

The Indian Caste System as a Means of Contract Enforcement

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Abstract

The caste system in India has been dated to approximately 1000 B.C. and still affects the lives of a billion people in South Asia. The persistence of this system of social stratification for 3000 years of changing economic and social environments is puzzling. This paper formalizes a model of the caste system to better understand the institution and the reasons for its persistence. It argues that the caste system provided a tool for contract enforcement and facilitated trade in services, giving an economic reason for its persistence. A caste is modeled as an information-sharing institution, which enforces collective action. Trade is modeled as a version of the one-sided prisoner's dilemma game, where the consumer has an opportunity to default. Consumers who default on a member of a caste are punished by denying them services produced in the caste. Various features of the caste system like occupational specialization by caste, a purity scale, and a hierarchy of castes are shown to be equilibrium outcomes that improve the efficiency of contract enforcement. The implications of the model are tested empirically using unique census data from Cochin (1875), Tirunelveli (1823) and Mysore (1941).

“I am persuaded that it is simply and solely due to the distribution of the people into castes that India did not lapse into a state of barbarism”–Abbé Dubois, 18th Century French Missionary in India

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1 Introduction

Estimates put the start of the caste system anywhere between 3000 B.C. to 1000 B.C.¹ Even today it remains an important issue for Indian society with the Indian government's proposals for caste based job quotas in the private sector and increases in caste based reservations at institutes of higher learning.² It is still an important determinant of people's economic choices.³ On the non-academic front, writings on caste tend to be polemic. Rabindranath Tagore called it a "gigantic, cold-blooded repression" and Nehru acknowledged that the caste system was "wholly opposed to modern conditions and the democratic ideal."⁴ With the widespread criticism the institution currently faces the persistence of this system of social stratification for 3000 years during periods of changing economic and social environments is puzzling.⁵

Given the long history of this institution and changes in recent decades, covering the whole time period is infeasible. The model of the caste system in the paper is more appropriate to pre-colonial India, or more specifically before the introduction of the British law courts. (Dirks 2001) argues that British policies introduced changes in the caste system. A snapshot of the pre-colonial economy shows a robust thriving economy. Lord Clive in 1757 noted that Murshidabad "is as extensive, populous, and rich as the city of London, with this difference that there were individuals in the first possessing infinitely greater property than in the last city".⁶ According to (Maddison 2003), in 1700 India's share of world GDP was 24.4% compared to Western Europe's 21.9%.⁷ The economy was largely agricultural but was noted for the high quality its manufactures. Another feature which is often called characteristic of the economy was its ability to sustain a high degree of division of labor.⁸ At the same time there is not much evidence of a well developed court system.⁹

This leaves us with two questions. First, can we model the caste system to better understand it and the reasons for its persistence over the years? Second, how was the economy able to sustain a high degree of specialization without a strong enforcement system? In answer to both these questions, I argue that the caste system functioned as a means of contract enforcement, thus providing an economic reason for its persistence over the years. I offer a model of how the system provided contract enforcement and check for testable implications. The caste system, like other institutions, shapes an individual's actions and choices. A model can help us understand the way the system works and by organizing our thinking, help understand its effects on the economy.

The central problem in the economy is sustaining trade in services within a village. Trade is modeled

¹(Thapar 2002)

²*Jobs for India's lowest castes* The Economist magazine, April 27th 2006. *We have a few reservations* The Economist magazine, May 25th 2006

³(Munshi and Rosenzweig Forthcoming)

⁴(Nehru 1946) page 532

(Tagore 1997) page 75, but at the same time admits "this is a fact which foreign observers too often overlook that it served a very useful purpose in its day"

⁵"Almost everyone who knows anything at all about India has heard of the caste system; almost every outsider and many people in India condemn it or criticize it as a whole" (Nehru 1946) page 242

⁶(Clive, 1756-59:ccii) Clive, Lord 1756-59 Indian Records Series 1756-1759. by Samuel Charles Hill. (London: John Murray, 1905)

⁷page 261, Table 8-b. In per capita terms India was \$550 per capita to western Europe's average of \$998

⁸(Raychaudhuri 1982) pages 180-181

⁹(Moreland 1920) page 35

as a one-sided prisoner's dilemma game. The consumer approaches a producer for a service. The producer then provides the service, choosing his effort level. Higher producer effort translates into a better quality service. After the service is rendered, the consumer decides whether he should pay the producer or not, leaving incentives for the consumer to default on payment. For trade to be sustained, there has to be a way of ensuring that default is credibly punished.

The major assumption made about castes is that they serve as a means to share information which can then be used to enforce collective action. Of all the possible equilibria of the game, consider those where punishments are collective and take the form of service denial: If a consumer defaults on payment to a member of caste c , *all* the members of c refuse to provide the consumer with services in the future.¹⁰ The utility the consumer forgoes by cheating on a member of a caste (the cost of cheating) is what is termed the bargaining power of the caste. It depends on the services which can only be obtained in caste c and nowhere else or if c offers a service with higher quality than producers outside the caste. The consumer will not cheat as long as the benefit from cheating is lower than the cost of doing so. This is his incentive compatibility constraint.

The producer has to choose the effort level he will provide. By assumption, the producer always prefers to provide the highest possible effort, since his profits are increasing in effort provision. There is no notion of efficiency wages or of effort unobservability. Both consumers and producers benefit from increasing effort levels. The only thing that restricts the producers effort level is the consumer's incentive to default. Increasing effort levels increases the consumer's benefit from cheating and make him more likely to default. Thus, producer effort is bounded by the bargaining power of his caste through the consumer's incentive compatibility constraint. The higher the punishment for the consumer in default, the higher the effort level the producer can provide. Efficiency of the equilibrium is defined by the effort levels sustainable in equilibrium.

The main part of the paper characterizes equilibria in which trade is sustained with these strategies, showing that the caste system served as a means of contract enforcement. The paper offers three ways to substantiate this claim. The first is anecdotal evidence in support of the assumptions and implications of the model. Section 2 details evidence of collective punishments and the informational capabilities of castes.

The second method of substantiation is by the other implications of the model. Collective punishments are not the best known feature of the caste system. Other features such as occupational specialization by caste, a purity scale and a hierarchy of castes are better known and are used as defining features of the caste system. The second part of the paper shows that these features are implications of the model of contract enforcement. Moreover, these features serve in equilibrium to increase the efficiency of contract enforcement. Thus the paper integrates the caste system's different aspects and features into one model that is based on a simple economic insight.

The third method of substantiation is empirical. The data used is census data from three different locations and time periods – Cochin (1875), Tirunelveli (1823) and Mysore (1941). Each individual census

¹⁰This particular strategy was chosen because it is what is seen in reality.

has limited observations, but together they provide a means to check for patterns in the data and if these patterns are consistent with the implications of the model. The main results will be about two implications – occupational specialization and the relationship between castes and population size.

To return to the features of the caste system briefly: the occupational specialization result argues that increasing the number of occupations that are unique to (monopoly of) some caste increases efficiency. Since punishments take the form of service denial, doing so strengthens the bargaining power of the caste, which then increases effort provision by producers and hence efficiency. The section on purity discusses the role of self production and occupational restrictions by caste. Self production restrictions allow individuals to commit, ex-ante, to reduce their outside option in the case of default, which strengthens the producer’s bargaining power. Occupational restrictions by caste prevents higher caste members from free-riding off the bargaining power of their caste and this allows for unequal bargaining power to be sustained across castes in equilibrium. Both these restrictions could be justified on the basis of purity and it leads naturally into a hierarchy of castes based on purity.

In addition, the relationship between the number of castes in a village and population size is also examined. If information collection is costly and increasing in caste size, the prediction is that the number of castes in a village should be increasing in population size. Finally, regarding the ascriptiveness of the system, restricting entry into castes follows naturally from the caste’s ability to decide to whom it will extend its punishment power. A person cannot ‘belong’ to a caste unless the caste is willing to punish consumer’s who default on him. If there are rents to be preserved, one could see restricted entry into castes in equilibrium.

Literature review

One consequence of this institution’s persistence and complexity is that it has been a subject of much study not just in economics but in anthropology and sociology as well. On the empirical side, papers such as (Banerjee and Somanathan 2006) and (Anderson 2005) detail the economic effects of caste. The most common explanation given for the persistence of the caste system is religious sanction, based on the ancient texts –the Rig Veda and the *Manu Smriti*.¹¹ However, people who converted to other religions like Christianity and Islam, still kept their caste even though their new religion did not have any notion of caste.¹² The racial theory, proposed by (Risley 1892) among others, claims the caste system was a means to prevent racial mixing. But it does not explain the other features of the caste system.

(Nesfield 1885) was a main proponent of the ‘functional’ view of the caste system.¹³ He argues that castes were akin to guilds in function. The ranking of castes depending on how ‘advanced’ in terms of industrial development the occupations they specialized in were. This does not however specify why industrial development would be associated with a purity scale and is inconsistent with evidence showing that castes rise in the rankings with an increase in income without changing their occupation.¹⁴ (Neale 1957) noticed that

¹¹The Manu Smriti is a book of laws written sometime between the second to fifth century B.C. It consists of 2,031 verses that supposedly codify the caste system. The Rig Veda is dated to the second millennium B.C.

¹²see(Searle-Chatterjee and Sharma 1994), (Barnabas and Mehta 1965). (Ballhatchet 1998) examines this in detail for Catholic conversions.

¹³(Ibbetson 1916) was also another proponent of this view

¹⁴see section 5.1.2

the caste system governed the exchange of services.¹⁵ Building on this observation, (Klass 1993) proposes that the solution to the division of labor problem that emerged in India was the caste system.¹⁶ The features helped maintain distinct boundaries and thus monopoly power. But he is unable to explain the purity scale.

One of the best known papers in economics about the caste system is that of (Akerlof 1976). His model of the caste system depends crucially on people's beliefs and is similar to the literature on discrimination ((Becker 1971)). If beliefs are such that a good will be consumed only if the labor used in its production belongs to a certain group. Then, the caste system can be sustained as an equilibrium as firms hire workers on the basis of which group they belong to. His model has hereditary occupations by group, but he gives no reasons for why such beliefs came about. (Lal 1988) uses the shortage of labor brought about as a result of settled agriculture as a reason for these beliefs. This would require the beliefs only to be about agriculture. Evidence however suggests that most occupations are monopolies with agriculture being an exception. Most castes are engaged in some type of agricultural activity. Also, blocking coalitions are possible and the caste system will not survive.

The equilibrium analysis of an institution is a separate from the question of institutional origin.¹⁷ This paper focuses on the former and cannot answer the question – what made equilibria with collective punishments a focal point in South Asia over other, possibly be Pareto-dominant equilibria? On this count, the above explanations may be complementary and provide a reason for why this equilibrium was a focal point.¹⁸ What is possible to say, is that given it appeared, it functioned as an effective means of contract enforcement and its various features facilitated this role.

This paper does not argue that the only economic role of the caste system was contract enforcement. It did have other functions, some guild like in nature and others like mutual insurance (see (Munshi and Rosenzweig 2005), (Roy 2006)). However each of these functions alone cannot account for a coherent explanation of all the features of the system. The contract enforcement role of the caste system is crucial to generate the essential features of the caste system. The informational abilities of the caste required to undertake contract enforcement can also assist in a caste's ability to provide other services like insurance.

In addition, the paper draws on the literature on collective enforcement. (Greif 1989) and (Greif 1993) use collective punishments to explain the success and failure of the Maghribi traders in the 11th century. The traders faced a principle-agent problem with their agents overseas which they solved by collectively punishing errant agents. (Greif, Milgrom, and Weingast 1994) consider the role of the merchant guild in the late medieval period. They argue that the guilds served as a means for the rulers to commit to the security of the merchants. In these models the analysis is about one group of people that uses collective punishments against an individual. A model that consider more than one group of people using collective punishments

¹⁵He states “No contract, no bargaining will account for its structure. It was founded on reciprocity.....Its sanction was religious but its function mainly economic. Each caste was economically entirely dependent upon the performance of their duties by the other group”.(Neale 1957) page 227

¹⁶page 181

¹⁷see (Greif 2006) for a discussion on this

¹⁸There are historical sources that claim that ancient India had a number of ethnic tribes/groups making information sharing in groups a focal point (see (Gadgil and Guha 1993) pp 93). It could be that a strong state enforcement system didn't appear, and so the possibility of following a more western style of enforcement was just never on the menu of options to choose from.

is, for example, (Greif 2002) which models how credit transactions between traders in different localities in medieval Europe were sustained using a collective responsibility system. In a similar vein, (Fearon and Laitin 1996) examine the role of in-group policing to facilitate inter-ethnic cooperation. In both these papers the crucial assumption required is that members of one group cannot individually identify members of another group. This makes collective punishment take the form that members of a defaulter's group are punished at random by the group whose member has been defaulted on. What is new in this paper (as far as I can tell) is looking at a number of groups, each of which uses collective punishments. The groups interact together in a system and individuals are clearly identifiable to all members in the population.

This paper fits into the broader research agenda in Institutional Economics on contract enforcement in societies without an effective legal apparatus (see (Dixit 2004)). It is also related to the literature that studies the role that information sharing in groups may play in development (for example (Banerjee and Newman 1998), (Cornell and Welch 1996)) and the role social networks can play in situations where enforcement may be limited or lacking. (for example (Besley 1995),(Spagnolo 1999)). On a broader note it is related to the literature that argues that legal and contracting institutions are important influences of long-run economic progress (for example: (North 2002), (Acemoglu, Johnson, and Robinson 2001), (Rodrik, Subramanian, and Trebbi 2004))

Abbé Dubois observes, "In India, where the princes and aristocracy live in extreme indolence, attaching little importance to making their dependents happy and taking small pains to inculcate in them a sense of right and wrong, there are no other means of attaining these desirable ends and preserving good order than by the authoritative rulings of the caste system."¹⁹

The paper proceeds as follows: section 2 describes the institutional details and the anecdotal evidence in support of the model's assumptions and implications. That is followed by the model and analysis in section 3 and 4. Analysis and anecdotal evidence of the implications of the model with regards to the main features of the caste system are covered in section 5. In section 6 the model's implications are tested using census data. Section 7 concludes.

2 The caste system

The word 'caste' is derived from the Portuguese word 'casta' meaning race or breed. A 'caste' is hard to define and is distinct from the concept of race, class, ethnic groups, and tribes. The caste system is defined here as a form of social stratification that satisfies a given number of features and a caste (also called subcastes or *jatis*) is the smallest subdivision of society that has all the features of the system. The exact form of the caste system varied over time and place and is also more fluid than is usually thought.²⁰ The set of features used is commonly described as being characteristic of the system. Several sources in the literature (see for

¹⁹(Dubois 1906) (pp33)

²⁰"Viewed at any given moment caste appears fixed and immutable, but this is by no means the case. The process of change is slow and imperceptible, like the movement of the hour hand of a watch, but it is nevertheless always going on" (Gait 1913) page 371

example (Klass 1993), (Dutt 1965), (Blunt 1969), (Ghurye 1961) and (Hutton 1981)) also use a similar set of features. I define a caste as possessing:

1. **Occupational Specialization** : Members of a caste usually followed occupations that the caste had a monopoly over. In addition, occupations were usually restricted to an ‘allowed’ subset.²¹ These restrictions were more to do with what occupations caste members could *not* follow rather than what they had to follow.
2. **Purity Scale**: Occupations were usually ranked on a purity scale. Purity was also associated with self production restrictions the members undertook and the purity of occupations members undertook not to follow.
3. **Hierarchy**: There was a broad ranking of castes based on the occupations and the consumption patterns of its members. This ranking was local and fluid with changes observed over time and place. An individual’s rank was determined by the rank of his caste.²²
4. **Commensality** : Castes placed restrictions on eating and drinking with members of other castes. Actions like accepting food and drink took on a pure/impure value depending on the caste of the person this action was being undertaken with. The commensality restrictions on a caste usually were an indicator on how they ranked in the social hierarchy.²³
5. **Ascriptiveness** : A person’s caste was determined by birth. Caste membership could be taken away, by other caste members, for ‘violation of caste rules’. Marriage was also restricted to members of the same caste. Marriage within a group is termed endogamy. ²⁴

These various features are discussed in greater detail in section 5.1. What follows is anecdotal evidence that motivates the informational assumption of the model and the focus on collective punishments.

2.1 Collective punishment

Collective punishments were an integral part of the institution. Punishments were used either within the caste to punish caste members or across castes to punish consumers from other castes for defaulting on payments. Dubois observes collective punishments across castes in action: “Sometimes one may see, as a result of a caste order, the tradesmen and merchants of a whole district closing their shops, the labourers

²¹ “If we examine the various references to caste in the law books, we find that the need of a clear differentiation of occupations was recognized quite early in Indian history. Indeed, this recognition was a great step in India’s industrial progress. In Vedic times, members of the same family apparently pursued a variety of occupations. ... but later on this elasticity seems to have been gradually restricted and stricter rules enjoined on the choice of occupations..... Not that any change in this respect was totally forbidden; but in every respect, such a departure was clearly recognized as an exceptional practice, only to be pursued when the traditional calling failed.” (Bose 1977) (pp217-218)

²²In modern day India an individual’s status is an amalgamation of his achievements and his caste

²³(Marriott 1965), (Miller 1975)

²⁴That said, within each caste there are many further subdivisions into exogamous groups called gotras. These are usually groups of people that claim to descend patrilinearly from the same ancestor, and the gotra name is usually the name of that ancestor. Members of the same gotra are not allowed to marry each other.

abandoning their fields, or the artisans leaving their workshops, all because of some petty insult or of some petty extortion suffered by some member of their caste; and the aggrieved people will remain obstinately in this state of opposition until the injury has been atoned for and those responsible punished”²⁵.

(Kolenda 1978) gives further evidence of this punishment strategy – “Any rash action on the part of the jajman might leave him boycotted with none of the Sweepers willing to work for him”.²⁶ (Blunt 1969) devotes a whole chapter to caste and occupation and talks about ‘the boycott’. “Since the occupational castes work for members of other castes, it follows that in many trade disputes one of the parties is not amenable to the discipline of the *panchayat* (governing body). In such a case the means used to bring him to reason is the boycott: the *panchayat* would forbid its subjects to work for him, and unless he succeeded in placating them, he would remain unserved. The use of this powerful weapon is thoroughly well understood in India”.²⁷ In (Martens 1912), “The Koshtis of Chanda in 1907 proscribed a certain cloth and yarn seller who had offended some of their members and resolved to outcaste any Koshti who dealt with him”.²⁸ In addition there are the following examples, “Dissatisfied with the rates paid for opium by the Government, [the Bhangi panchayat] summoned a monster panchayat and decided to refuse payment at the prevalent rate and to cease growing poppy, unless the rate was enhanced. In the end the rate had to be raised. The Dhobi’s of Shahjahanpur city boycotted the Kahars because of a dispute. No Dhobi would wash a Kahar’s clothes.”²⁹ (Blunt 1969) states that – “A planter tried to stop cattle-poisoning by insisting his tenants should slash the hides of all cattle that died without obvious cause. The tenants were willing but the Chamars [leatherworkers] refused to allow their women to act for them as mid-wives and the practise had to be stopped. A dancing girl who dismisses her musicians during the marriage season is boycotted by the Miraisi panchayat. A Darzi, once he has cut into a piece of cloth for an employer must be allowed to finish the job. Should he return the cloth with the work unfinished in consequence of some dispute, no other Darzi will be permitted to finish it, except with the leave of the original Darzi.”

Collective punishments were used in many ways and not just to punish individuals for trade disputes but to maintain within caste discipline. Outcasteing was a punishment extended by the caste *panchayat* on one of its members. It was tantamount to denying the outcaste access to services provided by the caste, be they social or economic. When the person is outcasted, all contact with members of the caste is cut-off. He could try for readmission into his caste, but in some cases that was not allowed.³⁰ The reasons for why a caste members were outcaste varied widely across castes, regions and time.³¹

²⁵ (Dubois 1906) (pp33)

²⁶ page 50

²⁷ page 243

²⁸ page 239

²⁹ page 342-3

³⁰ “It is a kind of social excommunication, which deprives the unhappy person who suffers it of all intercourse with his fellow creatures. It renders him, as it were, dead to the world and leaves him nothing in common with the rest of society. In losing his caste, he loses not only his friends and relations, but often his wife and children who would rather leave him to his fate than share his disgrace with him. Nobody dares to eat with him, or even offer him a drop of water. If he has marriageable daughters nobody asks them in marriage and in like manner his sons are refused wives. He has to take it for granted that wherever he goes he will be avoided, pointed at with scorn, and regarded as an outcaste.” (Dubois 1906) pp38

³¹ The interested reader is referred to (Gait 1913) for a broad discussion on outcasteing.

2.2 The informational role of the caste

The first major assumption in the model is that individuals have access to better information about their caste members than on other members of the population. It is difficult to give direct evidence of better information, but indirect evidence is ample. (Munshi and Rosenzweig 2005) show that caste networks provide mutual insurance to its members. This they add may be a reason why spatial mobility is so low in rural India, since mobility is associated with losing access to the network. (Wolcott 2006) provides further evidence using textile strikes in the Bombay Presidency 1921-38. She finds that Indian workers seemed to cooperate more effectively than the highly unionized English and U.S. labor force. She attributes this to the ability of castes to insure their members against uncertain income streams. Information is crucial for insurance and a caste's ability to provide mutual insurance hints at its informational capabilities.

(Hutton 1981) points to the superior informational abilities of the castes on the legal front. He notes that "Caste panchayats will generally be very much more likely to know the true facts of offences their castemen have committed than the ordinary law courts are"³². (O'Malley 1932) says " caste councils exercise a close control of the members of their community and keep up a pretty strict discipline. The limits for which they are constituted are small enough for neighbours to know fairly accurately all that goes on".³³

As (Marriott 1950) notes "The ethnic segmentation of caste within the village of Kishan Garhi is partly expressed by the tendency of the local caste groups to separate their residential houses spatially from those of other caste groups as far as possible and to consolidate their areas of residence"³⁴ and again "Wherever they must live, however, and whoever they must live next to, members of the same caste group usually manage to locate their doorways as close as possible to their own caste fellows"³⁵. If one believes that a person has better information on his neighbors, then choosing to live in close proximity implies better information on caste members is valued. (Gough 1960) further expands on this in the case of the Brahman caste. "The Brahmans exhibit a high degree of internal interaction and external exclusiveness. As kinsfolk, they invite each other to feasts of boys' initiations, marriage, death and ancestral rites... Houses are built with walls adjoining; holes in the walls permit women to pass messages to each other. Children are socialized within the street and until the age of five do not mingle with those of other castes."³⁶

One reason for the formation of new castes was geographical mobility.³⁷ As groups of caste members migrated to different areas in search of work, they ended up forming separate castes. This usually happened when they moved far enough such that information transmission between the groups became difficult. Calling a caste council meeting to judge and enforce their rulings became increasingly difficult the further away the members of the caste moved. This again hints that the information role of the caste was important.³⁸ The informational role of the caste is well understood but has not been used directly to try to explain caste.

³²(page 104)

³³(page 49)

³⁴(Marriott 1950) page 88

³⁵(Marriott 1950) page 89

³⁶(page 35)

³⁷Different from (Munshi and Rosenzweig 2005) who deal with individual mobility

³⁸((Blunt 1912) page 349)

2.3 Information collection and transmission

Information was collected and transmitted through a body called the *caste panchayat*. The exact details of how the *panchayats* worked varied across India. For example, the punishable offences which they deliberated on depended on the strength of the caste system and the local variation of the caste system. Some castes had a permanent *panchayat* and some had to be specially convened every time it was needed. The composition of the *panchayat* could vary from five members to the entire caste.³⁹ (See (Gait 1913), (Blunt 1969) and (Hayden 1999) for further details.) In general, the person who wanted to report a deviation had to make sure that the whole caste and the *panchayat* convened. Evidence was brought by both sides and weighed. If the default was verified, the *panchayat* announced the punishment and since all the caste members were present at the meeting they were aware of the ruling. Thus the information was collected and disseminated to the entire caste. Caste members were forced to attend such meetings on pain of punishment.

The Census of India 1911 has the most detailed information on the workings of the *caste panchayat*. They give detailed accounts from all parts of India. In general, the councils enforced their authority using two types of punishments⁴⁰:

1. **(Within caste enforcement) Fines, Outcasteing-** this was done by caste councils for violations of caste rules- these could be disobeying commensality, marriage, social restrictions, cheating on caste members, following impure occupations etc.⁴¹. Under some circumstances readmission was allowed after certain ‘purification’ actions were undertaken.
2. **(Across caste enforcement) Collectively punishing individuals who default on a payment:** This type of punishment, involved members of the producer’s caste refusing to provide services to the defaulting consumer and his offspring until the wrong had been righted.

Village *panchayats* to resolve inter-caste disputes, do get mentioned in the *Manu Smriti*, their function being to decide on social, religious, economic and administrative questions on which the *Manu Smriti* is silent.⁴² But even as of 1911, they were relatively rare.⁴³ (Hayden 1999)⁴⁴ has a fuller discussion on these *panchayats*. The punishments they used were fines and collective punishment by the village. Outcasteing by the whole village meant that the guilty party was cut off from all forms of social and economic interactions with all people in the village. This, Dumont also points out was not seen very often.⁴⁵

It should be stressed here that the *caste panchayat* ruled on the basis of consensus. There was no external legal code to govern judgements.⁴⁶ It took into account the opinions of all the caste members and only when

³⁹ “Some castes require a unanimous decision, others are satisfied with the decision of a majority: generally the permanent officials must be unanimous, and agree with the majority of the brethren present. The permanent officials decide the verdict and sentence which is announced by the headman.... and if he refuses to submit to his sentence he is outcasted till he does” (Blunt 1969) (pp 113)

⁴⁰ For further information the reader is referred to the various reports, in particular to (Desai 1911), (Blunt 1912), (Gait 1913), (Latimer 1912), and (Martens 1912). In addition (Hayden 1999) looks at the working of the *caste panchayat* of a nomadic caste in detail

⁴¹ only caste council can outcaste/reinstate- see (Hutton 1981)

⁴² See (Van de Sand 1976) for details on village *panchayats*

⁴³ Census of 1911 Vol I page 395

⁴⁴ page 155

⁴⁵ “No village *panchayats* as a permanent institution as distinct from *caste panchayats*” Dumont (1970) (pp172)

⁴⁶ “There has been no legal code neither has there been any record of legal usage” (Dubois 1906) pp654

a consensus was reached did it pronounce a verdict and the appropriate punishment. The decisions were usually not recorded on paper but were verbally issued. “The control of the caste panchayat ... is, as a rule, very efficient, and the outside community responds to its decisions and wishes. An offender usually finds himself unable to elude them, as the caste can make his life a burden to him”.⁴⁷

3 Model

Using the anecdotal evidence in the previous section to motivate the main assumptions, this section lays out the model

3.1 Primitives of the game

Consider an economy with measure N of infinitely lived agents, indexed by $i, j \in [0, N]$ distributed among C (finite) castes. Each person’s caste is denoted by $c_i \in C$, and the size of each caste is denoted by n_c , $\sum_c n_c = N$. Each individual takes his caste as given and once assigned to his caste, he cannot change it. This is equivalent to assuming the ascriptive nature of castes.⁴⁸ Time is indexed by $t = 0, 1, 2, \dots$. The discount factor between periods is given by β . At the beginning of the game, $t = 0$, each agent i chooses an occupation from a set of occupations of measure K , denoted by $k_i \in [0, K]$, $K < N$. Person i ’s occupation, once chosen, is fixed for all periods $t \geq 1$. Think of some irreversible investment in occupational skills that cannot be changed once invested.

From $t \geq 1$, people engage in service trade. Each person in this economy is a *producer* as well as a *consumer* of services. The strategies available to each person in his various roles are as follows:

1. *Producer* i of service k , if asked by consumer j , supplies him with k . He chooses the effort level with which he will provide the service – denoted by $e_{ij}^t \geq 0$. The cost of providing the effort is denoted by $c_k(e)$. The benefit (quality) of the service to the consumer depends on the producer’s effort and is denoted by $b_k(e)$. Effort is observable.
2. *Consumer* j at every period $t \geq 1$ demands exactly one unit of a randomly chosen service $x_j^t \in [0, K]$ – each service has the same probability of being chosen.
 - The consumer then has two choices, he can buy the service from a producer of that service ($y_j^t = 0$), or he can perform the service for himself ($y_j^t = 1$). Performing the service by himself gives him a utility of d . On the other hand, if he decides to buy the service he chooses a producer, say i_j^t , from all the producers who could potentially supply him with service x_j^t , i.e. $i_j^t \in \{i : k_i = x_j^t\}$. The total utility from obtaining service k from a producer who provides effort level e is denoted by $u_k(e)$.
 - *After* the service is provided, consumer j makes a payment w_{ij}^t to the producer. Assume for simplicity that the consumer can pay what is called a contractual payment, or default. If the

⁴⁷(Martens 1912) quoted in (Gait 1913) age 390

⁴⁸This assumption is relaxed later on in section 5.6

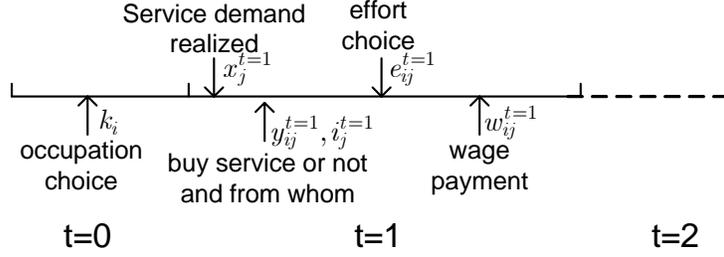


Figure 1: Timing of the game

consumer decides to default, then $w_{ij}^t = 0$. If consumer j decides to pay, then the producer, who provides effort e gets a constant markup ($\mu > 1$) of his cost as his wage

$$w_{ij}^t = w_k(e) := \mu c_k(e) \quad (1)$$

The timing of the game is summarized in figure 1. At time 0, each individual chooses an occupation. At the beginning of each period $t > 0$, Nature randomly chooses with equal probability a service demanded by each consumer. The consumer then decides to produce the service by himself, or buy it from someone else. If he buys it, he chooses a producer who then chooses the effort level used in the production of the service. After the service is provided, the consumer decides whether to pay the producer his wage or to default.

A strategy of player i is a tuple

$$\sigma_i = \left(k_i, (e_{ij}^t)_{j \in [0, N]}^{t=1, \dots, \infty}, (y_j^t, i_j^t, w_{ij}^t)_{j \in [0, N]}^{t=1, \dots, \infty} \right) \quad (2)$$

They are functions of player histories and the random realizations of services required every period.

In order to simplify the analysis, assume the following regularity conditions:

Assumption 1 $c_k(0) = b_k(0) = 0$. For $e \geq 0$, $b_k(e)$ and $c_k(e)$ are increasing with e .

A producer's profits are given by

$$w_k(e) - c_k(e) = (\mu - 1) c_k(e)$$

and are increasing in the producer's effort provision. The producer will always prefer to provide the maximum effort possible (subject to the consumer's incentive compatibility constraint).⁴⁹ Assume that the consumer's utility from consuming service k from a producer with effort level e is given by:

$$u_k(e) = b_k(e) + \mu c_k(e) + d \quad \text{for } e > 0 \quad (3)$$

This makes the net utility to the consumer equal to:

$$u_k(e) - w_k(e) = b_k(e) + d. \quad (4)$$

⁴⁹This assumption is made for simplicity. It can be relaxed and the main results still hold.

Thus, among two producers with the same occupation a consumer prefers to go to the one who provides a higher effort as it gives him a higher utility. As long as the producer provides an effort level that is above 0, the consumer strictly prefers to buy the service rather than to provide it himself. Total surplus in this economy is a sum of producers' profits and consumer utilities:

$$\text{Surplus} = E \sum_{t=1}^{\infty} \beta^t \frac{1}{K} \int_k \int_j [(1 - y_j) (b_k (e_{ij}^t) + (\mu - 1) c_k (e_{ij}^t)) + d] dj dk$$

3.2 Information

At the beginning of period t , each individual m in the economy knows the caste and occupation of every other individual in the economy. He also observes his own entire history as a *producer* – he knows the identities of all his consumers till now and whether or not they have defaulted on him before. In addition he observes his entire history as a *consumer* – he knows all the identities of the players that wanted to provide him a service, identities of these who actually performed the service, their effort levels and whether he defaulted on them. Being a member of a caste has informational advantages. Assume that the individual also has access to the information sets of the other members of his caste.

Assumption 2 (Role of the Caste) *At time t , each member of the caste c , considering trading with consumer j , observes a signal $H_{j,c}^t \geq 0$. That signal summarizes the results of consumer j 's past interactions with the members of caste c . If consumer j has ever defaulted against any member of caste c , then he observes $H_{j,c}^t = 1$ (that is, group knowledge says that he has cheated on some producer in his caste in the past). If consumer j 's record with caste c is clear, he observes $H_{j,c}^t = 0$. Assume that producer i does not observe anything else about the transactions of consumer j (in particular, his dealings with members of other castes).⁵⁰*

3.3 Payoffs

Suppose that each player i follows strategy σ_i (as in 2). Producer i 's lifetime expected profits are equal to

$$E \sum_{t=1}^{\infty} \beta^t \sum_{j:i=i_j^t} (w_{ij}^t - c(e_{ij}^t)) \quad (5)$$

Recall that the net utility of consumer j is given by equation (4). It depends on the effort provision by the producer. The lifetime expected utility of consumer j is equal to:

$$E \sum_{t=1}^{\infty} \beta^t [(1 - y_i) [b_k (e_{ij}^t) + w_i (e_{ij}^t) - w_{ij}^t] + d].$$

⁵⁰This is equivalent to assuming that individuals have information on a consumer's transactions with other castes, but cannot enforce collective action with non-members.

4 Equilibrium

I now show the caste system is an equilibrium (sequential equilibrium) that does in fact sustain trade in services. The equilibrium concept used is *sequential equilibrium*. Since information is shared within the caste and not between castes, producers have incomplete information on their consumers. As will be seen later, this matters in the case when producers perform an occupation that is not unique to their caste and their effort choice will depend on their beliefs. Due to this incomplete information, the usual sub-game perfect Nash equilibrium concept cannot be used. However the equilibrium will be essentially equivalent to a sub-game perfect Nash equilibrium, since beliefs do not play an important role.

An *equilibrium* is (a) a profile of strategies and a system of beliefs (σ, μ) for each player, such that strategy profile σ is sequentially rational given beliefs μ and (b) there exists a sequence of completely mixed strategies $\{\sigma^k\}_{k=1}^{\infty}$ with $\lim_{k \rightarrow \infty} \sigma^k = \sigma$, such that $\mu = \lim_{k \rightarrow \infty} \mu^k$, where μ^k denotes the beliefs derived from strategy profile σ^k using Bayes' rule. (see (Kreps and Wilson 1982))

Focus on equilibria which have the following strategies:

Collective Strategies:

- *Producer i – the effort level provided to consumer j depends only on the information about j in i 's caste c and does not depend on j 's identity (i.e. caste or occupation). If j has ever cheated on any one in caste c before he will be provided with zero effort:*

$$\begin{aligned} e_{ij}^t &= e_i^* \text{ if } H_{j,c}^t = 0 \\ e_{ij}^t &= 0 \text{ if } H_{j,c}^t = 1 \end{aligned}$$

where e_i^* is the maximum effort level that satisfies j 's incentive compatibility constraint.

- *Consumer j pays producer i for services only if i belongs to a caste with which j has a clean record*

$$w_{ij}^t = \begin{cases} w_k(e_i) & \text{if } i \in c \text{ and } H_{j,c}^t = 0 \\ 0 & \text{otherwise} \end{cases}$$

- *(Clean slate): All consumers have clean records at time $t = 0$: for all j , all c , $H_{j,c}^0 = 0$.*

This class of strategy profiles uses grim trigger strategies. A producer only provides a consumer with positive effort if the consumer's record with the caste is clear. Producer strategies are stationary in time and only change when their information on the consumer changes. The only thing that matters to the producer is the consumer's past record with the producer's caste. Consumers only pay producers if their record with the producer's caste is clear. To see that an equilibrium in this class exists at all, simply set $e_i^* = 0$ for all i .

4.1 Equilibrium in the exchange of services subgame $t \geq 1$

The consumer will always find it profitable to buy the service if he finds a producer willing to supply him with positive effort. Since his utility is increasing in the producer's effort he randomly chooses from amongst the producers willing to supply him with the highest effort. Let

$$e^*(k) := \max_i \{e_i^t : k_i = k\}$$

denote the highest possible effort exerted in equilibrium by producers with occupation k . A producer is said to be *active* if his effort is equal to $e^*(k_i)$. After the producer supplies the service, the consumer has to choose between paying the producer for services received or defaulting on him. The benefit from default is the wage that the consumer gets to keep. If the consumer chooses to default, then based on the strategies of the producers in the caste, members of caste c , will never provide him with a service again. The defaulting consumer loses access to the services unique to caste c . In addition, for non-unique services, if caste c provides a higher effort than the other producers of the service, he loses the difference. This is what is called the *bargaining power* of the caste which is denoted by:

$$B_c := \sum_{s=1}^{\infty} \beta^s \frac{1}{K} \int_{k \in K_c} \max\{b_k(e(k)) - b_k(e_{q'}(k)), 0\} dk$$

Where $e_{q'}(k)$ is the highest effort exerted in equilibrium by producers with occupation k not in caste c

$$e_{q'}(k) := \begin{cases} \max_i \{e_i^t : k_i = k, i \notin c\} & \text{if } k \neq K_c^{\text{unique}} \\ 0 & \text{otherwise} \end{cases}$$

and K_c^{unique} denotes the set of occupations unique to caste c . Occupation k is *unique* to caste c , if (a) there is a producer with occupation k in caste c and (b) there is no producer of k outside that caste. The consumer will pay only if his incentive compatibility constraint holds.

$$w_k(e(k_i)) \leq B_c \quad (\text{Consumer's IC})$$

The producer has to choose the effort level he will provide each consumer that approaches him. His strategy prescribes providing the maximum effort such that the consumer's incentive compatibility constraint holds with equality to a consumer who has a clear record with his caste. Consider a producer thinking of a one-period deviation and providing positive effort to a consumer that has cheated on a member in his (producer's) caste before. In this case, next period, even if the consumer pays the producer he (consumer) will not receive services from the caste as the other producer's strategies remain unchanged. Since there is no punishment for non-payment, the consumer will not pay the producer and this deviation is not profitable for the producer.

The other possible deviation concerns the effort level provided to a consumer who has a good record with the producer's caste. Producer profits are increasing in the effort he provides. He would like to provide as high an effort level as possible. The problem with increasing effort is that it increases the consumer's benefit

from default, making the consumer more likely to default. Providing an effort level less than e_i^* (which makes the consumer's incentive compatibility hold with equality), will not be a profitable deviation as producer profits are increasing in effort. On the other hand providing an effort level that is greater than e_i^* , will cause the consumer's benefit from cheating to be larger than the punishment and the producer will not get paid. This again is not a profitable deviation.⁵¹

Only the producer has imperfect information about the consumer. The uncertainty is about the consumer's history with other castes. This has a bearing on the consumer's outside options and hence the bargaining power of the caste, which in turn affects the effort level producers can supply. Consider a caste c that offers service that can also (only) be obtained in another caste c' . If the consumer cheats on c' then the service becomes unique to c , adding to its bargaining power. A sequential equilibrium has to specify beliefs in this case.

Consider the beliefs of active producers. If the consumer has not cheated, the producers best response would be to provide effort consistent with the usual bargaining power of the caste. If on the other hand the consumer has cheated on the other castes providing the same service, then the producers best response would be to increase the effort he provides till it is consistent with the new bargaining power of the caste. As the producer is unable to distinguish whether the consumer has cheated on other castes, he has to assign probabilities. Since the consumer's strategy is to pay the producer if his incentive compatibility constraint holds, the producer believes with probability 1 that the consumer has not cheated on other castes in the past.

If a producer who is not active (non-active) is approached by a consumer, he again has to form expectations about the consumer's history with the active producers of the service. If he believes that the consumer has not cheated on the active producers then he provides an effort level that is consistent with the bargaining power of his caste (lower than the active producers). If he believes the consumer approaches him because he has cheated on all the active producers then he can supply a higher effort. Conditional on the consumer approaching him, he has to assign probabilities to the above events. Since the consumer's strategies are specified such that their best response is to pay producers, non-active producers assign probability 1 to the event that the consumer has not cheated on the active producers and has approached them by mistake. As can be seen beliefs do not play an important role in the analysis of the equilibrium.

The set of producers willing to supply consumer j with service k is denoted by:

$$P_j^t(k) = \{i : \text{if } k_i = k \text{ and } i \in c \text{ s.t. } H_{j,c}^t = 0\}$$

Proposition 3 (service subgame) *The following strategies are an equilibrium in the service trade subgame.*

⁵¹This is not a principle agent problem where the producer needs to be given an incentive to provide effort. The producer's effort provision is only limited by the consumer's IC constraint.

- Consumer's strategies are

$$\sigma_j^C = \left(\begin{array}{l} y_j^t(k) = \left\{ \begin{array}{ll} 0 & \text{if } P_j^t(k) \neq \emptyset \\ 1 & \text{otherwise} \end{array} \right\}, \\ i_j^t(k) = \left\{ \begin{array}{l} \text{uniformly distributed across all producers} \\ \text{willing to supply } j \text{ with the maximum effort} \end{array} \right\} \\ w_{ij}^t(k) = \left\{ \begin{array}{ll} w_k(e_i) & \text{if } H_{j,c}^t = 0 \\ 0 & \text{otherwise} \end{array} \right\} \end{array} \right)^{t=1, \dots, \infty}$$

- Producer strategies are

$$\sigma_i^P = \left\{ \left(e_{ij}^t = \left\{ \begin{array}{ll} e_i^* & \text{if } H_{j,c}^t = 0 \\ 0 & \text{if } H_{j,c}^t = 1. \end{array} \right\} \right)_{j \in \{1, \dots, N\}} \right\}^{t=1, \dots, \infty}$$

where e_i^* satisfies the consumer's incentive compatibility constraint with equality

$$e_i^* : w_k(e_i^*) = B_{c_i}$$

- Beliefs for the producer on consumer j are $\mu = \{\text{with probability } 1, j \text{ has not cheated on other castes}\}$

Proof. See discussion above ■

There are simple corollaries to this analysis:

Corollary 4 (positive effort) *If there is at least one producer $i \in c$, who exerts positive effort, there must be at least one occupation such that $b_k(e(k)) - b_k(e_C(k)) > 0$.*

Proof. The corollary is straightforward given the incentive compatibility constraint (equation Consumer's IC). If caste c , does not have any bargaining power, then the right hand side of the constraint is equal to 0. But it means that the left hand side has to be equal to 0 and $w_k(e_i^*) = 0$ for any producer i $k_i = k$. But this means that $e_i^* = 0$. ■

Corollary 5 *Wages of producers in the same caste in any equilibrium (regardless of their occupation) must be the same and equal to the bargaining power of the caste.*

Proof. Equation (Consumer's IC) is the same for all producers regardless of their occupation in a caste. In equilibrium, based on the producer's strategies, the equation will be satisfied with equality. Hence wages for all occupations in a caste will be equal as they will have the same punishment power at their disposal. ■

Definition 6 *An equilibrium is efficient if it maximizes the surplus across all equilibria of the game with collective strategies.*

The analysis so far as only been for the time periods $t > 0$. However, at time $t = 0$, every individual has to make an occupation choice. In the following subsection, that choice is examined.

4.2 Occupation choice at $t=0$

At $t = 0$, each agent has to make an occupation choice. He knows the caste he belongs to and he knows how the service trade game will evolve. His decision to choose an occupation will depend on his potential profits. The expected demand for each service is $\frac{N}{K}$. Assume that the demand each period is shared equally by all active producers of the service. All active producers provide the same effort level e_k^* . If there are n_k active service producers of service k , then the producer's expected profits are:

$$\frac{1}{1-\beta} \frac{N}{K} \frac{1}{n_k} (\mu - 1) c_k (e_k^*)$$

The occupations with the highest $\frac{c_k(e_k^*)}{n_k}$ will be the most attractive. That depends on two factors; the effort the producer is able to supply and the number of producers he has to share the demand with.

Consider the occupation decision of individual i belonging to caste c . When making his choice he takes the occupations of all the other members of the population as given. The other players' occupational choices determine which occupations are unique to each caste and hence the bargaining power of each caste. The effort the producer supplies is determined solely by the consumer's incentive compatibility constraint. From proposition 3, e_k^* is chosen such that the consumer's incentive compatibility constraint holds with equality. This makes $c_k(e_k^*) = \frac{B_c}{\mu}$. The higher the bargaining power of his caste, the higher his effort and profits.

For i , the occupations he can follow are all those followed by castes with bargaining power less than or equal to the bargaining power of his caste. He can not choose an occupation that is unique to c' with a higher bargaining power than c , because he will not be able to provide enough effort to get consumers. The punishment power of his caste will be insufficient for him to match the effort levels of the service providers in c' , which means that no consumer will approach him (he will not be active). From amongst these occupations, he chooses the one that gives him the highest profits.

If all castes are required to provide positive effort in equilibrium, it puts an additional constraint on the equilibrium. It requires not only that each caste have positive bargaining power, but also that the bargaining power is the same for every caste. Going back to i 's choice, he will be able to choose an occupation that is unique to a caste with lower bargaining power c'' as he will be able to provide at least as much effort as service providers in c'' can. In particular he will be able to provide a strictly higher effort level and thus will steal all the consumers away from caste c'' , their producers becoming non-active. He is able to do so by free-riding on the bargaining power of his caste. This is therefore not an equilibrium because the other member of c will have similar incentives to change their decisions. Without any restrictions on occupation choices by caste, this leads to the only sustainable equilibrium being one where the bargaining power is equal across castes.

As corollary (5) shows, wages for each occupation within a caste will be the same. However, since bargaining power is equal across castes, the wages for all occupations will be the same. Differences in profits across occupations will be due to differences in expected demand which depend on the number of producers in each occupation. The profits across occupations within a caste, have to be equal otherwise caste members

will have an incentive to change their occupation. Similarly, across castes, profits have to be equal otherwise people will have an incentive to change their occupation even though bargaining power is equal. This leads to occupations having the same size in equilibrium.

If bargaining power is equal across castes it implies that all the producers of service k , whether or not they are in the same caste provide the same effort level. This makes the bargaining power of the caste only depend on the unique occupations of the castes (K_c^{unique}). The non-unique occupations can be obtained with exactly the same effort level outside the caste:

$$B_c = \sum_{s=1}^{\infty} \beta^s \frac{1}{K} \int_{k \in K_c^{\text{unique}}} b_k(e^*(k)) dk$$

The surplus in this case is characterized purely by the effort levels and is given by:

$$\frac{1}{1-\beta} N [b(e^*) + (\mu - 1) c(e^*) + d]$$

Proposition 7 *With subgame strategies as given in proposition 3, in any equilibria with positive effort provision in every caste, occupations have to be allocated to castes such that the bargaining power is equal across castes. The number of producers providing each service will be the same for all services.*

Proof. See argument above ■

The restriction that bargaining power has to be equal across castes, eliminates a number of equilibrium. In reality, bargaining power of castes may change over time. This makes the system very fragile and unlikely to survive. Section 5.4 examines the role restrictions on occupation choice by caste can play to allow for unequal bargaining power in equilibrium.

4.3 Renegotiation

Grim trigger strategies are not necessary to generate an equilibrium. The reason for focusing on them is because they are the strongest punishment strategies available as well as the simplest to deal with. Since the goal is to build a simple model to better understand the caste system, I choose to focus on grim trigger strategies. The equilibrium obtained, as with any equilibrium that uses grim trigger strategies, is not renegotiation proof.

In the game, the consumer has a choice as to which producer he would like to obtain service k from. When the consumer has more than one producer willing to provide the service bilateral trade will not be sustainable. For bilateral punishment to be sustainable, there has to be some probability that the consumer will return to the producer he has defaulted on. When the consumer has other options he will not return and bilateral trade cannot be sustained.

However, if the consumer has defaulted on a particular caste, then since no one in that caste is willing to trade with him, it opens up the possibility of side-deals in the occupation unique to the caste. A producer has an incentive to do a deal with the consumer who has defaulted. His threat to ensure that the consumer pays is bilateral punishment – refusing to deal with him anymore if he defaults. In this case, the consumer cannot obtain the service from anywhere else and so does not have any other options, making bilateral punishments sustainable.

The consumer’s payoff from default is that he gets to keep the wage. Whether he defaults or not, he is still punished by the other members of the caste as their strategies remain unchanged so in both castes he will be denied access to the services unique to the group, except by the producer considering a side-deal. If he does not default on this producer he gets access to the service in the future. If he does, he is denied access. The consumer’s incentive compatibility constraint will be:

$$w_k(e(k_i)) \leq \sum_{s=1}^{\infty} \beta^s \frac{1}{K} [b_k(e(k_i))]$$

The producer chooses his effort level so as to ensure the consumer’s incentive compatibility constraint holds with equality. The consumer is willing to pay for the service because if he defaults he will not get access to the service. Now the producer’s punishment power is restricted to just the service he provides, making the effort level (and his profits) not higher than in the case when the consumer has not defaulted. However, it is still higher than not providing the service to the consumer at all and thus he has an incentive to do a side-deal. This undermines the punishment power of the group which rests on denial of service to the defaulter and needs to be controlled. One way to get the producer not to indulge in side deals is to punish any side deals. The caste as a whole has an incentive to punish members indulging in side-deals.

This is not formally modeled but discussed informally, drawing on anecdotal evidence. (Greif, Milgrom, and Weingast 1994) also face a similar problem in their paper and have dealt with renegotiation in a similar fashion. The information potential of the group can be used here to identify members indulging in side-deals. If a producer is found to be dealing with consumer who has cheated on a caste member before, he can be punished by the group. Depending on how severe this punishment is, side deals can be prevented. This introduces an additional role for the caste. In reality, the punishments ranged from fines, corporal punishment even outcasting in some cases.

Evidence of this can be seen from the following example– “One barber was outcasted for working for a man who had been the customer of a fellow-barber, even though the latter had been dismissed by him; in a similar case the penalty was excommunication for twenty-five years.”⁵² “The Kasera (brass founder) caste expelling a man who tried to steal a march on his fellow castemen by working on a day which the caste had decided to keep a holiday....Poaching on the practice’ of a fellow casteman would be a proper subject for the caste *panchayat* to adjudicate on.”⁵³ (Srinivas 1960) discusses how in Rampura competition was subject to punishment – “Any other Brahmin acting in his place without prior consent might be asked to explain his conduct before the village *panchayat*. The man employing him would also be liable. In such a

⁵²(O’Malley 1932) page 134

⁵³(Hutton 1981) page 89-90

case the *panchayat* would fine the guilty parties.”⁵⁴ There is evidence that caste members in different villages coordinated among themselves to restrict competition and ‘divide their labor in mutually profitable ways.’⁵⁵ In (Blunt 1912) the following examples are provided. “In Ghazipur, two Chamars were fined Rs.10 and Rs. 6 for removing dead animals from the house of another Chamar’s clients: a Chamar woman worked as a midwife for another Chamar client and her husband was fined Rs. 5... There have been similar occurrences in Bahraich.”⁵⁶

This concludes the first part of the paper which sets out the basic model. The problem of sustaining trade in equilibrium is solved using collective punishments. Proposition 9 discusses the equilibrium in the service trade subgame and proposition 7 builds on that to detail occupation choice at $t = 0$.

5 Implications of the model: other features of the caste system

Features of the caste system, namely occupational specialization, purity scale, hierarchy and commensality are used in the definition of the caste system in section 2, but have not been addressed in the model yet. In this section I show that they can be obtained as implications of the model of the contract enforcement.

5.1 Anecdotal evidence

5.1.1 Occupation choice

At the start of the *Manu Smriti*, the occupations assigned to each caste are set out: “ But in order to protect this universe He, the most resplendent one, assigned separate (duties and) occupations to those who sprang from his mouth, arms, thighs, and feet. To Brahmanas he assigned teaching and studying (the Veda), sacrificing for their own benefit and for others, giving and accepting (of alms). The Kshatriya he commanded to protect the people, to bestow gifts, to offer sacrifices, to study (the Veda), and to abstain from attaching himself to sensual pleasures; The Vaisya to tend cattle, to bestow gifts, to offer sacrifices, to study (the Veda), to trade, to lend money, and to cultivate land. One occupation only the lord prescribed to the Sudra, to serve meekly even these (other) three castes.”⁵⁷

Chapter X further expands on these duties and more importantly which occupations are forbidden to each caste. What is important to interpret the results later on is what Manu has to say about castes following occupations that are the domain of other castes. He does make the broad statement that “It is better (to discharge) one’s own (appointed) duty incompletely than to perform completely that of another; for he who lives according to the law of another (caste) is instantly excluded from his own.”⁵⁸ However, he qualifies that with exceptions in the case whereby individuals are not able to subsist by following their caste occupations. He allows castes to follow occupations of castes lower than them but very categorically prohibits them from following the occupations of castes above them. “A man of low caste who through covetousness lives by

⁵⁴ page 43

⁵⁵ (Marriott 1950) page 77

⁵⁶ page 342

⁵⁷ (Buhler 1886) Chapter 1 verses 87-91

⁵⁸ (Buhler 1886) Chapter X, 97

the occupations of a higher one, the king shall deprive of his property and banish.”⁵⁹ Even though a higher caste member may be allowed to perform the occupations of a lower caste restrictions are placed on him to ensure that the occupations are not entirely profitable. If those restrictions are ignored then the upper caste individual is reduced to a lower caste. “ But a Brahmana, unable to subsist by his peculiar occupations just mentioned, may live according to the law applicable to Kshatriyas; for the latter is next to him in rank. If it be asked, ‘How shall it be, if he cannot maintain himself by either (of these occupations?’ the answer is), he may adopt a Vaisya’s mode of life, employing himself in agriculture and rearing cattle. But a Brahmana, or a Kshatriya, living by a Vaisya’s mode of subsistence, shall carefully avoid (the pursuit of) agriculture, (which causes) injury to many beings and depends on others. By (selling) flesh, salt, and lac a Brahmana at once becomes an outcast; by selling milk he becomes (equal to) a Sudra in three days. But by willingly selling in this world other (forbidden) commodities, a Brahmana assumes after seven nights the character of a Vaisya. A Kshatriya who has fallen into distress, may subsist by all these (means); but he must never arrogantly adopt the mode of life (prescribed for his) betters. A Vaisya who is unable to subsist by his own duties, may even maintain himself by a Sudra’s mode of life, avoiding (however) acts forbidden (to him), and he should give it up, when he is able (to do so). But a Sudra, being unable to find service with the twice-born and threatened with the loss of his sons and wife (through hunger), may maintain himself by handicrafts”⁶⁰.

5.1.2 Purity, hierarchy and commensality

The purity scale was a central feature of the caste system. A leading anthropologist on the caste system, Louis Dumont, conceived of Indian hierarchy as “a purely relative non-competitive ranking oriented to a single idea of higher and lower”.⁶¹ Louis Dumont considered the *relative* opposition of pure and impure to be the defining characteristic that kept the caste system together. In his book (Dumont 1970) he says “[caste] rest on one fundamental conception and are reducible to a single true principle, namely the opposition of the pure and the impure. This opposition underlies hierarchy, which is the superiority of the pure to the impure, underlies separation because the pure and the impure must be kept separate, and underlies the division of labor because the pure and impure occupations must likewise be kept separate”.⁶² (Miller 1975) argues that “some occupations are attributed certain polluting qualities and are identified with the pollutability of certain castes associated with them.”⁶³ Occupations are ranked on the basis of purity. The key word being ‘relative’– the pure occupations are only so relative to the occupations at the lower end of the ranking.

In addition to occupations being ranked, castes were ranked too. The rank of a caste had two sources. The first was the number of services they could get someone else to provide for them. The more ‘impure’ services a caste would get someone else to perform for them rather than having to do it themselves, the higher the ranking of the caste. (Kolenda 1978) notes “In Khalapur, the servants saved their high caste jajmans from work deemed to be dirty (the Barber, Laundryman, Sweeper), or manual (Potter and Carpenter), or menial

⁵⁹ (Buhler 1886) Chapter X, 96

⁶⁰ (Buhler 1886) Chapter X, 81-99

⁶¹ (Marriott 1969) page 1166

⁶² (page 43)

⁶³ (page 82)

(Watercarrier)".⁶⁴ This can be seen clearly in cases when castes rose and fell in the hierarchy. (Srinivas 1960) defines 'Sanskritization' as a means by which a low caste tries to raise its ranking by emulating the "customs, rituals, beliefs, ideology and style of life"⁶⁵ of the castes higher in the ranking. He notes that an attempt to move up in the hierarchy is usually preceded by an improvement in the economic or political fortunes of the caste. (Rowe 1968) undertakes a case study of the Noniya caste, a Shudra caste trying to raise their status to that of the Cauhan Rajputs, over North India. He finds that the claim made gains "whenever a group of Noniyas existed whose wealth enabled them to attempt social emulation of the Rajput style of life".⁶⁶ (Gupta 1991) discusses Rowe's study of the Noniya caste trying to raise their ranking to that of Cauhans. "The importance of the economic factor cannot be overemphasized for very often the claims of the well-to-do sections of a depressed *jati* are accepted by the powerful and dominant castes, while the identical claims of their indigent *jati* brethren do not win such acceptance. The prosperous Noniyas, for instance were accepted by the privileged castes as Chauhans but the poorer Noniyas were not accorded similar status".⁶⁷ (Srinivas 1996), based on his study on Rampura, finds that "a caste which is numerically strong and wealthy will be able to move up in the ritual hierarchy if it Sankritizes its ritual and way of life, and also loudly and persistently proclaims itself to be what it wants to be".⁶⁸ (Marriott 1950) discusses how the carpenter caste tries to raise their rank by emulating the ceremonies and lifestyles of the Brahmins.⁶⁹

The second source of purity that affected the rank of the caste was the occupation of its members (O'Malley 1932) says that "One section of a caste having taken up an occupation which is considered more respectable than those followed by other members of the caste, claims superiority on that account, refuses to let its women marry men belonging to other sections, and becomes a separate sub-caste."⁷⁰ (Desai 1911) says "A section of Kohlis left off their traditional occupation of menial labor and took to the making of bricks. They came to be known as Dalwadi or Talvar, that is cutter, because they dug up ponds and made bricks. This new and honourable profession gave them a higher social status and in the course of time, they came to be know as a new caste of Kohlis. Kalal (liquor sellers) were originally Kanbis or Rajputs. Owing to the degrading nature of their profession, they had to separate themselves from the parent castes and formed a new caste of their own".⁷¹

Commensality was usually a means for people to keep track of the ranking of the castes. (Marriott 1965) finds that "residents of both Kishan Garhi and Ram Nagla villages say that they are able to form exact opinions about the relative ranks of castes according to certain ritual interactions—i.e., formalized symbolic gestures between persons of different castes resembling the gestures used in religious worship. The ritual interactions which are said to be most significant for precise ranking are those which concern the giving and receiving of food, and the giving and receiving of a variety of honorific gestures and service"⁷². (Miller 1975) gives evidence of the case when a change in hierarchy is accompanied by a change in commensal

⁶⁴ (page 48)

⁶⁵ page 88

⁶⁶ (page 331)

⁶⁷ (page 132)

⁶⁸ (page 310)

⁶⁹ (page 68)

⁷⁰ (page 32)

⁷¹ (page 244-5)

⁷² (page 16)

relationships.⁷³ More importantly he stresses that the commensal relations are based on a perceived ‘purity/pollution’ basis. Castes that are deemed to be more ‘pure’ find that their food is more readily acceptable and social interactions become easier.

5.1.3 Castes and population sizes

The relation between the size of a village and the number of castes has not been explored in detail in the literature with the exception of (Marriott 1965). In his data description he notices that the number of castes in a village seem to be increasing with population size.⁷⁴ Most of the current literature treats the number of castes as fixed. This is not entirely true as growth of local caste groups due to migration, fission and fusion was a common occurrence.

One reason for the fission of castes was changes in occupation. (Nesfield 1885) examines the fission and fusion of castes on the basis of occupation changes in detail. He gives the example of the “Peshiraj or stone-quarrier, on the sides of the Mirzapur hills, who seems inclined to separate himself from the parent stem of Ahir or cattle-grazer; for it is in the neighborhood of these stone quarries that the Ahir finds woods and pasture for his herds...at Saharanpur, some fruit sellers, whose trade, it may be presumed, has been encouraged by the large public gardens at that station, have separated themselves from the common herd of Kunjras and decorated their small community with the Persian title of Mewafarosh”.⁷⁵ The best sources for evidence of formation of new castes locally are (Gait 1913), (Blunt 1912), (Desai 1911), (Martens 1912) and (Nesfield 1885). (Gait 1913) best summarizes this when he says “When one section of a caste develops peculiarities of any kind— a different occupation, habitat or social practice, more rarely a different religious cult—the tendency is for it to regard itself and be regarded by the rest of the caste, as something different. This feeling grows with time, until at last it, or the main body of the caste, withdraws from the marriage league. The result is a new subcaste, and often, in the end, a new caste. On the other hand, when a section of one caste adopts the occupations characteristic of another, the tendency is for it to be absorbed into the latter.”⁷⁶

5.2 Occupational specialization

This section examines the role that monopolies play in this economy.⁷⁷ Taking occupation choice as given, examine the game in the service trade sub-periods ($t > 0$). The punishment power of the caste depends on how large the set of occupations unique to a caste is. The larger it is, the easier it is to provide incentives for consumer j to pay for services as the bargaining power of the caste is higher. This in turn raises the effort level that producers are willing to supply thus improving efficiency. Define the set of occupations unique for some caste as $K^{\text{unique}} = \bigcup_c K_c^{\text{unique}}$. Proposition 9 below argues that it is more efficient for all producers of service k to be in the same caste— what is called occupational specialization – rather than to be spread

⁷³ page 75

⁷⁴ (Figure 2, page 33)

⁷⁵ (page 91)

⁷⁶ ((Gait 1913) page 371)

⁷⁷ As a reminder we abstract from the pricing effects of monopoly as demand does not vary with prices in this model.

across different castes. This would imply that monopolies in this economy serve to increase the efficiency with which the system can undertake contract enforcement.

As discussed in proposition 7, in equilibrium with equal bargaining power across castes, all occupations will have the same number of producers. With caste sizes fixed and bargaining power equal across castes, asymmetric occupation characteristics (different $b_k(e)$'s) make it difficult to analyze occupation allocation. To simplify matters assume that all occupations are symmetric. This assumption is not necessary, but it simplifies the analysis, keeping the intuition intact.

Assumption 8 (Symmetric occupations) *Assume that all occupations are symmetric, i.e. $b_k(e) = b(e)$, $c_k(e) = c(e)$ for all k*

With symmetric occupations, the bargaining power of each caste is determined by the number of unique occupations it has. Since bargaining powers have to be equal across castes, the maximum number of unique occupations per caste is determined by the size of the smallest caste, n_c^{\min} . If the size of each occupation is the same, then the maximum number of occupations the smallest caste can sustain is $\frac{n_c^{\min}}{N/K}$. With equal bargaining power across castes, the maximum number of occupations unique to some caste is $C \cdot \frac{n_c^{\min}}{N/K}$

Proposition 9 *Consider an equilibrium with symmetric occupations. Given caste sizes, the highest efficiency is obtained by setting $|K_{\max}^{\text{unique}}| = C \frac{K}{N} n_c^{\min}$.*

Proof. We know from proposition 7 that bargaining power has to be equal across castes and occupation sizes are equal. The surplus in this case is characterized purely by the effort levels. Increasing the effort levels will lead to a higher surplus. Equal bargaining power and symmetric occupations implies that the bargaining power of each caste is determined by the number of occupations unique to it, which is the same across castes. The number of unique occupations per caste is bounded above by the size of the smallest caste. For any given distribution of caste sizes, the maximum number of occupations unique to the smallest caste is given by $\frac{K}{N} n_c^{\min}$. This makes the maximum number of unique occupations in the economy $|K_{\max}^{\text{unique}}| = C \frac{K}{N} n_c^{\min}$.

Consider an equilibrium with equal bargaining power across castes such that $|K^{\text{unique}}| < |K_{\max}^{\text{unique}}|$. Compare this to an equilibrium with exactly one extra unique occupation per caste. This is possible as it satisfies the resource constraint on the number of people in each caste. The number of occupations in each caste will have to rise by the same amount, otherwise, as shown in proposition 7 the resulting equilibrium will not have positive effort provision in each caste. Adding to the number of unique occupations in each caste strengthens the incentive compatibility constraint for the consumers of that castes' services allowing producers to provide a service with a higher effort level. In the second case, both consumers as well as producers are better off with higher effort provision. Since surplus depends on effort provision, the second equilibrium is more efficient. The maximum efficiency reachable by this process, given a distribution of caste, is when $|K^{\text{unique}}| = C \frac{K}{N} n_c^{\min}$. ■

The intuition for the proposition above is straightforward – increasing the number of unique occupations per caste serves to increase the deterrence power of the caste. This then allows for a higher effort level by

the members of the caste, which then in turn leads to a more efficient equilibrium. The maximum number of occupations unique to some caste is restricted by the size of the smallest caste. The next corollary shows that having equal caste sizes serves to attain the maximum number of unique occupations.

Corollary 10 *If caste sizes are equal, $|K_{\max}^{\text{unique}}|$ can be expanded to include all occupations. This attains the maximum surplus possible due to occupational specialization.*

Proof. The binding constraint to determine $|K^{\text{unique}}|$ is the size of the smallest caste. It constrains the number of unique occupations for all the castes because of the equal bargaining power condition. The maximum $|K^{\text{unique}}| = C \frac{K}{N} n_c^{\min}$ is reached when $n_c^{\min} = \frac{N}{C}$, i.e. equal caste sizes. ■

The proposition was proved for the special case of symmetric occupations. If occupations are non-symmetric, this reorganization may be restricted by the fact that bargaining power has to be equal across castes, which will prevent the economy from reaching the efficient equilibrium. Section (5.4) discusses the role of purity restrictions that would allow for bargaining power to be unequal across caste allowing improvements in efficiency.

5.3 Castes and population size

So far the model takes the number of castes and the size of each caste as given. This section takes a step back and asks what determines the number of castes and the distribution of caste sizes in a village? Working from the perspective of a social planner, what distribution of castes and people into castes would maximize surplus in the economy? The relationship between population size and the number of castes in a village is also examined.

Suppose belonging to a caste is costly. One could think of this as a cost paid to belong to a group that provides accurate information and coordinates actions, which can then be used to enforce contracts. This gets more difficult as caste sizes increase so it is reasonable to assume that the cost is increasing in caste size. Formally, denote the cost of belonging to a caste by $P(n_c)$. It is increasing in the size of the caste and is paid by every individual at $t = 0$.

Assumption 11 *Assume that being alone costs nothing, $P(0) = 0$, while being in a multiperson caste is costly $P(n) > 0$, for $n > 0$ and $P'(n) > 0, P''(n) > 0$*

Increasing the number of people per caste raises the information costs of belonging. This gives us a force that pushes the economy towards smaller caste sizes (larger number of castes) to minimize the informational cost. On the other hand increasing the number of unique occupations per caste raises the bargaining power of each caste increasing the surplus, pushing towards a single caste with all occupations in it. For a given population size, N , the trade-off between costs and benefits leads to an optimal number of castes that maximizes surplus. The next step is to ask how this optimal number changes if the population size changes.

For simplicity continue assuming that all occupations are symmetric. As corollary (10) noted maximum occupational specialization with symmetric occupations is reached when caste sizes are equal.

Proposition 12 *Assume symmetric occupations. With positive effort provision in each caste, the optimal number of castes is non-decreasing in population size.*

Proof. For a given population size, N , the optimal number of castes is given by the C that maximizes surplus

$$-NP \left(\frac{N}{C} \right) + \frac{1}{1-\beta} N [b(e_C) + (\mu - 1) c(e_C) + d]$$

Consider two population sizes N_H, N_L , and the associated optimal number of castes C_H, C_L respectively. Denote the per-person benefit with C_i castes with N people in the population by $B_i(N)$ and cost by $P\left(\frac{N}{C_i}\right)$ for $i = \{H, L\}$. From the optimality conditions we know that

$$\begin{aligned} B_L(N_L) - P\left(\frac{N_L}{C_L}\right) &> B_H(N_L) - P\left(\frac{N_L}{C_H}\right) \\ \Rightarrow B_L(N_L) - B_H(N_L) &> P\left(\frac{N_L}{C_L}\right) - P\left(\frac{N_L}{C_H}\right) \\ B_H(N_H) - P\left(\frac{N_H}{C_H}\right) &> B_L(N_H) - P\left(\frac{N_H}{C_L}\right) \\ \Rightarrow B_L(N_H) - B_H(N_H) &< P\left(\frac{N_H}{C_L}\right) - P\left(\frac{N_H}{C_H}\right) \end{aligned}$$

Since

$$\begin{aligned} B_L(N_L) - B_H(N_L) &= B_L(N_H) - B_H(N_H) \\ \Rightarrow P\left(\frac{N_H}{C_L}\right) - P\left(\frac{N_H}{C_H}\right) &> P\left(\frac{N_L}{C_L}\right) - P\left(\frac{N_L}{C_H}\right) \end{aligned}$$

If $N_H > N_L$, if $C_H < C_L$ then

$$P\left(\frac{N_H}{C_H}\right) > P\left(\frac{N_H}{C_L}\right), P\left(\frac{N_L}{C_H}\right) > P\left(\frac{N_L}{C_L}\right)$$

With $P(n)$ a convex function and $N_H > N_L$

$$P\left(\frac{N_H}{C_L}\right) - P\left(\frac{N_H}{C_H}\right) < P\left(\frac{N_L}{C_L}\right) - P\left(\frac{N_L}{C_H}\right)$$

This is a contradiction of the optimality conditions. Thus, if $N_H > N_L$, if $C_H \geq C_L$ ■

The proposition above says that the way a population is divided into castes depends on its size. For a given number of castes, a larger population raises the size of each caste. This raises the informational cost. As the number of castes remains the same, the number of occupations unique to each caste remains the same. The benefits of belonging to a caste depends on the number of unique occupations and hence does not change. As this affects the trade-off between benefits and costs of the number of castes, it changes the optimal number of castes. The argument in the proposition was a proof by contradiction and showed that an increase in population size cannot be accompanied by a decrease in the number of castes. From

the optimality conditions the benefit from moving to the optimal number should be bigger than the cost of doing so for a given population size. Suppose the number of castes optimal for the larger population size (C_H) is smaller than that which is optimal for the smaller population (C_L). The optimality conditions would then say that the cost of moving from C_L to C_H with the high population (movement to optimal) would be smaller than the cost of moving from C_L to C_H with the low population (movement away from optimal). However, this is in contradiction to the convex nature of the cost function. If the number of castes is decreasing in population size, due to the convex nature of the cost function, moving from a high number of castes to a low number of castes is more costly with a higher population size. Thus the number of castes is non-decreasing in the population size.

The smaller is the population, the cheaper, in terms of net benefits, it is to set up only a few castes. The larger is the population, the cheaper it is to decentralize the social organization. Given the analysis in the previous sections, in equilibrium, it is expected that castes contain mostly occupations which are caste specific. Hence in this symmetric case, for small populations, it is expected that the number of castes will be small and castes will be highly heterogenous, containing different occupations (however occupations will not be shared across castes). This proposition gives us a testable implication that as the population size increases, for a given set of occupations, the number of castes increases. The assumption about the symmetric nature of the occupation is not a necessary one. This can be proved for a general case, but the symmetric case is simpler and the intuition remains the same.

5.4 Purity scale

This section examines the role of what are called ‘purity restrictions’. There are two parts to this section. The first part explores the role of ex-ante commitments that a consumer can make which reduces his outside option in default. These restrictions will take the form of restraints on self-production of services. Any reduction of the consumer’s outside option serves to strengthen his incentive compatibility constraint which then increases the effort producers provide him. Without explicitly modelling this, the paper describe the form these commitments can take, the role they play and the way they can be made credible.

The second part tackles the problem of equal bargaining power in equilibrium. As discussed in section 4.2 this arises because of the individual’s incentive to free-ride on the bargaining power of his caste. It may prevent the economy from attaining the efficient equilibrium if it involves unequal bargaining power across castes. The second part of this section examines how occupational restrictions by caste allows for unequal bargaining power in equilibrium.

5.4.1 Part I - self production restrictions

Suppose that the consumer ex-ante commits not to perform any service by himself i.e. ex-ante commits to ($y_i = 0$) for all t, k , even in a state of default. When he is not in default he strictly prefers to buy the service if he can find a producer with positive effort. In this case the self production restriction is not important. Where it plays a role is when the consumer is in default. If his commitment is credible, in default when he is denied access to the service his utility is 0. Without this commitment he could perform the service himself

and get a utility of d . The bargaining power of the castes is now:

$$\sum_{s=1}^{\infty} \beta^s \left[\frac{K_c^{\text{unique}}}{K} d + \frac{1}{K} \int_{k \in K_c} \left[\max\{b_k(e(k)) - b_k(e_{q'}(k)), 0\} \right] dk \right]$$

Comparing this to the incentive compatibility constraint without this commitment:

$$\sum_{s=1}^{\infty} \beta^s \frac{1}{K} \int_{k \in K_c} \max\{b_k(e(k)) - b_k(e_{q'}(k)), 0\} dk$$

notice that his outside option in the case of default is lowered. This increase in the bargaining power results in a higher equilibrium effort supply by the producer, which in turn leads to a higher surplus.

Off the equilibrium path the consumer always has the incentive to deviate and such a commitment might not be credible. There has to be a way to enforce this commitment. The caste supplying him with the service cannot enforce this as their power is restricted to service denial. This gives us an additional role for the caste. Not only is the caste able to punish non-payment by outsiders, but in addition it will also punish deviations by its own caste members. Group members have an incentive to punish deviations as these have an externality effect on all the members of the group. Suppose a caste is unable to enforce the restriction with one member. If it is not credible for one member of the caste, it is not credible for all members of the caste. Thus producers of service k , will reduce the effort they supply to *all* the members of the caste (to satisfy the old incentive compatibility constraint equation Consumer's IC). This is the externality effect. This should be incentive enough for group members to punish a deviation if they wish to consume that service in the future.

This assumption that people voluntarily undertake restrictions on their behavior is not unusual. (Berman 2000) shows that in the case of Ultra-Orthodox Jews, people voluntarily restrict their options in order to gain access to the mutual insurance of the group. In his paper, restrictions serve as costly signals to exclude free-riding on an excludable 'club good' (insurance). In the Indian case, people voluntarily restrict their options in order to gain a better quality service. The information potential of the caste is used to enforce these restrictions. These commitments could be justified on the basis of purity – performing a service by himself would make an individual impure, if the caste did not punish him his impurity would be contagious and have an effect on all of them.

5.4.2 Part II - occupation restrictions by caste

As shown in proposition 7 the requirement that all castes have positive effort provision requires that bargaining power is equal across castes. The problem is that an individual has incentives to free-ride on the occupation decisions of his caste members. A free-rider is someone who takes advantage of the high bargaining power of his caste to perform an occupation that is unique to another caste with a lower bargaining power making those producers non-active. If there is some way to restrict an individual's occupation choice to prevent this free-riding, efficiency could be improved. Since the focus is on collective grim trigger strategies, the only threat to deter default is at the group level. In each caste c a free rider $i \in c$ can be identified

by the signal $F_{i,c} = 1$ when $k_i = k$ s.t. $k \in K_{c'}^{\text{unique}}$ for $c' \neq c$ s.t. $B_{c'} \leq B_c$, given the occupation distribution for $N - i$. If he is not a free-rider, $F_{i,c} = 0$.

Outcasting:

The benefit of being in a caste is that when someone defaults, you have recourse to the punishment power of the caste. A person considering default on a member of caste c is threatened with the withdrawal of services by all the members of caste c . Consider punishing free-riders by outcasting them. Outcasting here is simply withdrawing the individual's access to the punishment power of his group. As before, each person in caste c has information on consumer j 's past dealings with its members. However now they only punish j if he has cheated on a producer in the caste who is not a free-rider. When a person is an outcaste, he does not have any credible threat of punishment as he cannot withhold a service that the consumer is unable find elsewhere. This means that the consumer will always default on a person who is an outcaste and thus the outcaste will not be able to earn an income as a producer.

Proposition 13 (purity restrictions on occupation choice) *In the service trade subgame, producers supply j with positive effort only when j has not cheated on any producer i in caste c for whom $F_{i,c} = 0$. The following strategies are an equilibrium.*

- For the producer

$$\sigma_i^P = \left\{ \left(e_{ij}^t = \begin{cases} e_i^* & \text{if } F_{i,c} = 0 \text{ and } H_{j,m}^t = 0 \forall m \in c \text{ s.t. } F_{m,c} = 0 \\ 0 & \text{otherwise} \end{cases} \right)_{j \in \{1, \dots, N\}} \right\}_{t=1, \dots, \infty}$$

where e_i^* satisfies the consumer's incentive compatibility constraint (Consumer's IC) with equality.

- The consumer's strategy is the same as it was in proposition (3) with the exception that

$$\sigma_j^C = \left\{ \left(w_{ij}^t(k) = \begin{cases} w_k(e_i) & \text{if } F_{i,c} = 0 \text{ and } H_{j,c}^t = 0 \\ 0 & \text{otherwise} \end{cases} \right) \right\}_{t=1, \dots, \infty}$$

- Occupations are allocated to castes such that every occupation is unique to some caste and the resulting allocation maximizes surplus.
- Members of caste c randomly choose from occupations unique to their caste.
- The number of producers of each service adjusts such that $n_k = n_{k'}$ if $k, k' \in K_c$
- Beliefs for the producer on consumer j are $\mu = \{\text{with probability 1, } j \text{ has not cheated on other castes}\}$.

Proof. Consider occupation choice at $t = 0$: given the strategies of the other members in the population, members of caste c find it optimal to choose from among occupations unique to their caste.

Consider the strategies in the subgame. The proof that consumer's strategies are an equilibrium is the same as in proposition 3. The change is in his decision to pay a producer. The first possible deviation is for the consumer not to pay a producer in caste c where his reputation in the caste is clear ($H_{j,c}^t = 0$). This is not

profitable as shown in proposition 3. The second possible deviation is where the consumer pays a producer who is free rider. In this case if the consumer defaults on the free riding producer he is not punished. So it not a profitable deviation for the consumer.

Producer: A producer deviating from the prescribed strategy, taking everyone's else's strategy as given can do so under the following cases.

case (i) Producer i who is not a free-rider, deviates by providing a service for a consumer j who has cheated on a producer m in i 's caste and i is not a free rider. As discussed in proposition (3) this one-period deviation is not profitable when the rest of the caste is following their strategies.

case (ii) Producer i who is not a free-rider, deviates by not providing positive effort for a consumer j when the consumer has cheated on a producer who is free riding . In this case, since i is not a free-rider he has access to the punishment mechanism of the caste. That means that the consumer j 's incentive compatibility constraint will hold when dealing with i . If i chooses not to work for j , he's giving up a wage that he would have been paid for, and thus it is not a profitable deviation. The proof for effort choices is the same as in proposition 3.

case (iii) Producer i who is a free-rider, providing a positive effort to a consumer in any status with any caste. In this case, if the consumer defaults, he will not be punished by the rest of i 's caste. As the producer i does not provide a unique service, the consumer can find another provider of the service in another caste. The consumer will always cheat on the free-rider and so the deviation is not profitable.

The proof for beliefs are the same as in proposition 3. Hence the strategy set is an equilibrium in the subgame.

As mentioned above, individuals will not be able to perform services unique to castes with w 's higher than theirs because of insufficient punishment power. Consider a person in caste c , considering an occupation choice. He could technically choose to perform a service k that is unique to caste c' . If he does so, he will be a free-rider at $t = 1$. He will choose an occupation unique to another caste only if the utility from being a free-rider is less than the utility from belonging to a caste. The utility loss from being branded a free rider is the loss of producer utility that the individual would have otherwise been able to sustain.

$$\frac{(\mu - 1)}{1 - \beta} E \sum_{j:i=i_j^t} c(e) > 0$$

As this is a positive net loss in equilibrium it is not a profitable deviation.

Occupations are allocated to castes such that every occupation is unique to some caste. Doing so allows for the maximum possible surplus as discussed in proposition 9. The equal bargaining power constraint no longer applies. Occupations are allocated in such a way to maximize surplus. ■

The result is an equilibrium where caste members are restricted to a subset of occupations and they are punished when they deviate from these choices. The higher the bargaining power of the caste, the higher the number of occupations caste members are prohibited from undertaking on pain of punishment. This leads very naturally into a purity scale, where the occupations are prohibited on the basis that they are considered 'impure'. The higher castes will be the ones with a higher bargaining power who are able to undertake a higher number of restrictions and thus will be deemed more pure.

The justifications for why caste members are prohibited from performing certain occupations are of course many. Why one justification is chosen over the other again is a point is open to debate. I conjecture that Indians for some reason settled on a purity explanation. That is, as a member of a caste, I cannot perform (on the pain of being outcasted) occupations that are unique to a caste with lower bargaining power, because those occupations are deemed ‘impure’. Performing these occupations would make me impure and hence the other caste members would outcaste me for fear of becoming impure themselves. This leads very naturally into a purity scale for castes. Castes higher up in the bargaining power ladder are able to undertake more restrictions on their occupation choices and hence are considered more ‘pure’. Evidence that fear of pollution is what caused outcasteing can be seen in (Hutton 1981)⁷⁸ where he talks about how the fear of contagion of pollution from one person’s impure act, is enough reason for a man to be outcasted: “ the shame which would reflect on the whole caste if one of its individual members went unpunished guarantees that the caste will execute justice, defend its own honour and keep all its members within the bounds of duty.”⁷⁹ For more anecdotal evidence refer to section 5.1.2.

Proposition 13 shows how different bargaining power can be sustained across castes in equilibrium. It is however not resistant to coalition deviations. Consider a deviation where the whole caste extends its punishment power to the free-rider. In this case the free-rider will be able to sustain a higher effort level than the other producers. The other caste members will now be able to obtain the services at a higher effort level and thus the equilibrium will not be sustainable. This free-riding however hurts the caste that produces this service, because their market share falls. These castes have an incentive to punish the free-rider but in the model as it stands they have no way of doing so. In reality unequal bargaining power across castes is sustained and the question is why these coalition deviations do not occur. This is not modeled, but discussed informally as to why free-riding may have a negative externality on the members of the caste. This ensures that coalition deviations are not possible and thus an equilibrium with unequal bargaining power can be sustained. One reason could be spillovers. The larger the number of active producers, the higher the spillovers and the higher the benefit to consumers. Now when a caste member deviates and free-rides, it is true that he will be able to provide a higher effort level, but because of the reduction in the number of producers of the service the overall effect is a lower benefit to the consumer of the service. This affects caste members as a whole and they now have an incentive to punish the deviator and this threat is credible.

5.5 Hierarchy and Commensality

Based on the argument in the previous section, an individual’s purity can be determined from two sources, the first the number of services he commits not to provide for himself and the second the number of occupations he can commit not to perform. Both depend on within-caste enforcement and will be the same for all individuals in a caste. There is a subtle difference in the sources of purity. Occupation choice is a way of making a living by selling a service. Committing ex-ante not to sell a service does not technically prohibit producing the service by oneself. An individual commits not to perform the service by himself in order to decrease his outside option and get a higher effort from his producers.

⁷⁸ (page 104)

⁷⁹ (O’Malley 1932) (page179)

So far, people consume all services. They have to decide whether to buy the service or to produce the service by themselves. As buying the service gives a higher utility the analysis so far assumes that people buy all the services. However, in reality, practical considerations like budget constraints, may make patterns of consumption differ across people. In particular it may not be possible for a person to buy all the services he requires and he may have to produce some by himself. Introducing income considerations raises a dilemma, because income need not be perfectly correlated with wage. Suppose a person in caste c is prohibited from performing occupation k' (belonging to caste c') but cannot afford to buy the service. That means he will have to perform the service himself. But if he considers the service impure, and would be outcasted for not performing the service as an occupation, how does he deal with having to provide the service for himself?

The answer lies in the distinction between the purity levels when I perform the impure act by myself or I perform it for someone else. In the Indian caste system, performing an impure act by myself is considered bad, but performing it for someone else is in essence taking the other person's impurity away which is considered much worse. See section 5.1.2 for anecdotal evidence. A caste is able to sustain beliefs about the occupation being impure and thus not performing it as an occupation but producing it for themselves at the same time is allowed. This leads very naturally into a hierarchy of castes. The hierarchy is dependent not only on the purity of the caste due to their bargaining power, but also on caste income which determines how many 'impure' services they can buy which entails someone 'taking away' their impurities. This is one reason why the income of a caste is correlated with its purity. Evidence of this can be found in the way castes change their ranking in the hierarchy. A rise is usually accompanied by increasing incomes or by dropping impure occupations. See section 5.1.2 for anecdotal evidence. The net resulting purity score determines the relative rank of the caste.

Since hierarchy depends both on purity of occupation as well as income levels that need to be tied into a comprehensive ranking, this brings in a role for commensality restrictions. The commensality rules of the caste help people keep track of the hierarchy of the castes. Commensality rules include restrictions on who a person as a member of his caste can eat or drink with, whom he can accept food from and what kind of food he can accept. As the net impurity of the caste changes for reasons like income changes, this will change its ranking and this is made known to people by changing rules of commensality.

5.6 Choice of caste: ascriptiveness and endogamy

The ascriptiveness of the caste system is one of the most defining features of the system. However, historically, it was not always true that castes and occupations were hereditary. People could freely switch between occupations, but they were removed from their caste if they followed an occupation unique to another caste, and over time joined the caste that claimed the occupation as its unique occupation. (Blunt 1969) discusses how in the early Buddhist times (prior to the 4th century B.C) people could freely switch between occupations and birth into a caste was not a constraint on occupation choice.⁸⁰ "There was nothing more to prevent a Kshatriya from joining a guild, or from 'becoming a Brahmin', than there is at the present day to prevent a peer from joining a business firm, or from taking Hold Orders, he no doubt 'lost his caste' by

⁸⁰Chapter II paragraphs 4 and 5 for example

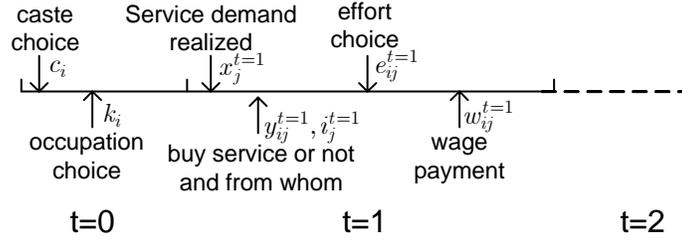


Figure 2: Timing with caste choice

doing so, but till a few years ago, so did his modern equivalent”.⁸¹ Endogamy was also not as important as it became later. “Marriage within the class was no doubt regarded as preferable to marriage without it, but only personal prejudice and social convention stood in the way”.⁸² This did change over time and the Greek visitor Megasthenes in 303 B.C. noticed that occupations were hereditary and marriages took places within castes. “No one is allowed to marry out of his own caste, or to exchange one profession or trade for another, or to follow more than one business”.⁸³ There is nothing in this model that would explain this.

The model so far (except in section 5.3) took the distribution of people into castes and the number of castes as given. This assumed the ascriptiveness of the system. Section 5.3 on castes and population size explored what the optimal number of castes would be for a given population size. However, it kept the assumption that people were assigned into castes by a social planner and could not change it. In this section that assumption is relaxed and people are allowed to choose their caste.

Change the timing of the game such that at the beginning of the game, $t = 0$, each agent i chooses a caste, $c_i \in C$, after which he then chooses an occupation $k_i \in [0, K]$. The choices of castes and occupations are fixed for all periods $t \geq 1$. The subgame of service trade remains the same. The new timing is given in figure 2. Allowing for a caste choice at time $t = 0$, before the occupation choice does not change the model results. All it adds is an additional constraint that producer profits must be the same across castes. So far, all that is required is that the returns to an occupation within a caste be equal. The purity scale explanation restricts the choice of occupation based on the caste’s bargaining power. However, allowing for free entry will equalize profits across castes.

Proposition 14 *Given a number of castes C , consider the equilibrium given in proposition 13. The number of people in each caste is determined by the equal profits across castes condition*

$$\frac{B_c}{n_k} = \frac{B_{c'}}{n_{k'}} \\ \forall k \in c, k' \in c'$$

⁸¹(page 230)

⁸²(page15)

⁸³((Blunt 1969),page 18)

Proof. At $t = 0$, if the lifetime utility as a producer differs across castes (consumers are identical and everyone consumes all services if they are not cheaters), producers will switch castes till they are indifferent to doing so. The rest of the proof is exactly as in proposition 13. ■

In the model, producers are indifferent between castes and consumers buy all services and hence all consumers regardless of the caste have the same utility. Making castes ascriptive in this model does not change the effort sustainable in equilibrium and so does not have any implications for contract enforcement. Even if the timing were changed to allow individuals to change their caste at $t > 0$, as the model stands, there will not be any change in effort by restricting entry or exit.

However, over time entry into castes does become restricted. This could be because there are rents to be had by belonging to a caste that free entry dissipates. Drawing a parallel with guilds, at the start of the system, guilds were not hereditary. Over time due to membership rents they became hereditary groups.⁸⁴ People have an incentive to change their caste only if there are perceived gains to be had by doing so.⁸⁵ From a producer's point of view, one reason why over time one would see incentives for people to change their caste would be if the relative bargaining power of castes changed. This could be due to different benefit functions for the consumers, newer technology, newer occupations etc. This would introduce changes in relative profits and hence an incentive to change one's caste. From the consumer's point of view suppose income considerations are introduced that change over time as in section (5.5). Higher incomes translate into higher utilities and incomes depend on the caste. Even if a free-entry condition from the consumer's point of view holds at $t = 0$, things could change and differences across castes could arise over time. One method this could take place is through the political fortunes of the caste. (Dirks 1993) has an interesting analysis of the political fortunes of the Kallar caste in South India. All these factors could give individuals an incentive to change their caste and occupation at some $t \geq 1$. The ascriptiveness of the caste would be sustained if caste members had an incentive to and were able to restrict entry into their caste. The incentive to restrict entry into the caste could come from two sources: one the increased information costs as discussed in section 5.3. The other is reduced profits by having to share the demand for the caste's occupation with another member.

The method of restricting entry in the model is very similar to the notion of outcasteing discussed in proposition 13. With outcasteing, a caste withdraws access to the punishment power of the caste. This hurts the individual in his capacity as a producer as he does not have a credible threat to deter consumer default. In a similar fashion, to restrict entry, a caste extends its punishment power only to individuals who were in the caste before. Suppose an individual belonging to c wants to join a caste c' . Unless the other individuals in c' extend their caste's punishment power to him, joining c' has no value. In fact, it is a loss as he is unable to sustain any trade as a producer now, whereas if he stayed in c , he could sustain some trade. Belonging to a caste in this model has the natural interpretation that the caste is willing to punish people who default on you. An individual will always find it optimal to stay in the same caste even if he has an opportunity to change his caste, since without access to the punishment power of another caste it is not a profitable change.

⁸⁴(Ogilvie 2004)

⁸⁵ability issues are assumed away in this model

To summarize, the ascriptiveness nature of the caste system is not an intrinsic part of the model and does not affect effort provision. However, it may have been tacked on later because of strategic behavior like attempts to preserve membership rents. The ability of the caste to restrict entry however, follows naturally from the model. If the caste is able to choose which people it extends its punishment power to, entry can be restricted.

This ascriptive nature of the caste system can be strengthened by endogamy. Endogamy is marrying within the group. It ensures that all kin relationships are within the caste. Kin relationships across castes will serve to weaken the strategy of keeping castes separate and could also allow for people to move across castes. Thus endogamy is just a social counterpart to keep the system functioning by keeping castes separate.

6 Empirical Evidence

This section tests the predictions of the model on the relationship between castes and population size. It also considers the relationship between occupation diversity and the bargaining power of the caste. The predictions tested are:

1. Castes and population size: Keeping the number of occupations fixed, an increase in population size will be accompanied by a rise in the number of castes.
2. Occupational diversity:
 - If castes have unequal bargaining power, castes with higher bargaining power have more occupation choices open to them.
 - Larger castes should have occupations with a higher bargaining power or they should have a monopoly over a larger number of occupations.

The model is more appropriate to pre-colonial India, but data from this period that is amenable to testing the predictions are difficult to find. The censuses used are from Tirunelveli (1823)⁸⁶, Cochin (1875) and Mysore (1941). These particular censuses are used because they are the earliest available census that have the appropriate data. The Tirunelveli data is before India was under direct control of the British Crown. Also, both Cochin and Mysore at the time of the census were native states and not under direct control of the British. The model focuses on intra-village trade and the narrowest definition of what constitutes a caste. Testing requires detailed village level caste data that is difficult to obtain. Individual level data was collected, however, due to resource constraints, all census data were presented in reports that tabulated this information. Individual level information has long since been lost.

The Tirunelveli and Mysore censuses are used to test the castes and population size implications. The caste data available are the number of castes and the number of people in the largest castes and detailed economic data for the villages are also available. The 1941 census, though not pre-colonial, it is useful as it

⁸⁶I'm very grateful to David Ludden for sharing his Tirunelveli data

is one of the few censuses with village level data, narrow caste definitions and it also provides some measure of geographic variation.

The occupational predictions are tested using data taken from a report on the census of the native state of Cochin in 1875. It has a breakdown of occupations by caste. Other census undertakings also collected this data but usually prioritized economic information about the region over a detailed breakdown of occupation by caste. In the case of this census, no detailed economic information was available as a revenue survey of the region was yet to be undertaken so the census focuses on caste information. However, a lack of economic data restricts our testing. This data is at the district level. Castes are grouped into 23 categories and the data is for each caste category. This information is also available in the later British Censuses but they are by definition colonial censuses. In addition, the British census information is worse as it is for broader categories of castes, occupations as well it aggregates information over much larger areas.

As the observations in each census are limited, the results should be interpreted with caution. These empirical results should be treated as suggestive evidence only. It is extremely difficult to establish causality in this context due to the paucity of data and instruments. It should be seen more as checking for patterns in the data – Are the implications of the model consistent with the patterns in the data? One general caveat about data on caste in general is that the data are noisy because of people’s confusion regarding the degree of specificity required when answering the caste question, confusion by the census enumerators and other problems (see (Barrier 1981)).

6.1 Occupational Specialization

Data description

This part uses data from the 1875 census of Cochin. The purpose of the Cochin census was to update information on the condition of the people. In particular it focused on age, occupation, education, infirmities, caste and religion. The state had attempted to ascertain the numbers of people on five earlier occasions, the last being 17 years before this census. This though, was the first attempt at a systematic enumeration.⁸⁷ Data was reported at the district level. The state had 7 districts. If a person had two or more occupations the one he considered most important by him was returned as his occupation.⁸⁸ There are 18 occupation categories which together with the occupations included in each category are given in table 1a. Castes were categorized into 23 broad categories. The population of these castes is broken down into 18 occupation categories. In addition for each caste the population, number of houses and number of women is available. Caste data are summarized in table1b and district data are summarized in table1c.

Implications from the theory

In the model, a caste is able to sustain trade in the services it supplied if it had some bargaining power. Its bargaining power depends on the services unique to the caste and/or the services which the caste provides

⁸⁷ The data were collected over several waves, with a final collection of missing information and a check of all the information was done on the 20th of July 1875. The enumerator tables were first checked by supervisors, who had to check at least 20% of the data for mistakes which then had to be corrected on the spot. The village level reports were then tabulated by the district Tehsildars, who again had to verify the accuracy of the data by checking at least 20% of it. These were then examined and copied by the Deputy Registrar.

⁸⁸Data on secondary occupations is not available. Based on colonial censuses, the most common secondary agricultural occupation was agriculture. Because of this agriculture as a primary occupation is excluded from the analysis.

at a better quality than other castes. A caste can increase in bargaining power by increasing the number of services it has a monopoly over or by specializing in services that have a high bargaining power. If castes have unequal bargaining power, castes with higher bargaining power have more occupation choices open to them.⁸⁹

The section on castes and population sizes (section 5.3) also provides some implications on occupational choice by caste. If the optimal caste size is determined by the trade-off between information costs and the benefits due to increased monopoly power, then larger castes should also have occupations with a higher bargaining power or they should have a monopoly of a larger number of occupations.

To test these implications there needs to be a measure of what practically constitutes bargaining power. Three measures are used: economic bargaining power, social bargaining power and occupational bargaining power. One of the occupation categories is property ownership. The first measure of bargaining power is a measure of how a caste is able to monopolize control over land resources. This is a proxy for economic bargaining power. The second is the social rank of the caste. Caste categories in the native state are ranked into 5 categories according to the perception of the census enumerators. This roughly corresponds to the average social rank of the caste across districts, as the census report does not give this ranking by district. For the third measure of occupational bargaining power, occupation categories are further categorized into high or low bargaining power (table 1a). A caste's bargaining power is that of the occupation that the caste has either the highest fraction of people following or the occupation they have the largest monopoly in.

The relative measure of caste size used in the regressions is the fraction of district population in the caste. Other caste characteristics considered are the fraction of the caste engaged in cultivation and interactions of the various measures of bargaining power with the relative size of the caste. The main district characteristic considered to affect occupational specialization is the population of the district. Economic measures of the district such as the fraction of the population literate, a weak measure of poverty of the district (the fraction of houses classified as class 3 or the lowest category), a measure of agricultural surplus (the fraction of population engaged in cultivation) and the fraction of the caste engaged in cultivation are also controlled for. In addition, papers like (Banerjee and Somanathan 2006), (Anderson 2005) and (Chaudhary 2005) highlight the role of social diversity, economic inequality and the fraction of upper castes in determining economic outcomes. These measures are also controlled for in the regression to check if they are correlated with caste occupational diversity.

There are insufficient data to include occupation fixed effects, however table 1a summarizes how specialized occupations are across the various districts. The labor category appears to be the most diversified across castes with almost all castes in the district having at least one person following an occupation classified as labor. The book binding occupation on the other hand is the most specialized by caste.

As the data is categorized both by caste and occupation this introduces certain biases into the results. Since occupations are classified into categories, two castes may be in reality specialized in different occupations but if these occupations fall in the same category, then the castes will appear as if they are both

⁸⁹The theory then discusses the role that purity restrictions are able to play to prevent this free-riding by individuals.

following the same occupation and hence do not have a monopoly over those services. This makes castes appear less specialized than they actually are. Lumping various occupations also biases the bargaining power of occupation measure. Occupations in the same category need not have the same bargaining power. For example the category religious service includes servants attached to religious buildings of all ranks. It is likely that people attached to religious buildings as priests have a different bargaining power than those attached as servants. To counteract this other measures of bargaining power namely economic and social are used in the analysis.

6.1.1 Empirical specification

Occupational specialization has two aspects in this paper. The first is determining how many occupations are unique to a caste (i.e. those that the caste has a monopoly over). The second is capturing the diversity of occupations caste members may follow that are not unique to the caste. The measure of occupational specialization used would need to capture both these dimensions.

One standard way of capturing diversity is a Herfindhal like measure of occupational specialization for each caste c :

$$diversity_c = \sum_{k \in K_c} \left(\frac{n_{c,k}}{n_c} \right)^2$$

$n_{c,k}$: number of people in caste c following occupation k
 n_c : number of people in caste c

An decreasing index value implies a higher diversity of occupations in a caste. This index works well in most cases, but in this context there is a problem. Suppose a caste has a monopoly over two occupations and its members only follow those two occupations, say half in each occupation. This would show up as a measure of diversity of 0.5. Another caste whose members are also equally divided between two occupations but which has a monopoly over one of those occupations will also have the same measure of 0.5. However, according to our definition of occupational specialization, the first caste is more specialized than the second because it has a monopoly over more occupations.

Consider a measure that just considers the degree of monopoly each caste has over the occupations of its members:

$$monopoly_c = \sum_{k \in K_c} \left(\frac{n_{c,k}}{n_k} \right)^2$$

$n_{c,k}$: number of people in caste c following occupation k
 n_k : number of people in occupation k in the district

This measure has the following problem: two castes may be in reality specialized in different occupations but if these occupations fall in the same category, then they will appear as if they are following non-unique occupations. This is due to data limitations, but the problem is confounded as the relative population

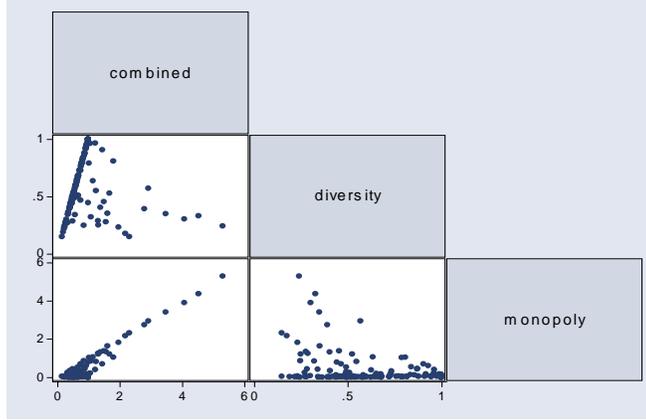


Figure 3: Relationship between the various indices

sizes of castes will matter. Castes that have a larger fraction of the population will show up as having more monopolies over occupations than they actually have. For example consider a caste that has a small population relative to the other castes. Just considering the monopoly index above, even if all the members of the caste followed one occupation, if the occupation was a small fraction of service providers in its occupation category, it will show up as a small index value when in reality since all the members follow the same occupation the index value should be high.

The index used needs to combine both the above indices. It needs to capture the number of occupations castes have a monopoly over without giving too much emphasis to the relative size of the caste. One way of doing so is by using the following index:

$$index_c = \sum_{k \in K_c} \left(\max \left\{ \frac{n_{c,k}}{n_k}, \frac{n_{c,k}}{n_c} \right\} \right)^2$$

It uses the maximum of the degree of monopoly the caste has in an occupation and the fraction of the caste engaged in that occupation. It should counteract the effect discussed above. It is not the only possible index but it is a simple way of capturing the intuition. The monopoly and diversity indices are also used as robustness checks and to check for additional insights. The relationship between the indices in graphical form is given in figure 3 The index excluded the occupation categories property and cultivation. There is evidence that agriculture/cultivation was an occupation undertaken by most castes. Property will be used as a measure of economic bargaining power (discussed later) and so will be excluded from the index.

The specification is as follows:

$$index_{c,i} = \alpha + \beta_1 D_i + \beta_2 C_c + \beta_3 E_{i,c} + \varepsilon_{ic}$$

where :

D_i : District i characteristics

C_c : Caste c characteristics

$E_{i,c}$: District-caste interactions

6.1.2 Results

The dataset contains 7 districts. This makes isolating district factors that affect occupational choice difficult. Putting district factors alone into a regression gives a maximum R^2 of 0.02 and none of the variables are significant. In the interests of space district level results are not reported. They are however controlled for in the caste regressions by adding district dummies.

The results with caste factors are given in table 1-d. In support of the second implication, the larger the caste relative to the population in the district the higher the degree of specialization. To check if this is purely coming from the size effect discussed earlier, I run the same regressions on the diversity index that just measures the degree of occupational diversity in a caste (table 1-f). From those regressions larger castes are on average following more occupations, lending further credence to the implication.

All the bargaining power indices when considered separately are negatively correlated with specialization, indicating that castes with higher bargaining power on any dimension on average follow more occupations. This supports the implication that castes with higher bargaining power have a larger choice of occupations they can follow. When the three indices are considered together, the occupation rank measure and the social rank measure still retain their negative signs, but lose their significance. However, the economic bargaining power is the only significant coefficient, but with the sign switched. This indicates that wealthier (more propertied) castes on average follow a fewer number of occupations. The correlation between economic bargaining power and occupational diversity seems to be the least robust finding. The sign is positive when factors like other measures of bargaining power and caste interactions are introduced. This suggests a potential channel that economic factors of a caste may play on occupation choice.

The fraction of the caste engaged in cultivation is negatively correlated with occupational diversity indicating that castes that take up agriculture tend to be more diversified on average. Interacting the relative size of the caste with the measures of bargaining power gives a negative coefficient. This indicates that as the bargaining power of larger castes rises, they tend to be more diversified using the combined index. To check if this is coming due to monopoly or occupational diversity, the coefficients are compared to those using the diversity index. For the diversity index, the social and occupational bargaining power interactions seem to be positively correlated indicating that as the bargaining power of larger castes rises,

they tend to be less diversified using the diversity index. Bargaining power comes from two sources – the number of unique occupations and the bargaining power of those occupations. This supports the implication that if larger castes follow occupations that have higher bargaining power, then they do not need to have a monopoly over many occupations. The monopoly index regression are not reported as the only significant variable there is the relative size of the caste.

6.2 Castes and population size

Belonging to a caste is costly because of informational considerations and this cost is rising in caste size (see section 5.3). The benefit from belonging to a caste is increasing in the number of occupations unique to a caste. If all occupations are unique to some caste, the trade-off between costs and benefits determines the optimal number of castes in a village. Increasing the population for the same number of castes will raise the size of each caste, increasing the cost of belonging. For the same number of occupations, this changes the balance between costs and benefits and the number of castes in the village rises. This gives rise to the following testable prediction: Keeping the number of occupations fixed, an increase in population size will be accompanied by a rise in the number of castes.

Data description

1823 data: The data is from the Dehazada and Census of the Province of Tirunelveli (Tinnevely), 1823⁹⁰. Tirunelveli is situated in the present day state of Tamil Nadu. The dataset consists of 152 census villages in four contiguous taluks.⁹¹ This enables us to control for a variety of village characteristics. The census was collected by officers of the Survey of India department and was commissioned by the Collector of Tirunelveli.⁹² For further data details see (Ludden 1996) and references therein. The summary of various data items is given in table 2a. The relation between castes and populations size is given in figure 4

1941 data : These data are from the British India Census. Most of the data on caste collected by the British Census are reported at the District level. These districts are extremely large and the caste categories are reported only if the caste was considered ‘large’ enough. The exception to this is the Mysore Census of 1941, which is (are far as I know) the only village level data reported by the Census that has data on castes. For each of the 235 villages in the survey, there is detailed economic information. On castes they report the name of all the castes present in the village (no exclusions) and for the biggest castes, some caste level information. I conduct the same investigations as with the 1823 data. The variables do not correspond exactly to the ones in the 1823 dataset but I keep them as close as possible. These data are summarized in table 3a . The relation between castes and populations size is given in figure 5.

⁹⁰I am very grateful to David Ludden for sharing these data with me.

⁹¹see (Ludden 1996) for data details

⁹²The revenue department needed a detailed count of taxable assets in the province to regularize administration. Survey officials while mapping the countryside, when asked also conducted a census of the districts to assist the revenue department. Land measurements were executed by Indian officials and checked by British supervisors to ensure that they were correct and not biased by collusion. For the other items in the census it is not clear who collected information on them. However, it seems like a standard form was circulated to tahsildars (tax officers) as the data at the taluk level appears in a standard format.

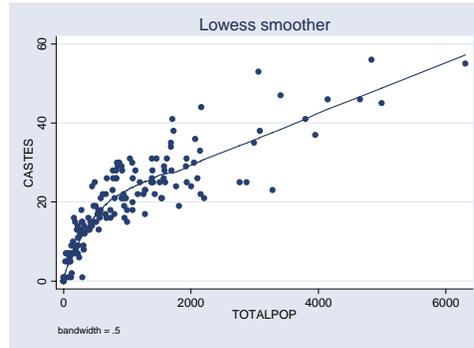


Figure 4: Castes versus village population in Tirunelveli, 1823

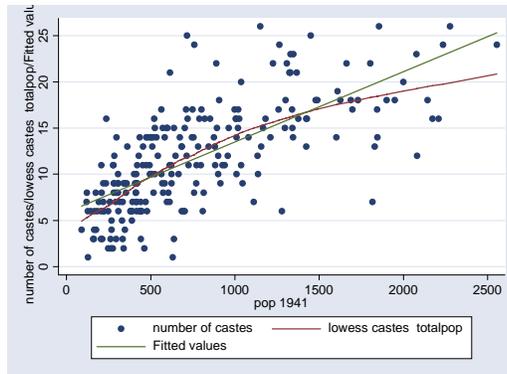


Figure 5: Castes versus village population in Mysore, 1941

6.2.1 Empirical specification

$$\log C_i = \alpha + \beta_1 \log Pop_i + \beta_3 fracwet_i + \beta_4 fracwet_i^2 + \beta_5 density_i + \beta X_i + \varepsilon_i$$

where

- C_i : Number of castes in village i
- Pop_i : Population of village i
- $fracwet_i$: Fraction of cultivated land under irrigation in village i
- $density_i$: Population per cultivated acre in village i
- X_i : Other characteristics of village i

The variable of interest is population. The theory holds the number of occupations in a village constant, so factors in the village that may be correlated with the number of occupations are controlled for. Irrigated land may be more productive than dry cultivation. Having more productive agriculture would allow for the village population to specialize in other services, which may affect the number of occupations in the village.

The fraction of land under irrigation is a control for this. Population pressures may also affect the agricultural surplus available and is controlled for by adding population density as a control. The results of this basic specification for both 1823 and 1941 are given in tables 2b and 3b . In the 1823 census villages may have sub-villages under them and this is controlled for by adding the number of sub-villages as an additional control.

6.2.2 Results

The total population of the village is strongly positively correlated with the number of castes in a village in both datasets. Looking at the 1823 data in table 2b, an increase in village population by 1% is associated with a 0.54% increase in the number of castes in the village. Similarly for the 1941 data (table 3b), a 1% increase in population size is associated with a 0.57% increase in the number of castes in the village. The coefficient is similar to the one in the 1823 data, however the R^2 is much lower. In both datasets, factors that increase agricultural surplus in the village, namely the fraction of cultivated land under irrigation and lower population density are associated with a higher number of castes in the village. This is consistent with the view that a higher agricultural surplus allows for a larger non-agricultural economy, which would be associated with a larger number of castes. Apart from these factors other factors that may influence agricultural productivity like the number of plows per acre, bullocks per acre and waterworks per acre are also controlled for. None of these controls significantly affect the coefficient on population.

In the 1823 data, the occupational structure of the village is also directly controlled for by adding variables like the number of looms per capita and artisan shops per capita among others. They are on average significant and positively correlated with the number of castes in the village. However, the significance of the population coefficient remains unchanged. It does however drop to a 0.48% increase in the number of castes in the village for a 1% change in population. In the 1941 data, I am unable to control for the various service/occupations available in the villages. However an attempt is made by including controls for whether the village is interior or not, the fraction of income sent as remittances and spent on travel. The coefficient on population does drop to 0.55% but again the significance is unaffected.

Another way of controlling for the strength of the local economy is to control for market activity. In the 1823 data this is done by using factors such as bazaars per capita. These are also associated with a larger number of castes without taking away from the population coefficient. To check if wealth of the village on average makes a difference, factors such as the fraction of houses that are tiled, animals per capita, and taxable tree per capita are controlled for. In the 1823 data these are all associated with a higher number of castes in the village leaving the population coefficient unchanged. In 1941 an increase in the fraction of houses tiles is associated with a lower number of castes. Whether this is due to the fact that the data is from a different part of the country or due to the colonial policies one cannot distinguish. However, it is related to (Banerjee and Somanathan 2006)'s findings where social heterogeneity is not a positive for the economic conditions of a village. Literacy is another source of difference in the datasets. Unlike 1823 where villages with a larger number of schools per capita are associated with a larger number of castes, in 1941 literacy is not strongly correlated with the number of castes.

6.2.3 Robustness checks

Various interaction terms are also considered to check for other possible patterns. However, none of them are statistically significant. The results are not included in the interests of space. The same regressions are repeated for average caste size and the results are shown in tables 2c and 3c. In the 1823 data a rise in village population is associated with a rise in the average caste size. An increase of a 100 people in the village is associated with 1.6 extra people per caste. The corresponding number is 3.3 for 1941. In 1823 population density seems to have the biggest effect and is positively correlated with the number of people per caste. All the measures that are correlated with agricultural surplus, wealth or market activity are associated with a lower caste size. In 1941 all these factors seem unimportant and only population seems to matter for the average caste size.

Instrumental variables

Reverse causality is a problem here. For example, economic factors that cause castes to migrate to an area, would increase the population size purely because the number of castes increased. An appropriate instrument would be one that is correlated with population size but not with the number of castes. Appropriate instruments would be fertility rates and death rates. Unfortunately, these are not available for the 1823 Census. Deaths from small-pox, cholera and plague in each village in the 1941 census are available. This is not the best instrument for total population due to the presence of a large number of zeros. The first stage R^2 is .13, F -stat=10.95.⁹³ Using this in a 2SLS regression (table 3-d), reduces the population coefficient to 0.54% (which is the same as the 1823 number). There is some increase in castes due to migration but the effect of population still remains strong.

6.3 Summary

The empirical evidence presented serves to substantiate the implications of the theory model. The bargaining power of the caste seems to be an important factor in determining the occupational decisions of the caste. The higher the bargaining power of the caste, the more occupational diversified the caste. Secondly, there seems to be a trade-off between the number of occupations and the bargaining power of the occupations the caste specializes in. If the caste specializes in occupations with high bargaining power, it does not need to specialize in as many occupations.

The castes and population size implication is empirically verifiable. An increase in the population of the village is correlated with a larger number of castes. The results holds even after factors that may affect the number of castes in the village such as agricultural productivity, population density, wealth and occupational distribution are controlled for.

7 Conclusions

The caste system is difficult to define, complex and it changes over time and place. Because of this, it has often proved difficult to analyze and conceptualize. However, we know that it has real effects on the

⁹³The instrument passes the weak instrument test of (Stock and Yogo 2003)

economy. To sufficiently understand the effects, the reasons for the effect and the mechanism of transmission a model is invaluable. This paper provides a model of the caste system with its features as an equilibrium of a game where the central problem is contract enforcement. The implications of the model provide a coherent explanation for why we see features like the purity scale and occupational specialization in equilibrium. This should not be interpreted as saying that the caste system was free of inefficiencies. In fact features like restricting occupations by caste may cause inefficiencies in the economy on other dimensions which are not considered in this paper. The focus is on the role the features of the system play in increasing the efficiency with which the system can undertake contract enforcement.

The first part of the analysis shows that trade is sustainable with collective punishments. The various features of the system are shown to be implications of the model that increase efficiency. The bargaining power of a caste is a key concept in the analysis. Factors that increase the bargaining power of the caste increase effort provision by the producer and hence efficiency. Increasing the number of occupations unique to some caste in the economy increases efficiency, providing a reason for occupational specialization by caste. Self-production restrictions increase bargaining power as by giving up the option of producing the service for himself a consumer lowers his outside option. Each individual also has an incentive to free-ride off the bargaining power of his caste. To prevent this, the paper discusses the role of occupational restrictions by caste. Since bargaining power is so important to the analysis, data from Cochin (1875) is used to check how occupational patterns are correlated with bargaining power of the caste. The last part of the analysis examines the ascriptive nature of castes. Reasons for why this is observed may be tied to a caste's attempts to preserve rents. Restricting entry into castes in equilibrium is tantamount to choosing whom to extend the caste's punishment power.

The determinants of the number of castes in a village are also examined. The central assumption about castes is that they serve as information sharing devices. Coordinating and enforcing collective punishments is assumed to be costly and increasing in the size of the caste (see (Olson 1971)). This introduces a trade-off that determines the size of the caste and the optimal number of castes in a village. The prediction being that the optimal number of castes in the village is increasing in the population of the village. This implication is tested using data from Tirunelveli (1823) and Mysore (1941) and found to be consistent with patterns in the data.

Institutions are a key determinant of economic outcomes because they affect individual's incentives. In the developing world setting up an environment in which countries can achieve their growth potential has become the current push for policy makers. In order to do that effectively current institutions must be better understood. The caste system is a persistent institution that governs a large fraction of people in the developing world. Nehru, writing on the eve on Indian independence summed it up well when he said about the caste system "we have to pay attention to the human material we have to deal with, to the background of its thoughts and urges, and to the environment in which we have to function. To ignore all this and to fashion some idealistic scheme in the air, or merely to think in terms of imitating what others have done elsewhere, would be folly. It becomes desirable therefore to examine and understand the old Indian social structure which has so powerfully influenced our people."⁹⁴ This paper models the caste system in a tractable

⁹⁴((Nehru 1946) pg 244)

way. Future work will involve delving into the role of the caste system in post-colonial India.

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Table 1-a: Occupation categories and their contents

Category	Occupations	bargaining power	Degree of caste monopoly (1: monopoly by 1 caste)			
			Mean	Std. Dev.	Min	Max
Government Service	All paid servants of the Sirkar, except the military	High	0.47	0.09	0.34	0.60
Military	The Military	Low	0.73	0.42	0.00	1.00
Learned	Medical men, lawyers, vakeels, astrologers, musicians, actors, astronomers, pundits	High	0.38	0.12	0.23	0.51
Minor Professions	School masters, accountants, volunteers, devil drivers	High	0.45	0.24	0.25	0.92
Personal service	Barbers, washermen, domestic servants, sweepers	Low	0.29	0.03	0.26	0.33
Trade	Trade of all descriptions, bazaarmen, grocers, oilmongers	High	0.31	0.11	0.19	0.53
Conveyers	Bandyemen, elephant-drivers, horse-keepers, cartmen, boatmen, bearers	Low	0.44	0.12	0.22	0.57
Cultivation	Tenants, field-laborers, gardeners	Low	0.34	0.09	0.19	0.49
Dress		Low	0.55	0.20	0.32	0.86
Food	Toddy-drawers, fishery, cooks, butlers, beetlenut-seller	Low	0.84	0.09	0.73	0.97
Metals	Blacksmiths, braziers, goldsmiths, tin-makers,	High	0.63	0.27	0.20	0.92
Construction	copper-smiths, Bricklayers, carpenters, box-makers, coopers, boat-makers, pot-makers, glass-workers, painters, sawyers, masons, marahmut maisteries, chuna-makers, tile-makers	Low	0.46	0.10	0.27	0.57
Books	Book-binders, ink-makers	Low	0.78	0.19	0.57	1.00
Household Goods	Basket-makers, mat-weavers	Low	0.46	0.26	0.26	1.00
Combustibles	Firework-makers	Low	0.45	0.45	0.00	1.00
Laborers	All coolies, umbrella makers, laborers, workmen	Low	0.23	0.04	0.16	0.28
Property	Jemnies, farmers, landed proprietors	High	0.36	0.23	0.00	0.69
Religious Service	Servants attached to religious buildings of all ranks	High	0.33	0.19	0.21	0.74

Table 1-b: Caste data summary

Castes	Rank	Population	Population	Occupation diversity index	
	(5: highest)	mean	std dev	mean	std dev
Brahmans (Malabar).	5	1377.5	1814.71	0.76	0.12
Brahmans (Tamil)	5	2301	2974.24	0.38	0.13
Brahmans (other)	5	1669.25	2487.56	0.49	0.16
Kshatriyas	5	180.5	261.76	0.62	0.28
Vaiyyas	5	57.25	105.39	0.53	0.41
Ambalawasy	4	1210.5	1589.21	0.66	0.17
Sudras (Malabar)	4	26028.25	33427.03	0.56	0.14
Sudras (Tamil)	4	4277.75	6694.84	0.29	0.11
Sudras (other)	4	5490.75	7157.56	0.59	0.15
Neithukaran	2	1124.5	1483.26	0.62	0.20
Kushawan	2	517.75	681.14	0.64	0.23
Veluthedan	2	625.25	820.52	0.93	0.12
Kshavarakaran	2	643.25	832.35	0.88	0.16
Kallashary	1	385.25	500.41	0.67	0.19
Marashary	1	3092.5	3911.79	0.75	0.12
Eezhuwan	1	44630	54831.78	0.98	0.31
Cheruman	1	13119.25	16291.48	0.97	0.07
Ravuthan	3	904.25	1442.21	0.63	0.22
Jonaga Moplah	3	6505.5	8070.89	0.54	0.10
Patany	3	499.5	655.76	0.41	0.15
Others	3	215	392.61	0.50	0.35
Nasrani Moplah	2	35066.25	44608.84	0.60	0.19
East Indians	2	35.5	53.43	0.55	0.40

Table 1-c: District data summary

District	Area in sq km	Villages	Houses	Population	%Male	% literate
Chittoor	285	24	13737	65952	49.47%	5.46%
Cochin	62.75	59	18759	93901	51.16%	4.79%
Kanayannoor	80.75	93	19167	93683	51.07%	6.10%
Kodungaloor	18.75	7	4317	20397	52.75%	2.87%
Mukundapuram	418.25	137	22406	114974	50.10%	2.97%
Talapilly	271	164	20404	110465	49.86%	4.42%
Trichoor	225	169	18578	101742	49.57%	3.90%
Total for the State	1361.5	653	117368	601114	5.39%	4.44%

Table 1-d : Relationship between caste factors and the combined index of occupational diversity

Dependent variable: Combined index of occupation diversity

	Basic	Property monopoly	Occupation rank	Social rank	All three	Interactions with fraction of district population			
						Property	Occupation	Rank	All
District fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fraction of district population in caste	6.47 [5.85]***	7.25 [5.05]***	6.18 [5.64]***	6.01 [5.76]***	6.57 [5.08]***	7.59 [4.00]***	10.41 [3.85]***	8.47 [4.08]***	11.70 [3.84]***
Fraction in cultivation	-1.68 [1.79]*	-2.41 [2.28]**	-1.36 [1.47]	-0.90 [0.93]	-1.92 [1.83]*	-2.55 [2.34]**	-0.31 [0.32]	1.02 [0.76]	0.48 [0.36]
Degree of monopoly over property		-0.49 [0.33]			0.43 [1.69]*	0.41 [1.24]			0.57 [1.79]*
Degree of monopoly over property square		1.04 [0.50]							
Caste rank				-0.07 [2.69]***	-0.04 [0.95]			-0.03 [1.48]	-0.02 [0.77]
Occupation bargaining power			-0.18 [2.77]***		-0.15 [1.34]		-0.07 [1.27]		-0.06 [0.72]
Fraction of pop* Rank								-1.54 [1.96]*	-1.29 [1.24]
Fraction of pop* occupation b.p.							-3.83 [2.30]**		-2.69 [1.04]
Fraction of pop* monopoly over property						-5.08 [0.50]			-0.52 [0.07]
Observations	143	126	143	143	126	126	143	143	126
R-squared	0.59	0.59	0.6	0.6	0.61	0.59	0.62	0.63	0.66

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1-f: Relationship between caste factors and the diversity index of occupational diversity

Dependent variable: Diversity index of occupation diversity

	fraction of district population								
	Basic	Property monopoly	Occupation rank	Social rank	All three	Property	Occupation	Rank	All
District	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effects									
Fraction of district population in caste	-0.423 [2.91]***	-0.348 [1.68]*	-0.620 [3.72]***	-0.77997 [4.54]***	-0.806 [3.43]***	-0.290 [1.01]	-1.990 [4.24]***	-1.150 [3.88]***	-2.031 [3.86]***
Fraction in cultivation	-1.657 [5.74]***	-1.682 [4.92]***	-1.434 [4.41]***	-1.057 [3.13]***	-1.017 [2.33]**	-1.657 [4.85]***	-1.774 [6.35]***	-1.346 [4.07]***	-1.520 [3.78]***
Degree of monopoly over property		0.040 [0.11]			0.067 [0.48]	-0.110 [0.72]			0.117 [0.70]
Degree of monopoly over property square		-0.259 [0.44]							
Caste rank				-0.052 [3.68]***	-0.051 [2.53]**			-0.057 [3.78]***	-0.048 [2.00]**
Occupation bargaining power			-0.121 [3.12]***		-0.042 [0.78]		-0.155 [3.64]***		-0.079 [1.20]
Fraction of pop* Rank								0.232 [1.47]	0.135 [0.70]
Fraction of pop* occupation b.p.							1.242 [3.20]***		1.065 [1.92]*
Fraction of pop* monopoly over property						-0.305 [0.20]			-1.752 [1.19]
Observations	143	126	143	143	126	126	143	143	126
R-squared	0.27	0.23	0.32	0.34	0.32	0.23	0.35	0.35	0.35

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2-a: Summary statistics for Tirunelveli 1823

Variable	Obs	Mean	Std. Dev.	Min	Max
Total population	152	1092.533	1108.066	1	6305
No. of castes	152	20.579	11.456	1	56
average no. people per caste	152	46.513	33.887	1	292
maximum caste size	152	287.033	341.192	0	2477
Population density	150	0.633	0.850	0.01	5.75
Fraction land irrigated	150	0.379	0.291	0	1
Inhabited Sub-villages	152	4.947	6.842	0	46
Plows per acre	148	0.036	0.037	0	0.19
Bulls per acre	150	0.104	0.150	0	1.24
Water works per acre	150	0.035	0.032	0	0.17
Fraction houses tiled	150	0.011	0.023	0	0.14
animals per capita	152	0.481	0.968	0	11.92
Schools per capita	152	0.001	0.001	0	0.01
Bazaars per capita	152	0.004	0.007	0	0.05
Annual Bazaars per capita	152	0.000	0.001	0	0.01
Beetle bazaars per capita	152	0.001	0.001	0	0.01
Carts per capita	152	0.002	0.004	0	0.03
looms per capita	152	0.012	0.023	0	0.16
bleach per capita	152	0.002	0.004	0	0.04
razcase works per capita	152	0.002	0.002	0	0.02
pottery works per capita	152	0.002	0.003	0	0.02
artisan shops per capita	123	0.000	0.001	0	0.01
brass shops per capita	152	0.0003	0.001	0	0.01
silver shops per capita	152	0.001	0.001	0	0.01
carpentry yards per capita	152	0.002	0.002	0	0.02
limekilns per capita	152	0.0005	0.001	0	0.01
sugar mills per capita	152	0.001	0.002	0	0.02
oilmills per capita	152	0.001	0.001	0	0.01
mattress frames per capita	152	0.001	0.002	0	0.02
gunny frames per capita	152	0.001	0.007	0	0.06

Table 2-b: 1823-- Regression results showing castes are positively correlated with population size

Dependent variable: log of castes

	Basic	Agricultural productivity	Wealth	Schools per capita	Customs	Market activity		Occupations
log population	0.545 [14.46]***	0.545 [18.60]***	0.587 [13.32]***	0.531 [14.35]***	0.543 [13.96]***	0.545 [13.71]***	log population	0.483 [11.27]***
fraction irrigated	0.785 [1.70]*	0.649 [1.81]*	0.668 [1.47]	0.946 [1.99]**	0.787 [1.68]*	0.926 [1.98]**	fraction irrigated	0.803 [1.58]
fraction irrigated sq.	-0.741 [1.15]	-0.941 [1.70]*	-0.631 [1.00]	-0.858 [1.32]	-0.746 [1.14]	-0.803 [1.28]	fraction irrigated sq.	-0.729 [1.06]
Population density	-0.186 [1.77]*	-0.259 [2.39]**	-0.201 [2.24]**	-0.185 [1.79]*	-0.186 [1.76]*	-0.210 [2.32]**	Population density	-0.189 [1.96]*
no. of sub-villages	-0.011 [3.07]***	-0.010 [3.00]***	-0.013 [3.31]***	-0.011 [3.36]***	-0.011 [2.99]***	-0.009 [2.48]**	no. of sub-villages	-0.009 [2.44]**
Plows per acre		-0.633 [0.37]					looms p.c.	0.358 [0.28]
Bulls per acre		0.065 [0.19]					mattress frames p.c.	14.503 [1.46]
Waterworks p. acre		7.093 [3.18]***					oil mills p.c.	33.722 [1.89]*
Town customs					0.141 [1.63]	0.030 [0.39]	sugar mills p.c.	6.744 [0.59]
Road customs					-0.085 [1.16]	-0.051 [0.82]	lime klins p.c.	-15.647 [0.69]
Carts per capita						14.190 [1.96]*	carpentry yards p.c.	21.284 [2.32]**
Annual bazaars p.c.						10.092 [0.58]	silver shops p.c.	91.272 [2.61]**
bazaars per capita						13.700 [2.42]**	artisan shops p.c.	31.424 [1.42]
Beetel bazaars p.c.						38.838 [1.78]*	pottery works p.c.	22.238 [2.80]***
schools per capita				78.404 [2.99]***			razor cases p.c.	20.437 [1.85]*
Faction houses tiled			3.266 [1.90]*				bleach works p.c.	16.791 [2.72]***
No. of two story houses			0.005 [0.26]					
Animals per capita			0.051 [2.74]***					
Taxable trees p.c			0.000 [0.19]					
Observations	150	148	148	150	150	150		121
R-squared	0.8	0.83	0.78	0.8	0.8	0.81		0.85

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

p.c.: per capita

Table 2-c: 1823-- Robustness check: Number of people per caste positively correlated with population size

Dependent variable: Number of people per caste

	Basic	Agricultural productivity	Wealth	Schools per capita	Customs	Market activity		Occupations
log population	0.016 [10.22]***	0.017 [11.28]***	0.018 [10.49]***	0.016 [10.69]***	0.016 [10.07]***	0.015 [9.62]***	log population	0.018 [9.14]***
fraction irrigated	-50.768 [1.50]	-43.502 [1.74]*	-48.104 [1.41]	-57.946 [1.63]	-49.106 [1.42]	-56.084 [1.57]	fraction irrigated	-46.829 [1.19]
fraction irrigated sq.	48.568 [1.08]	61.055 [1.52]	51.073 [1.07]	53.053 [1.16]	47.289 [1.04]	49.231 [1.09]	fraction irrigated sq.	43.863 [0.87]
Population density	10.551 [2.42]**	14.402 [2.11]**	10.546 [2.60]**	10.687 [2.53]**	10.524 [2.38]**	12.182 [3.61]***	Population density	10.844 [2.69]***
no. of sub-villages	1.122 [3.71]***	0.895 [2.90]***	0.959 [3.20]***	1.116 [4.05]***	1.082 [3.61]***	1.009 [3.35]***	no. of sub-villages	1.006 [3.33]***
Plows per acre		73.975 [0.63]					looms p.c.	-62.812 [0.79]
Bulls per acre		-4.886 [0.19]					mattress frames p.c.	-652.378 [1.16]
Waterworks p. acre		-452.466 [1.76]*					oil mills p.c.	-19.955 [0.02]
Town customs					-5.310 [1.49]	2.341 [0.58]	sugar mills p.c.	-616.675 [0.63]
Road customs					-1.159 [0.22]	-1.326 [0.31]	lime klins p.c.	1777.998 [1.19]
Carts per capita						-859.279 [2.04]**	carpentry yards p.c.	-947.186 [1.77]*
Annual bazaars p.c.						-1449.250 [1.38]	silver shops p.c.	-2157.600 [1.02]
bazaars per capita						-802.421 [2.22]**	artisan shops p.c.	-3474.310 [1.69]*
Beetel bazaars p.c.						-1970.970 [2.18]**	pottery works p.c.	-1119.750 [2.12]**
schools per capita				-3680.380 [2.92]***			razor cases p.c.	-669.425 [1.15]
Faction houses tiled			-167.708 [1.68]*				bleach works p.c.	-708.564 [2.17]**
No. of two story houses			-2.631 [2.12]**					
Animals per capita			-1.032 [1.06]					
Taxable trees p.c			-0.046 [0.58]					
Observations	150	148	148	150	150	150		121
R-squared	0.49	0.57	0.50	0.50	0.49	0.52		0.50

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-a: Summary statistics for Mysore 1941

Variable	Obs	Mean	Std. Dev.	Min	Max
total population	235	769.02	527.67	90	2554
castes	235	11.74	5.70	1	26
avg people per caste	235	70.01	52.46	14.81	632
maximum caste size	199	58.60	38.54	8	294
Fracion land irrigated	231	0.23	0.29	0	1
Population density	231	1.48	1.68	0.30	20.63
fraction literate	235	0.14	0.09	0.01	0.50
interior	235	0.55	0.50	0	1
watperac	231	0.22	0.36	0	3.3
fractile	235	0.43	0.32	0	0.98
animals per capita	211	1.11	0.60	0.10	5.31
expenditures per capita	235	26.36	17.48	0	125.61
fraction of income sent as remittances	211	0.02	0.21	0	2.99
fraction income on travel	211	0.03	0.10	0	1.39

Table 3-b: 1941-- Regression results showing castes are positively correlated with population size
 Dependent variable: Log of the number of castes in the village

	Basic	Agricultural productivity	Wealth	Literacy	Exposure to the outside world	
log population	0.571 [13.21]***	0.571 [12.58]***	0.617 [12.76]***	0.569 [12.51]***	0.558 [12.84]***	0.551 [12.01]***
fraction irrigated	1.313 [3.96]***	1.271 [3.52]***	1.241 [3.55]***	1.285 [3.49]***	1.270 [3.73]***	1.306 [3.29]***
fraction irrigated sq.	-1.220 [3.30]***	-1.175 [3.09]***	-1.159 [3.08]***	-1.200 [3.05]***	-1.186 [3.15]***	-1.349 [2.99]***
Population density	-0.005 [0.50]	0.022 [0.74]	-0.004 [0.29]	-0.006 [0.56]	-0.004 [0.46]	0.001 [0.14]
Bulls per acre		-0.215 [1.32]				
Water works per acre		0.097 [0.84]				
Interior village					-0.075 [1.33]	-0.048 [0.75]
Fraction of income on remittances						-1.694 [1.39]
Fraction income on travel						3.925 [1.49]
fraction literate				0.134 [0.31]		
fraction houses tiled			-0.427 [5.32]***			
Animals per capita			0.017 [0.31]			
Expenditures per capita			-0.001 [0.64]			
Observations	231	207	207	231	231	207
R-squared	0.49	0.5	0.55	0.49	0.5	0.5

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-c: 1941-- Robustness check: Number of people per caste positively correlated with population size
 Dependent variable: Number of people per caste

	Basic	Agricultural productivity	Wealth	Literacy	Outside exposure	
log population	0.03 [6.70]***	0.03 [6.51]***	0.03 [5.81]***	0.03 [7.34]***	0.04 [7.66]***	0.04 [7.20]***
fraction irrigated	-67.23 [1.59]	-56.68 [1.34]	-62.96 [1.40]	-58.60 [1.15]	-61.57 [1.37]	-61.00 [1.11]
fraction irrigated sq.	57.83 [1.17]	53.14 [1.12]	54.60 [1.07]	51.46 [0.92]	52.84 [1.02]	58.63 [0.90]
Population density	-0.02 [0.03]	0.28 [0.08]	-0.39 [0.33]	0.51 [0.38]	-0.09 [0.10]	-0.47 [0.53]
Bulls per acre		7.69 [0.43]				
Water works per acre		-15.45 [1.24]				
Interior village					9.30 [1.46]	8.76 [1.17]
Fraction of income on remittances						30.42 [0.26]
Fraction income on travel						-85.83 [0.35]
fraction literate				-40.99 [0.79]		
fraction houses tiled			34.71 [5.07]***			
Animals per capita			-2.05 [0.60]			
Expenditures per capita			0.18 [0.94]			
Observations	231	207	207	231	231	207
R-squared	0.14	0.14	0.18	0.14	0.14	0.13

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-d: 1941-- Instrumental variable regression results showing castes are positively correlated with population size
Instrument: number of deaths in the village due to cholera, small-pox and plague

IV	log population	log no. of castes
log (deaths+1)	0.16 [4.44]***	
log population_hat		0.54 [3.34]***
fraction irrigated	0.27 [0.51]	1.32 [3.90]***
fraction irrigated sq.	-0.98 [1.67]*	-1.25 [2.98]***
Population density	0.06 [1.08]	0.00 [0.18]
Observations	231.00	231.00
R-squared	0.13	0.49

Robust t statistics in parentheses
significant at 5%; ** significant at 1