

Why should these three conditions describing marriage customs in India be of interest to the economist? First, note that those who fail to follow, or even to enforce the caste customs do not gain the profits of the successful arbitrageur but instead suffer the stigma of the outcaste. If the punishment of becoming an outcaste is predicted to be sufficiently severe, the system of caste is held in equilibrium irrespective of individual tastes, by economic incentives; the predictions of the caste system become a self-fulfilling prophecy.<sup>23</sup>

Second, the recent extensions of the model of supply and demand to discrimination, household organization, crime and marriage show that the boundaries between sociology and economics are by no means clear; if economic models can explain sociological phenomena, so also the process can work in reverse with sociological models describing economic phenomena. With appropriate adjustment, the model of marriage in India explains both economies pathologically different from the A-D utopia, and also special pathologies in economies in which perfect competition, or slight deviations therefrom, are the norm.

Finally, the formal model of caste equilibrium works spontaneously without direction of any individual or organization. But in this model it is also natural to have the exact same economic structure with some arbiter of the caste code. Indeed the model is therefore useful in indicating how individuals and organizations can yield great powers—quite possibly, as in some of the later examples, with considerable abuse.

### *Formal Model of Caste Equilibrium*

This subsection presents a formal model of caste equilibrium. Caste equilibrium is defined as a state of the economy in which caste customs are obeyed, yet no single individual, by behaving differently, can make himself better off. The first concern is, of course, to describe this equilibrium. However, since there are also coalitions of individuals who by acting together can make themselves better off than in equilibrium, it is also of interest to know the relative ease or difficulty of forming such a coalition. For this purpose we also look at the size and nature of the smallest equilibrium-breaking coalition.

Four sets of assumptions describe the economy; those describing technology, market structures, tastes, and the social system. The assumptions describing the social system are laid out in parallel with the earlier description of marriage in India. In general this model is extremely simple, subject to one complication. By its very nature the caste system involves trade and the division of labor. If outcastes could set up their own economy independent of caste members, the caste system would fall apart. Therefore, three assumptions are inserted that lead individuals to trade with one another; laborers can produce only one product; firms produce only one product; and tastes are such that persons will wish to purchase more than one good.

<sup>23</sup> Note that this is the 'terrorist' model of economic activity. One good example is the terrorist regime of Henry V of England, described by G. Mattingly, *Catherine of Aragon* (New York: Random House Paperback, 1960). Note also that this model describes the college 'honors' systems.

*Technology T1.* There are three types of jobs: skilled jobs, unskilled jobs, and scavenging jobs. (Subscripts  $sk$ ,  $u$ , and  $sc$  refer to *skilled*, *unskilled* and *scavenging*, respectively.)

*T2.* There are  $n$  different products, labeled  $i = 1, \dots, n$ .

*T3.* The production of each product depends upon the quantity of labor employed and the jobs performed by the labor. Let  $\theta_{sk}$ ,  $\theta_u$ , and  $\theta_{sc}$  denote the output of one unit of labor in producing any product in a skilled job, unskilled job, or scavenging job, respectively. The production function of good  $i$  is then

$$q_i = \sum_j \theta_j n_{ij},$$

where

$j = sk, u, sc, i = 1, \dots, n$

$q_i$  = output of product  $i$ , and

$n_{ij}$  = quantity of labor employed in job type  $j$  in production of good  $i$ .

Of course,

$$\theta_{sc} < \theta_u < \theta_{sk}. \quad (1)$$

*T4.* Because of economies due to specialization workers can work on the production of only one product.

*Market Structures.* All firms are competitive profit maximizers. These firms can produce only one product. They hire labor and sell output on the market. A firm is willing to bid for labor the expected marginal value product of that labor.

*Tastes.* All persons have the same utility function  $U$ , which is independent of the caste code.

$$U = \sum_{i=1}^n \min(x_i, \alpha), \quad (2)$$

where  $x_i$  is consumption of good  $i$  and  $\alpha$  is a parameter of the utility function.

*Social Structure S1.* By birth there are just two castes divided into a dominant caste  $D$  and a nondominant caste  $N$ . Labor of both castes  $D$  and  $N$  can be outcasted. Outcastes, if any, form a third group.

*S2.* The caste code dictates that  $D$  labor may work in only skilled jobs;  $N$  labor may work in only unskilled jobs; and outcaste labor may only hold scavenging jobs. The caste code also says that all persons who purchase from firms not using labor according to the caste code will themselves be outcasted.

*S3.* Persons predict that breakers of the caste code will be outcasted and receive the wages bid for outcaste labor.

*Caste Equilibrium.* Let the economy be described as above. Let  $w_k$ ,  $k = D, N$  denote the wage of caste  $k$ . Let  $p_i$  denote the price of good  $i$  produced by firms that use labor

according to the caste code. Let good 1 be the numeraire good, with price equal to 1. Assume parameter values

$$\alpha < (\theta_u - \theta_{sc}) / (1 - \theta_{sc} / \theta_{sk}) \quad (3)$$

and

$$n > \theta_{sk} / \alpha. \quad (4)$$

The following describe an equilibrium with fulfilled expectations:

1.  $w_D = \theta_{sk}$ ,  $w_N = \theta_u$ .
2. The price of all goods produced by firms using labor according to caste code is 1.
3. There are no outcastes.  $N$  labor works at unskilled jobs.  $D$  labor works at skilled jobs.
4. Utility of  $D$  labor is  $\theta_{sk}$ ; utility of  $N$  labor is  $\theta_u$ .
5. The highest wage bid for outcaste labor is  $\theta_{sc}$ .

A coalition of  $k^*$  firms, producing  $k^*$  different products and using outcaste labor in skilled jobs, can break this equilibrium if

$$k^* > (\theta_u - \theta_{sc}) / \alpha(1 - \theta_{sc} / \theta_{sk}).$$

*Proof.* It is obvious that the described equilibrium is feasible. We need show only that no new firm can make zero or positive profits and bid a higher wage either for  $N$  labor or for outcaste labor.

*N Labor.* Suppose that a new firm bids a higher wage for  $N$  labor than  $\theta_u$ . It must use some of this labor in skilled jobs. In this case its profits per laborer will not exceed

$$p\theta_{sk} - \theta_u,$$

where  $p$  is the price received for its product. If profits are nonnegative,

$$p \geq \theta_u / \theta_{sk}.$$

But at a price as great as  $\theta_u / \theta_{sk}$  this firm will have no customers. Consider a prospective customer. This customer will be outcasted because  $N$  labor is used in skilled jobs. Therefore, his expected wage is  $\theta_{sc}$ . He will maximize expected utility by purchasing  $\alpha$  units at a price  $p$  and  $(\theta_{sc} - \alpha p)$  units of other goods from other firms that use labor according to the caste code.

His total utility will therefore be

$$\theta_{sc} - \alpha p + \alpha \leq \theta_{sc} - \alpha \theta_u / \theta_{sk} + \alpha. \quad (5)$$

But by (1) and (3) the right-hand side of (5) is less than  $\theta_u$ .

Since the customer of this firm receives utility at least as large as  $\theta_u$  if he does not purchase from the caste-breaking firm, the demand for the firm's products will be zero.

*Outcaste Labor.* No firm can bid a wage higher than  $\theta_{sc}$  for outcaste labor and receive a profit if this bid is accepted. For a firm to pay a higher wage than  $\theta_{sc}$ , it must employ outcaste labor in skilled or unskilled jobs. Its profits per laborer will not exceed

$$p\theta_{sk} - \theta_{sc}.$$

If profits are nonnegative,

$$p \geq \theta_{sc}/\theta_{sk}.$$

But at a price as great as  $\theta_{sc}/\theta_{sk}$  the firm will have no customers: any prospective customer will be outcasted and expect to receive a wage  $\theta_{sc}$ . Consider this customer. He will buy  $\alpha$  units from this firm at a price  $p$  and will purchase  $(\theta_{sc} - \alpha p)$  units of other goods from other firms. Therefore, his utility will be no greater than

$$\theta_{sc} - \alpha\theta_{sc}/\theta_{sk} + \alpha. \quad (6)$$

But since (6) is less than  $\theta_u$  by (3), this firm will have no customers. Hence the maximum bid for outcaste labor will be  $\theta_{sc}$ .

### *Equilibrium-Breaking Coalition*

Finally, a coalition of  $k^*$  firms,  $k^* > (\theta_u - \theta_{sc})/\alpha(1 - \theta_{sc}/\theta_{sk})$  can break the equilibrium. Such firms can offer a wage bid  $\theta_{sc}$  for outcaste labor, and offer to sell their output at a price  $\theta_{sc}/\theta_{sk}$ . The expected utility of a person purchasing from these firms will be

$$\min(\theta_{sk}, \theta_{sc} - k^*\alpha\theta_{sc}/\theta_{sk} + k^*\alpha),$$

which is greater than  $\theta_u$  if  $k^* > (\theta_u - \theta_{sc})/\alpha(1 - \theta_{sc}/\theta_{sk})$ . Thus the coalition of firms will be able to attract customers; and since workers will be better off receiving  $\theta_{sc}$  in wages and purchasing from firms that break the caste code, these firms will also be able to attract workers.

### *Comments on Caste Equilibrium*

1. The equilibrium described has two types of distortions due to caste structure. The equilibrium is not Pareto optimal, since in a Pareto-optimal equilibrium  $N$  workers would work in skilled jobs, for which they are fully qualified. Also, income distribution is skewed along caste lines, since in the absence of caste all workers would receive the same wage.
2. There is another equilibrium, also with fulfilled expectations, in which all workers work in skilled jobs and receive a wage  $\theta_{sk}$ . The price of all goods is 1.