditional Sector. Non-traditional Sector is known

by higher productivity which increases with technological progress. However, there is an increased risk to sexual violence for the agents employed in that sector. Furthermore, reporting of rapes varies across sectors. It can safely be assumed that the chance of a reported rape is far lesser for an agent working in the traditional sector compared to her counterpart working in the non-traditional sector. As technological progress happens, more and more agents start working in the non-traditional sector. Both sexual violence and reported sexual violence grow with the incidence of technological progress.

This growth in sexual violence is associated with diminish in gender wage gap. This is a consequence of my model. As women find employment in the non-traditional sector, they receive wage at par with men. With increasing proportion of women being employed in the non-traditional sector, gender wage gap falls. This is accompanied with rise in rate of rape as per model's prediction. This result has many policy implications. For example, how much the government should emphasise on gender wage gap? How should the government approach facilitating more support for women professionals regarding legal infrastructure? These are more important questions rather than gender wage gap to ensure gender parity.

I narrate the plan of this paper. Section 2 describes the stylised facts and their implications. Section 3 presents my baseline model. Section 4 extends this baseline model to a more evolved model that tackles question like gender parity. Section 5 concludes.

## **2 Empirical Picture: What Can be Observed and What not**

In this section, I explore the problem from an empirical perspective.

### **2.1 Data Sources**

My data come from many sources, all of which are publicly available.

1. The Indian data on rape are collected from Crime in India Yearly Handbooks (National Crime Records Bureau, 2014).

2. The panel data on number of rapes for many countries over 2003-2012 are reported in UN Womens Safe Cities Global Initiative (United Nations Office on Drugs and Crime, 2014).
3. The income data are captured using the Penn World Table (Feenstra et al., 2013). I have chosen two variables from the tables, the real GDP measure and population, across countries for various years to construct the per capita real GDP.
4. The labour force participation data have been obtained from World Bank (2014). I use female labour force participation for all women (aged 15–64 years) and for young women (aged 15–24 years), separately.

## 2.2 Stylised Facts

From the above data-sets I document the salient statistical facts below.

1. I present the Indian data with respect to the world. In terms of absolute numbers there was a sharp rise in reported rapes in India during 1971-2012. The data on rapes in India are collected from National Crime Records Bureau (2014). The population of India is enumerated once in each decade by the Census Bureau of India. For the other years, I have interpolated/extrapolated the census data, as necessary. Interestingly, rape per 100,000 population has also risen considerably in these years. (Figure 1) Starting from 0.45 in 1971, this figure went up to 2.03 in 2012.
2. A legitimate question is whether this secular increase with time has anything to do with the nature of the crime. I frame the question in a different manner. Does rape as a share of comparable crimes increase over time? I considered all Indian Penal Code (IPC) crimes as a good proxy for the denominator and calculated rapes as percentage of all IPC crimes. Most of the crimes are marked under IPC. Those that do not come under IPC, are not uniformly defined over time, which is the reason I chose to ignore them. Figure 1 shows the secular rise in this percentage too, from 0.26% in 1971 to 1.04% in 2012.

3. At the same time, I looked (United Nations Office on Drugs and Crime, 2014) into a cross section of countries across the world and compared the number of rapes per 100,000 population in those countries. (Figure 2) The variation is huge. At the lower end, countries like Azerbaijan have quite less number of rapes (0.2 per 100,000 population). At the higher end, countries like Sweden have much higher figures (66.5). I acknowledge the difference in laws regarding sexual assault among different countries. The judicial procedures and conviction rates vary quite largely across countries. In spite of these issues, the variation is way too high to ignore. The top country has more than 300 times more rapes reported compared to a bottom-end country. This inequality requires further examination.

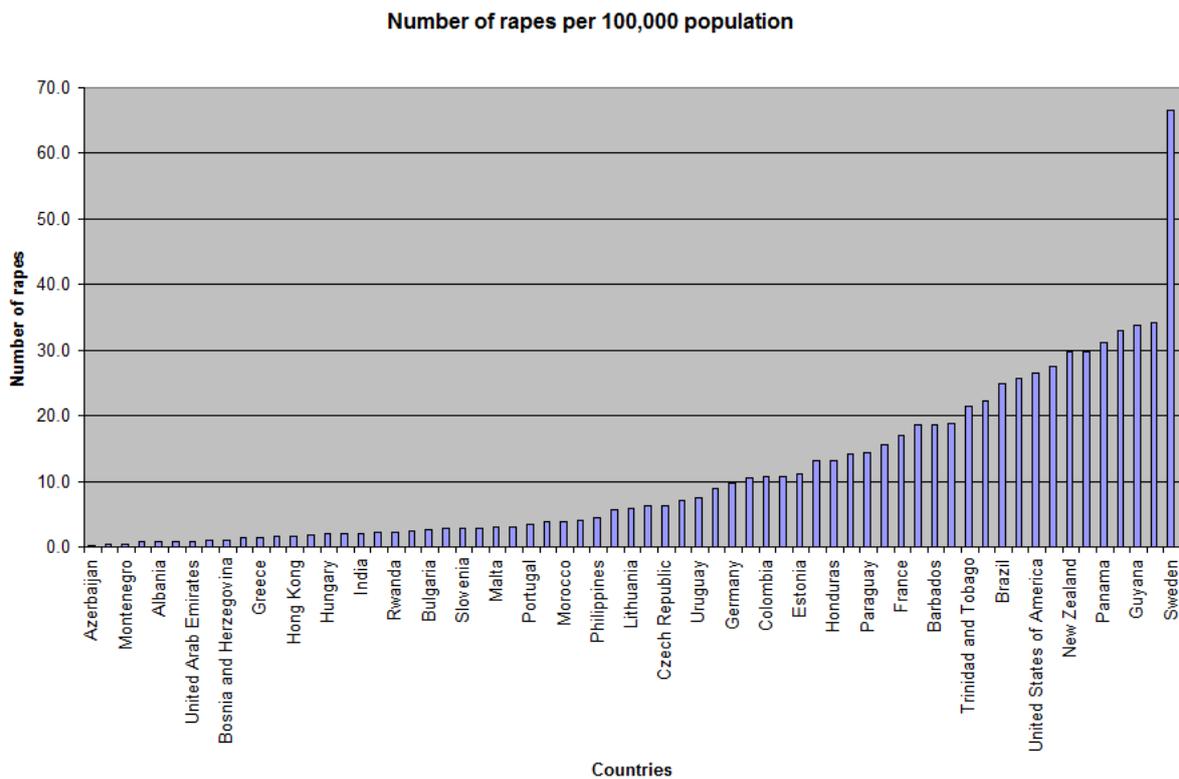


Figure 2: Numbers of rapes per 100,000 population is plotted against countries for 2012. Source: United Nations Office on Drugs and Crime (2014).

4. Figure 3(a) plots normalised number of rapes against per capita Gross Domestic Product (GDP) of a country for 2011, whereas Figure 3(b) does that for 2003–2011. These two variables, both in logarithm scale, are positively correlated with a statistically significant correlation coefficient of 0.181 during 2003–2011. This is the demonstration that on a richer country, one may expect higher rate of rapes. This is also consistent with our previous observation of rise in rapes in India over the years as India registered strong growth in GDP for last two decades.
5. Figures 4(a) and 4.2 plot normalised number of rapes against labour force participation rate for all women (aged 15–64) and young women (15–24). Again, we find that number of reported rapes is correlated with women’s labour force participation. The correlation coefficients are 0.337 and 0.305, for all women and for young women respectively. This is also pertinent in the Indian context as women’s labour force participation went up in the last two decades.

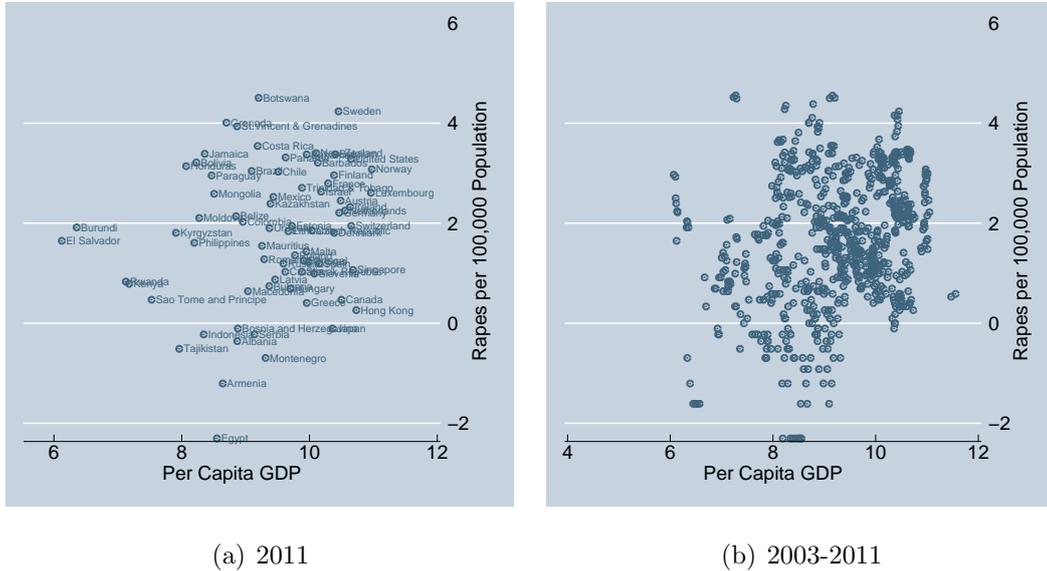
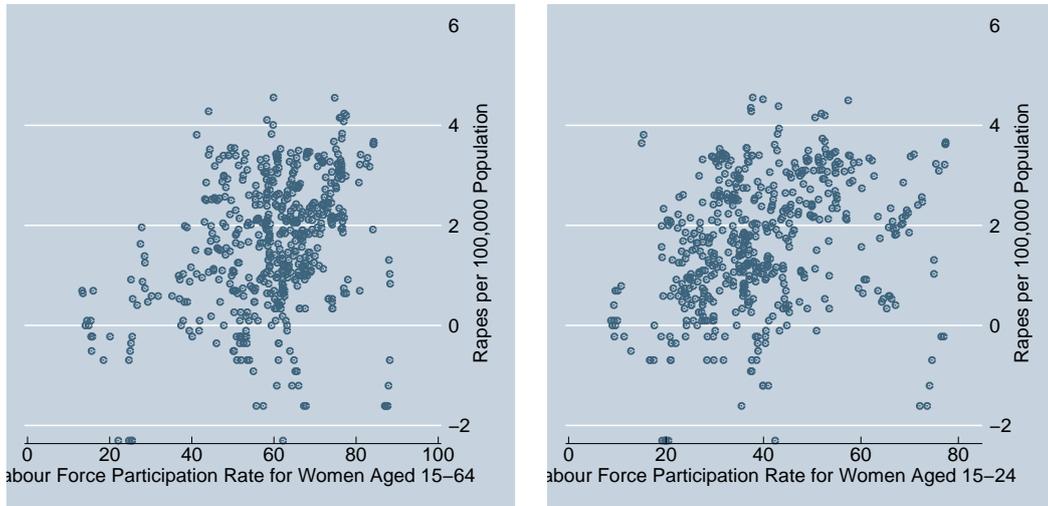


Figure 3: Scatter plot showing numbers of rapes per 100,000 population plotted against per capita G.D.P. across countries (both variables are in log-scale). Source: United Nations Office on Drugs and Crime (2014); Feenstra et al. (2013)



(a) All Women (Aged 15-64)

(b) Young Women (Aged 15-24)

Figure 4: Scatter plot showing numbers of rapes per 100,000 population (in log-scale) plotted against labour force participation rate for females. Source: United Nations Office on Drugs and Crime (2014); World Bank (2014)

## 2.3 Unreliability of Empirical Observations

There is a strong reason to believe that an empirical approach to understand this issue may not be reliable. Statistics may not deliver the reader a complete picture. As a matter of fact, when compared to other countries of the world, rape figures for India are on the lower side of the spectrum. The latest data reveals that per 100,000 population wise, India had only 2.0 rapes annually whereas the U.S. had 26.6 rapes (United Nations Office on Drugs and Crime, 2014). Overall, almost all countries in Europe, South and Central America have much higher or comparable figures (Table 1). Moreover, countries in Africa have much less number of rapes compared to those countries. Developed countries, in general, have more rapes than developing ones.

### 2.3.1 Stigma for Rape-victim

This picture may very well be distorted and deceptive one on account of huge under-reporting of rapes. This anecdotal argument banks on the position that typically women

Country	Rape Rate	Country	Rape Rate	Country	Rape Rate
Azerbaijan	0.2	Slovenia	2.8	Honduras	13.1
Armenia	0.5	Croatia	2.9	Kazakhstan	14.1
Montenegro	0.5	Malta	3.0	Paraguay	14.3
Indonesia	0.7	Latvia	3.1	Dominican Republic	15.5
Albania	0.8	Portugal	3.5	France	17.0
Serbia	0.9	Poland	3.7	Finland	18.7
United Arab Emirates	0.9	Morocco	3.9	Barbados	18.7
Japan	1.0	Romania	4.1	Chile	18.8
Bosnia & Herzegovina	1.1	Philippines	4.5	Trinidad & Tobago	21.4
Canada	1.4	Denmark	5.7	Norway	22.3
Greece	1.5	Lithuania	5.9	Brazil	24.9
Slovakia	1.6	El Salvador	6.3	Grenada	25.6
Hong Kong	1.7	Czech Republic	6.3	United States of America	26.6
Kenya	1.8	Switzerland	7.1	Belgium	27.6
Hungary	1.9	Uruguay	7.6	New Zealand	29.6
Algeria	2.0	Netherlands	8.9	Costa Rica	29.8
India	2.0	Germany	9.7	Panama	31.2
Cyprus	2.2	Austria	10.4	Bolivia	33.0
Rwanda	2.3	Colombia	10.7	Guyana	33.8
Singapore	2.5	Ireland	10.8	Jamaica	34.1
Bulgaria	2.6	Estonia	11.1	Sweden	66.5
Spain	2.7	Mexico	13.1		

Table 1: Number of rapes per 100,000 population across countries in 2012

suffer from a great deal of stigma for being victim of sexual crimes (such as rape) in many societies. This stigma has prevented reporting of sexual crimes and also exists even now. Weidner and Griffitt (1983) rigorously tested this rape stigma idea by a randomised control trial. They asked for personal impressions and degree of social distance desired for a rape victim and contrasted these responses to the corresponding ones for a non-rape victim woman of similar demographic profile. These individual responses were further analysed to discover negative attitudes towards victims. These responses also furnish proof for belief in rape myths and the perceived target behavior which attributes responsibility of the rape to the victim, directly or indirectly. All these are related to stigmatisation hypothesis of the rape victim. This survey also observed more favorable perception for the rapist.

Another important feature is that stigma for rape victim is not equally observed across societies. For example, Luo (2000) discussed the trauma of rape survivors and how is it different compared to western society constructs. Luo (2000) interviewed 35 rape survivors in Taiwan. Their experience provides the basis for documentation of stigmatisation of rape in Taiwanese society. There is similarities between Taiwanese and Western societies, to a degree, regarding rape victim's psychological trauma. However, differences between societal constructs regarding rape stigmatisation also surface in victim's trauma, which needs to be taken care specifically. This also provides the evidence that stigma varies across societies and women in western societies may incur less stigma than their counterparts in developing countries.

This stigma is not the only reason of under-reporting. Family pressures, the manner of the police dealings, the unreasonably long and unjust process and application of law and the resulting consequences thereof, all these issues contribute to underreporting.

### **2.3.2 Extent of Underreporting in Various Countries**

How widespread is this under-reporting?

There are surveys to quantify the extent of under-reporting which could potentially vary between society to society. For example, Jewkes and Abrahams (2002) provided

quantitative evidence on extremely high level of rape in South Africa that goes unreported. Even though 240 incidents of rape and attempted rape per 100,000 women each year were reported, representative community-based surveys found, for example, that in the 1748 age group there were 2070 such incidents annually per 100,000 women. This provides a high ceiling for rape statistics. The reporting rate would be around 12% in that case.

There are other estimates from other countries. For example, Hwang (1995) examined the number of sexual assault cases from the medical institutions in Taiwan. From the conjectured sexual assaults in medical practitioners and the number of cases reported to the police, this study estimated the extent of under-reporting. The reporting rate was estimated at 10%. A survey was conducted on the extent and nature of rapes in the United States under the auspices of Centre for Disease Control, which found that only one in five adult women report their own rape to the police. (Tjaden and Thoennes, 2006, page iii) The reporting rate was, then, 20%. The quanta of under-reporting is, therefore, huge particularly when considered in conjunction with the fact the U.S. stands at the top end of the spectrum in terms of reported rapes.

The expected notion would be that under-reporting diminishes with increasing modernisation of societies. By this expected notion, under-reporting of rapes may have been less prevalent in a developed country like the U.S. Even then, the magnitude of under-reporting is overwhelming. As per conventional wisdom, possibilities are high that such underreporting will be even much more in the developing countries so as to render the data from those countries unsuitable for any empiric based practises. Unsurprisingly, under-reporting from some other countries is even higher which is in tune with the prevalent wisdom.

### **2.3.3 Can India Have Higher Proportion of Rapes Compared to the United States?**

I illustrate the unlikeliness of this proposition. Let us assume that the number of rapes per population are equal in all societies. Then, one may appeal to the extent of under-reporting from the U.S. survey, which would mean approximately 133 rapes per 100,000

population of which only a fifth are reported. By our assumption, this figure may be considered as the benchmark for all societies. Then what follows is that for a country like India only 1.5% of the total rapes are reported. This is way lower than under-reporting in all other surveys that put its extent in the range of 10–20%. If such is the extent of under-reporting then obviously, the data is less than the tip of the proverbial iceberg. Any objective analysis of the reality based on data will rather cloud the true picture than unearth anything. One may, of course, dispute our initial assumption of equal prevalence of rapes in all societies. That being granted, still objectivity of the data is in jeopardy given the extent of under-reporting revealed by surveys conducted in various countries.

In sum, I have demonstrated that widespread under-reporting in the documented cases, questions the sanctity and objectivity of the data. A economic model may be useful for a proper analysis of the prevailing situation.

### 3 Economic Environment

My economic model, makes some gender specific stereotyping. The notion of my model is abstraction to have insights into the mechanism of sexual violence. The stereotyping is only for the sake of abstraction and ensuring understanding of the reader not for imbibing any such notion into the reader’s mind. For example, the victim of sexual violence need not always be females unlike what is assumed in the economic environment.<sup>1</sup>

#### 3.1 Agents

There is a measure 1 of agents who are identical. An agent can choose her Sector: One a Traditional Sector (T), and two a Non-traditional Sector (N). With probability  $p_T$ , an agent could fall victim to rapes in Sector  $T$ . The corresponding probability for Sector  $N$  is  $p_N$ . Similarly, the probability of reporting for a victim in Sector  $T$  is  $q_T$ ;  $q_N$  is the corresponding probability in Sector  $N$ .

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<sup>1</sup>This point was discussed in appendix A as well.

**Assumption 1.** *The probability of a reported rape is lower in the Sector T. Mathematically,  $p_T q_T \leq p_N q_N$ .*

The felicity of an agent is given by,

$$u(c_i) - p_i$$

where  $c_i$  is the consumption of the agent  $i$  and  $u(\cdot)$  is the utility function which is strictly increasing.  $p_i$  is the probability of rape in the sector where agent  $i$  works. Agents consume out of their wage and their share of profit. Therefore,

$$c_i = w_i + \pi, \tag{1}$$

where  $\pi$  is the profit of the economy.

## 3.2 Firms

There is a measure one of firms in both sectors  $T$  and  $N$ . The technology in the  $T$  sector is given by the following production function:

$$y_T(L) = \omega_T \cdot L_T^\alpha, \tag{2}$$

where  $L_T$  is the number of labourers in the sector and  $\omega_T$  denotes the productivity in Sector  $T$ .

For Sector  $N$ , the corresponding production function is given by:

$$y_N(L) = \omega_N \cdot L_N, \tag{3}$$

where  $L_N$  is the number of labourers in sector  $N$ , and  $\omega_N$  denotes the productivity in the sector  $N$ . As technological progress occurs,  $\omega_N$  rises. This divergence of traditional and non-traditional technology has been used in economics literature, most prominently by Hansen and Prescott (2002).

Since there is competition among the firms in sector, a firm will pay labourers the marginal productivity. Moreover, workers can also switch between the sectors. Let  $w_i$  be

the wage in Sector  $i$ , where  $i = N, T$ .

$$\begin{aligned} w_T &= \omega_T \cdot \alpha L_T^{\alpha-1} \\ w_N &= \omega_N \end{aligned} \tag{4}$$

Labour markets clear without any unemployment. Therefore,

$$L_T + L_N = 1 \tag{5}$$

The marginal productivity of labour is constant in Sector  $N$ , whereas, it is decreasing with number of labourers in Sector  $T$ . For a low value of  $L_T$ , the marginal product of labour in Sector  $T$  is extremely high. Although for a high value of  $L_T$ , that marginal product is low. This essentially implies that under all circumstances Sector  $T$  will operate with positive number of labourers. Sector  $N$  may or may not work depending upon the value of  $\omega_N$ . If the marginal productivity of Sector  $N$  falls short of lowest value observed in Sector  $T$ , then this sector will not be operative. Otherwise, Sector  $N$  may be operative.

### 3.3 Characterization of Equilibrium

I characterise the equilibrium for this model.

#### **Proposition 1.**

*Either only traditional sector is being operational, or agents are indifferent between joining any of the two sectors.*

*Proof:* For an agent, the problem is whether to join Sector  $T$  or Sector  $N$ . In the equilibrium, she will be indifferent between them. Therefore, her utility must be equal subsequent on joining any of the sectors. Mathematically,

$$u(c_N) - p_N = u(c_T) - p_T$$

, where  $c_N$  and  $c_T$  are consumptions noted in Equation (1).

Substitution the values of  $c_N$  and  $c_T$  in the above equation, we have:

$$u(w_N + \pi) - p_N = u(w_T + \pi) - p_T \tag{6}$$

**Remark 1.** *Either the Traditional Sector is the only operational one, or Equation (6) holds.*

If Sector  $N$  is operative and Left Hand Side of Equation (6) is greater than its Right Hand Side. Then, an agent will switch from Sector  $T$  to Sector  $N$ . As she switches,  $L_T$ , the number of agents employed in Sector  $T$  decreases leading to increase in marginal productivity of Labour in that Sector. As the sectors are competitive, worker's wage in a sector is the marginal productivity in that sector. Therefore,  $w_T$  increases with increase in  $L_T$ . Since productivity could go up to infinitely high values,  $w_T$  can also go up to infinitely high values. Since all other factors in Equation (6) are bounded, there exists a particular value of  $L_T$  for which equality holds. On the other hand, if RHS is greater than LHS, then an agent will switch from Sector  $N$  to Sector  $T$ . In that process, either both sides will be equal as  $w_T$  falls or all labour force will be employed in Sector  $T$ .

### 3.4 Model Predictions

This model can explain cross-sectional variation, as illustrated in Figure 3, among different countries regarding rape statistics.

**Proposition 2.** *In a cross section of diverse technologically advanced countries, proportion of reported rapes and income are positively related.*

*Proof:* In my model, countries can vary on account of their productivity in Sector  $N$ , which is represented by  $\omega_N$ . As  $\omega_N$  increases, the size of Sector  $N$  is larger that is  $L_N$  is larger. From the assumption of greater probability of reported rape in Sector  $N$ , it is expected that number of rapes will be larger.

My model can also explain increase in rapes over time for India as documented in Section 2.2.

**Proposition 3.** *Technological progress increases the proportion of reported rapes.*

I have already discussed the key features of the above proposition. Clearly, as technological progress happens, that is productivity in Sector  $N$  increases,  $L_N$  increases. Since

probability of rapes being reported is higher in Sector  $N$ , proportion of rapes reported will increase.

## 4 Gender Discrimination and Woman Safety

I extend my baseline model to relate to gender discrimination.

### 4.1 Extension to Our Baseline Model

#### 4.1.1 Agent Types

There are two types of agents: Males and Females. A proportion  $\phi$  of all agents are male and the rest,  $1 - \phi$ , are females. The felicity function of these two types of agents depend.

For a male agent, the felicity is given by,

$$u(c)$$

where  $c$  is the consumption of the agent. For a female agent, the felicity is given by,

$$u(c) - p$$

where  $c$  is the consumption of the agent and  $p$  is the probability of rape in the sector she works in.

#### 4.1.2 Assumptions Added

**Assumption 2.**  $p_N > p_T$ .

In Sector  $N$  the probability of rape is more than that in Sector  $T$ . This is known to the agents but not the econometrician who only knows that about total reported rapes as assumed in Assumption 1. Assumption 1 says that the reported rapes in Sector  $N$  is more prevalent than in Sector  $T$  which essentially a falsifiable hypothesis. However, this added Assumption 2 is not be empirically falsifiable. Therefore, we motivate the reader the conditions under which this assumption will hold ground.

A sufficient condition for Assumption 2 is Assumption 1 and  $q_N = q_T$ . If probability of rapes being reported in both the sectors are equal, then any inequality in reporting of rapes between the sectors translates into the same inequality regarding actual incidence in the sectors. One may argue the veracity of this condition. It is possible that we have more rapes being reported in Sector  $N$ . The following proposition provides the necessary and sufficient condition for Assumption 2.

**Proposition 4.** *Let  $\lambda = \frac{p_N q_N}{p_T q_T}$ . Assumption 2 holds if and only if  $\frac{q_N}{q_T} < \lambda$ .*

The proof of this proposition is almost immediate.  $\lambda$  denotes the ratio of reported rapes across Sector  $N$  and Sector  $T$ . Note that by 1,  $\lambda > 1$ . Higher  $\lambda$  implies a weaker necessary and sufficient condition for Assumption 2. For example, if  $\lambda$  is 2.1, then it implies that Assumption 2 is valid even though probability of reporting of rapes is twice more likely in Sector  $N$  compared to Sector  $T$ . The quantitative estimate of  $\lambda$  will provide a bound for relative probability of reporting between Sector  $N$  and Sector  $T$ . If we assume the maximum rate of reported rape in a country as a proxy for  $p_N q_N$  and the minimum as a proxy for  $p_T q_T$ , then  $\lambda$  is more than 300. Definitely, this means that Assumption 2 is a weak one.

**Assumption 3.**  *$u(\cdot)$  is a linear function.*

The importance of this assumption will be discussed in Section 4.2. This may look like a strong assumption, for in the neoclassical literature, usual utility function is concave. However, I have strong reasons to believe that Assumption 3 is consistent with neoclassical notion of utility function. In my model, I have a linear cost which is simply the probability of rape in the sector where one works. If I take a convex cost function as the norm, I can rewrite the utility of the female agent as

$$z(c) - v(p)$$

where  $v(\cdot)$  is a convex function that is strictly increasing in its argument and  $z(\cdot)$  is a concave increasing function. I can define its inverse function  $v^{-1}(\cdot)$  such that  $v^{-1}(v(\cdot))$  is

the identity function. This problem can be mapped onto the problem with utility function for female agents as  $u(c) - p$ . In this particular case,  $u \equiv v^{-1} \cdot w$  is linear when the convexity is  $v(\cdot)$  is same as the concavity of  $w(\cdot)$ . In general, as long as the convexity is  $v(\cdot)$  is more than the concavity of  $w(\cdot)$ , my main results will stand valid.

## 4.2 Equilibrium Analysis

The equilibrium conditions for males are different compared to them for the females. Since, a male agent's felicity does not include the probability of rape, he cares about the wage alone. If one sector is offering any higher wage compared to the other sector, he will move to higher wage paying sector. In equilibrium, all males should have the same wage. Therefore, either the wages in the both sectors are the same or all the male agents work in one of the sectors.

For the convenience of analysis, I will consider different range of parameter values regarding productivity of both the sectors.

- Scenario 1:  $\omega_N \leq \alpha \cdot \omega_T$

If the marginal productivity of sector  $N$  is low then the above condition holds. The LHS in the above inequality is the wage in Sector  $N$  (Equation 4). The RHS is the minimum productivity in Sector  $T$  which is offered as wage to the labourers when the number of labourers in this sector is unity. Therefore, the potential wage in Sector  $N$  is lower than in Sector  $T$ . Sector  $N$  has not taken off in this scenario.

- Scenario 2:  $\omega_T \cdot \alpha \phi^{\alpha-1} > \omega_N > \alpha \cdot \omega_T$

In this range of values for  $\omega_N$ , as Sector  $N$  productivity rises, it leads to increase in wage of Sector  $N$  compared to Scenario 1. Sector  $T$  simultaneously employs less than the entire labour force and the wage in Sector  $T$  goes up to match the wage in the other sector. A crucial observation to note here is that no female joins Sector  $N$  in this scenario. Since, being employed in this sector means more probability

of sexual assault for females, they refrain from joining the sector, when there is no compensation to that through wages.

The above continues till all the males (total measure is  $\phi$  by our assumption) join Sector  $N$ . Under that circumstances,  $1 - \phi$  labourers are employed in Sector  $T$ . The wage in Sector  $T$  depends on number of labourers employed which is given by  $\omega_T \cdot \alpha\phi^{\alpha-1}$ , which, again is equal to  $\omega_N$ .

- Scenario 3:  $u^{-1}(u(\omega_T \cdot \alpha\phi^{\alpha-1}) + p_N - p_T) > \omega_N > \omega_T \cdot \alpha\phi^{\alpha-1}$

As the value of  $\omega_N$  rises further, the wage increases but not enough to cover the differential impact of sectors to probability of sexual assault. Therefore, the males, all of whom are employed in Sector  $N$ , continue to enjoy more wages with increase in  $\omega_N$ . However, the wage in Sector  $T$  remains unchanged. Together, the male-female wage difference increases. This stops when wage difference has increased to such an extent that a female agent can feel the wage in Sector  $N$  is *just* high enough to join that Sector. This becomes the case when her utility from working in either of the sectors is identical. Mathematically,

$$u(w_N) - p_N = u(w_T) - p_T. \quad (7)$$

We substitute the value of  $w_T$  to arrive at the limiting value of  $\omega_N$ :

$$\omega_N = u^{-1}(u(\omega_T \cdot \alpha\phi^{\alpha-1}) + p_N - p_T).$$

- Scenario 4:  $u^{-1}(u(\omega_T \cdot \alpha\phi^{\alpha-1}) + p_N - p_T) \leq \omega_N$

As the value of  $\omega_N$  augments further, females started joining Sector  $N$ . The wage gap between the sectors remain the same. But with increasing productivity, wage in both Sectors increase. The reason for the wage gap remaining the same is that if the gap is larger than what makes a female indifferent between the two sectors, then the females will all leave Sector  $T$  to join the other sector. This would increase the marginal productivity of labour in Sector  $T$  which will, in turn, enhance the

prevailing wage. Therefore, the wage gap would be reduced back to the original value. If the gap reduces even more, then females move to Sector  $N$  again raising the wage gap to this fixed value.

This scenario is quite different compared to the previous three scenario regarding gender differential in wages and amount of crimes. The gender difference between wages is reduced. The reason is that under scenario 3, the difference between average male wage and average female wage was given by Equation 7. Since under scenario 4, females start joining Sector  $N$  to receive the same wage as that of the males, average wage for the females becomes closer to that of males. (See Figure 5)

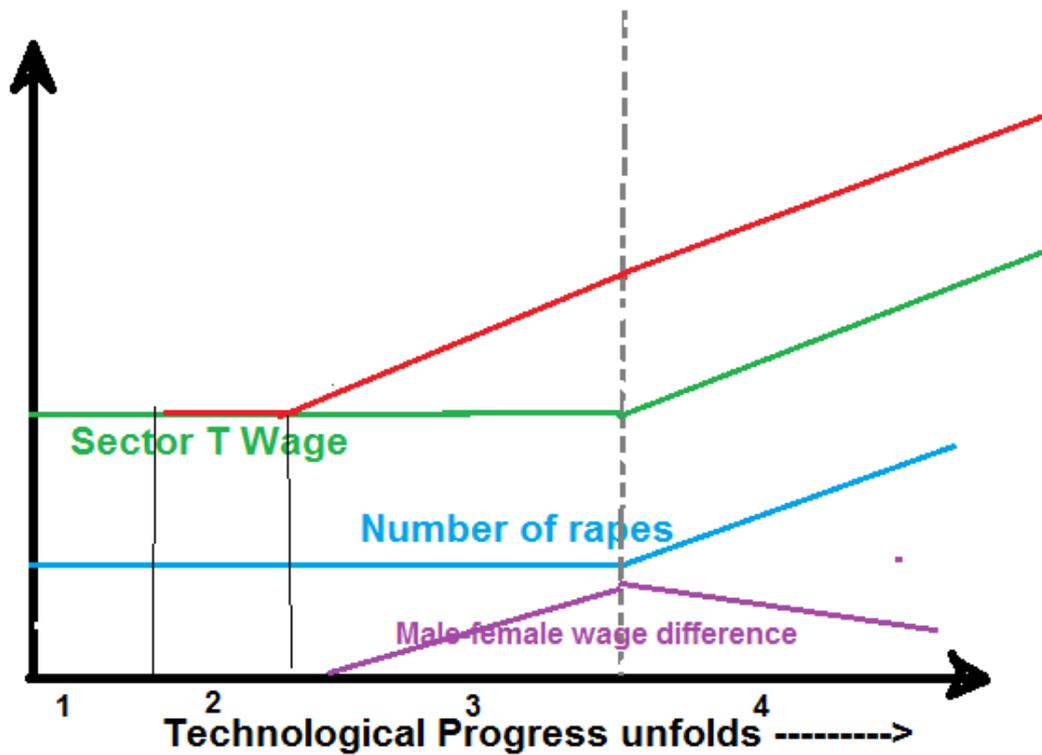


Figure 5: Various Scenarios in My Extended Model

### 4.3 Gender Gap in Labour Market, and Demand for Policing

**Proposition 5.** *With technological progress, the gender gap in wage falls and rate of reported rape rises.*

The proof of this proposition has already been discussed in the previous subsection, while discussing the scenario 4 of the equilibrium analysis. I have simulated my model for certain parameter values that give rise to Figure 5 which depicts the key conclusion of my theoretical model. Interestingly, the data supports the association between greater participation by women in the labour force and more rapes. This also is illustrative of the fact that women employed in Sector  $N$  are more likely to be counted as a part of the labour force.

#### 4.3.1 Demand for Policing

I discuss on demand for stricter law and better policing on the wake of rise in rape in India as well as other developing countries. The stricter law and better policing may reduce rape for women working in Sector  $N$ . It will arguably have much lesser impact for women working in Sector  $T$ . Therefore, it is natural that as the proportion of women working in Sector  $N$  increases, the demand for policing also increases. India recorded increasing importance of the technologically advanced sectors over time and also saw significant rise in GDP in the last two decades. All these are indicative of technological progress. As women move to technologically advanced sectors, they demand more stringent implementation of law or strengthening of law, which is a well-documented fact.

#### 4.3.2 Measure for Gender Parity in the Labour Market

Reduction of gender gap in wages is a usual measure of gender parity in the labour market. This gender gap may hide some aspects of work-safety environment. There can be some jobs which may be more dangerous for women than men, at least in a developing country perspective. We can denote the safe Sector as  $T$  and the relatively unsafe one as  $N$ . In such a situation, an employer may allot jobs in Sector  $N$  to men than women. The latter

sector being relatively unsafe, women may find it appropriate to accept lower wage in lieu of not working in that sector.

It is easy to observe that moving females to Sector  $N$  reduces gender gap in wages as per the above proposition. The government may decide to impose laws on firms to reduce wage gap. Emphasis on reduction of gender gap may motivate such an employer to discontinue the earlier practice of employing females in Sector  $T$  and employ women in Sector  $N$ . This will result increase in rape rate. If gender parity is considered, the government should not isolate gender wage gap as the sole measure. It may not be Pareto optimal to assign women to jobs that increases risk for sexual assault. Government too should focus on building legal and policing infrastructure that will make it safe for women to avoid sexual assault. These infrastructure should also be counted as an important part of gender parity measures.

## 5 Conclusion

Women's security is a pertinent issue in India and many other developing countries. I document various aspects of statistics on rape. I discover some stylised facts appealing to panel data on rape for various countries. I also document such facts for rape in India. These stylised facts indicate positive association between per capita GDP and rate of rape. Positive association is also observed between women's labour force participation and rate of rape. There are, however, concerns regarding the applicability of data. I have studied that concern in this paper. I have found that while the extent of under-reporting is significant, it may not merit complete reversal of the empirical understanding. A suitably built model may be crucial to developing a better understanding.

Consequently, I have presented a model that allows various empirical scenarios to be represented. At one end, it predicts that with rising GDP, number of reported rapes would be higher. There are certain benefits of having a model for analysing the situation. Empirical analysis often lacks the power to forecast, whereas a suitable model can be of immense predictive power. My model can explain the stylised facts that I have unearthed.

Interestingly, the model indicates a negative association between gender wage gap and the extent of sexual assault. Moreover, this model can help formulate policy decisions regarding women's parity with men in the labour market.

I can run some policy experiments in the form of thought experiments. Often a core issue in women's labour market discrimination is minimisation of gender wage gap in the labour market. However, this apparent stress on gender parity can be in lieu of security risk for women. Then, without any vigil on gender discrimination, firms will let women choose traditional sector as possible. However, the wages of women's will be lower than their male counterparts on average, as males do not make that choice. As government makes gender parity essential regarding wage, firms will be compelled to assign women to risky jobs increasing the sexual crime on them. Therefore, any such policy for gender parity should also be complemented with infrastructure in which both sexes are equally safe.

## References

- Basu, M. (2013). The Girl Whose Rape Changed A Country. accessed 12-December-2014.
- Desai, D. (2012). Sexual Harassment and Rape Laws in India. accessed 12-December-2014.
- Feenstra, R. C., Inklaar, R., and Timmer, M. (2013). The next generation of the penn world table. Technical report, National Bureau of Economic Research.
- Fernández-Villaverde, J., Greenwood, J., and Guner, N. (2014). From shame to game in one hundred years: An economic model of the rise in premarital sex and its de-stigmatization. *Journal of the European Economic Association*, 12(1):25–61.
- Greenwood, J., Seshadri, A., and Vandenbroucke, G. (2005a). The baby boom and baby bust. *American Economic Review*, pages 183–207.
- Greenwood, J., Seshadri, A., and Yorukoglu, M. (2005b). Engines of liberation. *The Review of Economic Studies*, 72(1):109–133.

- Hansen, G. D. and Prescott, E. C. (2002). Malthus to solow. *American Economic Review*, pages 1205–1217.
- Hwang, F. (1995). An examination of womens personal safety. In *conference on Public Policies for Women in the 21st Century, Taipei, Taiwan*.
- Jewkes, R. and Abrahams, N. (2002). The epidemiology of rape and sexual coercion in south africa: an overview. *Social Science & Medicine*, 55(7):1231–1244.
- Luo, T.-Y. (2000). marrying my rapist?! the cultural trauma among chinese rape survivors. *Gender & society*, 14(4):581–597.
- Ministry of Law and Justice (2013). The Gazette of India. accessed 12-December-2014.
- National Crime Records Bureau (2014). Crime in india yearly handbook. Available online at <http://ncrb.gov.in/>; accessed 27-July-2014.
- Rukmini S. (2014). The many shades of rape cases in delhi. *The Hindu*. Available online at <http://www.thehindu.com/data/the-many-shades-of-rape-cases-in-delhi/article6261042.ece>; accessed 15-December-2014.
- The Economist (2013). Indias women rape and murder in delhi. *The Economist*. Available online at <http://www.economist.com/news/leaders/21569031-horrible-attack-could-prove-turning-point-indias-women-rape-and-murder-delhi>; accessed 15-July-2014.
- Tjaden, P. and Thoennes, N. (2006). Extent,Nature,andConsequencesofRapeVictimization: FindingsFromtheNationalViolenceAgainstWomenSurvey. accessed 27-July-2014.
- UN Women: United Nations Entity for Gender Equality and Empowerment of Women (2014). UN Womens Safe Cities Global Initiative. accessed 27-July-2014.
- United Nations Office on Drugs and Crime (2014). Crime and Criminal Justice Statistics. Available online at <http://www.unodc.org/unodc/en/data-and-analysis/statistics/crime.html>; accessed 27-July-2014.

Weidner, G. and Griffitt, W. (1983). Rape: A sexual stigma? *Journal of Personality*, 51(2):151–166.

World Bank (2014). World Development Indicators 2014. Washington, DC: World Bank. Available online at <http://data.worldbank.org>; accessed 18-November-2014.

## A Evolution of Jurisprudence in Sexual Assault Cases

In this section, we undertake an overview of evolution of jurisprudence in sexual assault cases for India. The reader may understand how the law is, generally speaking, becoming tougher on perpetrators over time.

Sexual assault is sexual violation of a person against her/his will. Rape undermines the integrity of the victim, physically as well as mentally. Justice Arjit Pasayat observed ((2003) 8 S.C.C. 590) “While a murderer destroys the physical frame of the victim, a rapist degrades and defiles the soul of a helpless female.” Almost 90% of the rape victims are females.<sup>2</sup> A small but significant minority of victims are males. Indian law do not particularly recognise male victims of rapes.

The definition of Rape is given in the Indian Penal Code (IPC), 1860. As per Section 375 of IPC a man is said to commit the offence of rape with a woman under the following six circumstances:

- Sexual intercourse against the victim’s will,
- Without the victim’s consent,
- With her consent, when her consent has been obtained by putting her or any person that she may be interested in fear of death or hurt,
- With her consent, when the man knows that he is not her husband,

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<sup>2</sup>U.S. Bureau of Justice Statistics (1999) estimated that 91% of rape victims are female and 9% are male.

- With her consent, when at the time of giving such consent she was intoxicated, or is suffering from unsoundness of mind and does not understand the nature and consequences of that to which she gives consent,
- With or without her consent when she is under sixteen years of age.

As such vaginal penetration is sufficient to constitute the offence of rape, whereas the exception leaves out marital rape altogether if the wife is not under fifteen years of age. With the changing values of the times, the marital exception is revoked in England ((1991) 4 ALL ER 481 (HL)). Even though English laws were the source of inspiration in drafting IPC, however, no such change has been made in the Indian law.

An important milestone regarding sexual assault laws in India is the Mathura rape case, wherein Mathura, a 16-year old Scheduled Tribe girl, was raped by two police constables in the Desaijanj Police station, Maharashtra in the year of 1972. (Basu, 2013) Her relatives, who had come to register a complaint, were patiently waiting outside even as she was raped in the police station. Remoteness of the location delayed the medical tests almost by 24 hours, which essentially concluded evidence of intercourse without any proof of force.

In 1974, the case came for hearing in the sessions court , which acquitted the policemen. Mathura's testimony was discarded as she was "habituated to sexual intercourse". That Mathura did not scream during the time of intercourse, went against her. On appeal the Nagpur bench of the Bombay High Court set aside the judgment of the Sessions Court, and sentenced the both accused to rigorous imprisonment of varied duration, one and five years. The Court held that passive submission due to fear induced by serious threats could not be construed as consent.

However, the Supreme Court again reversed the judgment of the Bombay High Court in 1980. There were widespread protests again this verdict of the Supreme Court which, as was widely felt, did not adequately address the concern of a teenage girl from the hinterlands who was prevailed upon in the face of inevitable compulsion. These concerns eventually led to enactment of a new law. The Criminal Law Amendment Act, 1983 has made a statutory provision regarding Section 114 (A) of the Evidence Act, which states

that if the victim girl says that she did no consent to the sexual intercourse, the Court shall presume that she did not consent.

Women do have the right to bodily integrity, as this right is guaranteed under Article 21 of the Constitution of India. The question is one of implementation of this law. We record the dynamics of this law in response to ensure equity to women, on the wake of legal cases of high importance. These changes which are considered as “victories” by afflicted parties, often happen after long wait, sometimes a decade or so, as the Mathura trial shows.

In 1997, came the first legal instance (*Vishaka Vs. State of Rajasthan and others* AIR, 1997 S.C 3011) which defined sexual harassment as an unwelcome sexual gesture or behaviour (direct or indirect) that includes

1. sexually coloured remarks,
2. physical contact and advances,
3. showing pornography,
4. a demand or request for sexual favours,
5. any other unwelcome physical, verbal/non-verbal conduct being sexual in nature.

The above case is landmark in the sense that henceforth sexual harassment has been identified as an illegal conduct in its own right. (Desai, 2012) The critical factor in deciding sexual harassment is the unwelcomeness of the behaviour in-question. Therefore, the impact of such actions on the recipient (victim) is adjudged more relevant over the intent of the actor (perpetrator).

The 2012 Delhi gang rape marks the latest landmark in enactments against sexual assault in India. On 16 December 2012 Jyoti Singh Pandey, a 23-year-old female physiotherapy intern, was severely tortured and gang raped in a private bus in which she was travelling with a male friend in South Delhi. Six others in the bus, including the driver, raped the woman and beat her friend. The incident engendered widespread national outrage and considerable international coverage. The woman, despite being offered

best available treatment by Government of India, succumbed to her injuries in two weeks. Meanwhile, massive public protests against the deteriorating law and order situation particularly for security of women, took place in New Delhi and also in some other major cities throughout India.

The government could not ignore these popular protest and passed several new sexual assault laws with almost lightening speed considering the bureaucratic procedures in mind. The newly enacted law, the Criminal Law (Amendment) Act, 2013 amended the Indian Penal Code, Indian Evidence Act, and Code of Criminal Procedure, 1973 on laws related to sexual offences. This law also guarantees provision of a mandatory minimum sentence of 20 years for gang rape, and six new fast-track courts created solely for rape prosecutions.

The most important change in the law is made regarding definition of rape under Indian Penal Code. (Ministry of Law and Justice, 2013) In the Act the word 'rape' includes acts like penetration of penis, or any object or any part of body to any extent, into the vagina, mouth, urethra or anus of another person or making another person do so, apply of mouth or touching private parts constitutes the offence of sexual assault in addition to vaginal penetration. The Act has also clarified that lack of physical resistance will not be obstructive to constituting an offence. The punishment will be imprisonment not less than seven years but which may extend to imprisonment for life, and shall also be liable to fine.

There is another aspect of rape laws in India. Section 376 says that sex is rape if it is without the woman's consent. Section 90 says that consent obtained via "misconception of fact" is not really consent. Many high courts and lower courts, based on these two sections together, have held that sex based on a false promise of marriage is rape. The Supreme Court also maintained this stand in some situations (Deepak Gulati vs State Of Haryana case in 2013). A great proportion of the reported cases actually by women who were a party to consensual sex Rukmini S. (2014). Obviously, this pushes the rape statistics for India upward, which is not the case for most of the other countries.

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