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ABSTRACT

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Institutions are an important determinant of a society's economic performance. To understand why institutions affect economic activity we have to understand how they affect people's incentives in the economy. The patterns of social interaction and beliefs in a society determine the choice of institution. This dissertation focuses on societies where interactions in groups and networks are important. For these societies consider two particular aspects of an economy: contract enforcement and marriage markets

Pre-colonial India had a thriving economy that was able to sustain a high degree of division of labor. At the same time there is not much evidence of a well developed court system which is puzzling because for economic activity to take place a means of contract enforcement is vital. Chapter 2 of this dissertation argues that India did have a means of contract enforcement, in the form of the caste system, an important and persistent Indian institution, which is not well understood. It formalizes a model of the caste system that argues that contracts were enforced using a specific form of collective punishments to punish consumers who default on payments. Based on this, various observed features of

the caste system like occupational specialization by caste, a purity scale for occupations, purity restrictions by caste, and a hierarchy of castes are shown to be equilibrium outcomes that improve the efficiency of contract enforcement.

The caste system requires strong networks and gaining access to a better network could be valuable. Marriages are a way of maintaining and gaining networks. As families compete for the best match payments from one side to the other could arise. Chapter 3 explores the determinants of the direction and recipient of these flows. Specifically, it considers the importance of network benefits versus benefits from the couple. The prediction is that as networks lose importance, societies will move from the bride's family receiving payments (bride price) to one where they make payments (dowry). Chapter 1 highlights the contribution of these chapters relative to the literature.

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Table of Contents

List of Tables

List of Figures

CHAPTER 1

Institutions and Economics

Institutions are important determinants of a society's economic performance. They determine the patterns of interactions (economic, social and political) and the incentives of agents in an economy. There are numerous studies examining the impact of institutions on growth and economic performance. (Acemoglu, Johnson, and Robinson 2001) use the difference in institutions set up by European colonial powers to estimate the effect of institutions. They find large effects of institutions on income per capita. (La Porta, de Silanes, Shleifer, and Vishny 1998) show how legal origins impact financial markets. See also (La Porta, de Silanes, Shleifer, and Vishny 1997), (La Porta, de Silanes, Shleifer, and Vishny 1999). The effect of institutions on trade is discussed in (Dollar and Kraay 2003). And (Banerjee and Newman 1998) show how credit market institutions can impact the modernization of a country. Institutions also have a long run effect on an economy's performance and current institutions also have an impact on the path of institutional change in an economy. In terms of the long run impact of institutions, (Sokoloff and Engerman 2000) show how persistent institutions can have a long run growth effect. (Greif 2006) discusses the different institutions that supported trade in the medieval European and Muslim worlds and why these economies evolved along different trajectories.

Identifying that institutions matter and which institutions perform the best to solve a certain problem does not tell us how and why these institutions affect the economy. More

importantly, it doesn't tell us why if there are better institutions available, agents don't simply adopt the best institutions. To do this we need to examine how and why institutions affect the incentives of the agents in the economy. This microeconomic analysis of incentives provides a complement to the macro analysis of the effect of institutions. For this, the tools that economics provides allow us to build theoretical models of institutions. A model clarifies the channels through which institutions affect incentives. Since a model has to be internally consistent and also has to satisfy the constraint that the institution should be an equilibrium outcome it is also a disciplining device. Identifying how an institution works, will then lead to a second stage where one can ask the question why are inefficient institutions observed in reality and why are they able to persist? A theory model also provides predictions which can be tested using data.

Analyzing an institution using a model however has its drawbacks. It has to make a lot of simplifying assumptions and the richness of the institution may not be fully captured. In addition it could produce predictions that are qualitative and not statistically testable. In these cases, narratives, commonly used in history, are used to check for the consistency and validity of the model. Here the qualitative predictions are matched to descriptions of the institution and agents choices in the economies (Bates, Greif, Levi, Rosenthal, and Weingast 1998).

In order to model an institution we first have to determine what exactly constitutes an institution. There are two main approaches in the literature. The first approach treats institutions as rules. This approach to analyzing institutions treats institutions as constraints or rules imposed on agents which they take as given when they interact. Rules

affect the costs of undertaking certain actions. Taking these costs as given, individual agents interacting within a market devise organizations that minimize the transaction costs of interacting. These rules are humanly determined rules that could be politically determined or socially, depending on how formal the institution is. Institutional change in this approach occurs when agents in organizations perceive marginal improvements that would make them better off and vote on/implement these changes. Whether these changes can actually occur however depend on the information available to the agents and how they process it and ultimately the bargaining power of the agents who want change. Political institutions and organizations like interest groups and unions are an important for the analysis of institutions as rules. (North 1990), (Eggertsson 1990), (Williamson 1985), (Barzel 1989)

The second approach views institutions as self-enforcing patterns of behavior. This approach relies heavily on Game theory. It sets out a strategic situation that fully rational agents face as a game and then examines the possible equilibria of this game. These agents are not bound by rules as in the previous case and so the emphasis is on the actions and behavior of the individuals and not factors that determine the rules in an economy. Every agent given his information and beliefs plays a strategy that maximizes his utility. For an institution to be self enforcing, in equilibrium no agent will want to change his behavior as his behavior is optimal given the choices of the other agents. In this case, behavior becomes patterned and predictable and 'institutionalized'. It will not change unless something exogenous changes that no longer makes this an equilibrium of the game. This approach allows us to answer the question why do different countries

choose different institutions by looking at why one country would choose one equilibrium of the game versus any other. The process of tracking institutional change in this setting amounts to identifying the factors that cause the economy to move from one equilibrium to another. The role of history and past institutional choices on current institutional change is emphasized. Analysis of these institutions tends to be problem driven and not theory driven. (Greif 2006), (Aoki 2001), (Williamson 2000).

To see how these approaches differ consider the following example. Consider a strategic setting where agents are playing against each other and choose their actions from a set of possible options.

In the institutions as rules approach, the first step would be for all/some of the agents to decide/vote on a set of rules. These rules lay out a set of punishments (meted out formally or informally) for a subset of the possible set of actions. These rules change the payoffs by changing the costs of certain actions. Now an agent chooses his optimal strategy not only taking into account what everyone else is doing, because their actions affect his payoffs, but also taking into account how the rules affect his payoffs. An institution is these rules which by affecting payoffs affect the equilibrium strategies chosen. Institutional change would be essentially a renegotiation of the rules. This is when and how rules are decided, the voting abilities of the agents etc. matter for how and how much the rules change.

The second approach does not have this first stage. People have the whole possible range of strategies open to them, and chose their best responses to everyone else. Payoffs

will only be affected by people's strategy choices in equilibrium and not exogenous rules. An institution in this case will be the equilibrium strategies that everyone plays. Since no agent has an incentive to change his strategy given what everyone else is doing, behavior follows a pattern and this is the institutionalized behavior in the economy. The agents in the institutions as rules approach also behave optimally but the emphasis of the two approaches is different. In the first approach the first stage of rule determination and the process of changing rules is the major emphasis. Since the second approach does not have this first stage the emphasis is on the second stage of individual decisions.

In this second approach however most games have multiple equilibria and different economies could be in different equilibria with different equilibrium strategies and hence different institutions. To answer why one economy is in a particular equilibrium, we would have to explain why the characteristics of the economy made one equilibrium a focal point over others. This approach highlights information transmission, networks, asymmetric information, limited cognition, and endogenous preferences. Institutional change will be studied by tracing how these economy wide characteristics change and how this changes the current equilibrium being played.

I focus on the second view of institutions as self enforcing equilibria of a game played by economic agents without imposed rules. In particular I will focus on the role of information transmission and networks with an emphasis on group based interaction. As (Greif 1994) point out, the institutions present in an economy could depend on the culture of the society. Culture is defined as the patterns of social interaction and beliefs in a society. He focuses on the difference between collectivist and individualist societies.

A collectivist society has the characteristic that interactions are primarily group based, with greater cooperation within a group and relative non-cooperation across groups. For the individualist societies on the other hand, the emphasis is on the individual and self reliance, with interactions scattered across society.

This dissertation focuses on two important aspects of economic life: contract enforcement and efficient marriage markets. These are important for every society and institutions are needed to ensure that markets function properly. Without a contract enforcement institution, economic exchange would become close to impossible (Greif 2000). The producer needs to be sure he will be paid in order to have an incentive to undertake production and trade with the consumers. Contract enforcement institutions lay out the punishments for non-payment. How effectively the punishments are enforced and how severe the punishments are, affect a producer's incentives. Through this channel they affect the functioning and efficiency of the economy. (North 1981) argues that the differences in growth across countries can be attributed to their different contract enforcement institutions (see also (Dixit 2004)). (La Porta, de Silanes, Shleifer, and Vishny 1998) show how the legal framework of a country has effects on the financial markets of a country. They find that in countries where the legal system has low protection for investors, large public companies have a higher concentration of ownership of shares. The efficient functioning of financial markets is an important determinant of growth[1]. For contract enforcement, individualist societies tend to choose law courts, but the solution that collectivist societies choose could vary depending on the patterns of interactions across groups.

[1]See (Levine 2003) for a survey of the literature

Marriage is another important institution. Gary Becker was one of the first economists to apply economic tools to analysis of the family. The decisions a family makes has important effects on labor supply, education choices, fertility decisions etc. All these choices are important for the functioning of the economy as a whole. The marriage market by determining how spouses are matched thus affects the functioning of the economy (Becker 1991).

In addition to affecting growth in an economy, contract enforcement and marriages have a lot of similarities. Both these institutions have agents interacting based on explicit or implicit contracts. For trade, the producer and consumer agree that services will be provided and paid for. In a marriage, the bride and groom informally 'contract' on how they will make household decisions and divide the marital surplus. The fact that family law is an important part of the legal institution in a country hints at the contractual element of marriage.

The length of the contractual term could be different across these institutions. A producer and consumer only interact for a short time, but a marriage could last for the lifetimes of the spouse. What is common however is that there is a difference in timing between the actions of the agents in the contract. A producer has to put effort into creating the good and could deliver it to the consumer before he is paid. In a marriage, the wife could have a child and stay at home with the understanding that once this happened the husband will support them. Making sure that these expectations are met is crucial for the institution to be effective.

In undertaking these contracts, because of the difference in the timing of actions, a certain level of trust is required. A producer needs to trust that the consumer will pay him. The wife needs to trust that her husband will support her when she gives up her job to look after their children. Usually at the heart of this trust lies explicit formal and/or informal sanctions for breaking the contract. I trust that the consumer will pay me because if he doesn't he will be put into jail.

Both these institutions could involve more than two agents in a contract, which means that their incentives need to be considered. The larger families of the bride and groom could also treat the marriage as a 'contract' with the other side with the understanding that the other side will provide things like credit, labor, insurance etc. when needed. The bride/groom's families could have an effect on what type of contract is chosen and how matching takes place. For contract enforcement, it could be the case that we have collective punishments for default. Not only the producer punishes the consumer, but a number of other producers could also punish the consumer.

I focus on different aspects of these institutions. With the contract enforcement institution the emphasis is on the form the institution takes in one particular area and time - pre-colonial India. The persistence and stability of the institution is the focus and how a particular patterns of interactions and information transmission networks in society can give rise to the observed form of the institution. With the institution of marriage, the emphasis is not on explaining the form of the institution but on the patterns of payments that accompany a marriage. Understanding the transition and changes in these payment

patterns in a given society and across societies are emphasized more than explaining one particular case. However again here, the importance of networks is emphasized.

The first institution considered in this dissertation looks at the solution that pre-colonial India, a collectivist society chose to fulfill its need for contract enforcement. Pre-colonial India had a thriving economy that was able to sustain a high degree of division of labor (Raychaudhuri and Habib 1982) pages 180-181. At the same time there is not much evidence of a well developed court system which is puzzling (Moreland 1920) page 35. Chapter 2 argues that there was no need for a separate court system because the caste system in India, usually thought of as oppressive or irrational functioned as a viable means of contract enforcement. The chapter on castes builds a model of the caste system based on contract enforcement. It shows that with the punishments of the caste system as seen in reality, castes can function as an effective means of contract enforcement. In addition it shows that the various characteristic features of the caste system serve as equilibrium outcomes to increase the efficiency of contract enforcement. It ties the prevalent patterns of interactions across groups and beliefs to their ability to enforce inter-group trade. The caste system is defined here as a form of social stratification that satisfies a given number of features, namely occupational specialization, purity scale, hierarchy, commensality and ascriptiveness. A caste[2] is the smallest subdivision of society that has all the features of the system. These will be discussed in detail later.

In order to work efficiently, the caste system requires strong networks and gaining access to a better network could be valuable. Marriages are a way of maintaining and

[2]also called subcastes or jatis

gaining networks. As families compete for the best match, payments from one side to the other could arise. Chapter 3 sets up a model of a marriage markets where network benefits are one important part of the benefits of the marriage and focuses on the determinants of the direction and recipient of payment flows. The importance of networks versus the other sources of benefits affects how agents compete for the best match and this has implications for the patterns of marriage payments in a society. Chapter 3 explores the determinants of the direction of these flows. Specifically, it considers the importance of network benefits from the match versus benefits from the couple to explain direction of payments. Dowry is a positive payment by the bride's side at the time of marriage. A payment by the groom's side is broadly classified as bride price. This time however, the evolution of the institution is emphasized more. As collectivist societies evolve towards more individualist societies the transition of payments is studied. The result briefly is that as network benefits decrease in importance relative to the importance of the nuclear household, one should see a transition from bride price to dowry in a society.

In addition, both these institutions are very India-centric. The caste system in its fully developed form is unique to South Asia and is one of the most important Indian institutions. Nehru, India's first Prime Minister said "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. Dowry is fast becoming a serious problem in India and has often be attributed as a source of social evils like female infanticide, bride burning and abandonment of widows (Oldenburg 2002). There are two reasons for focusing on Indian institutions. The first is the fact that India

is a developing country with a large fraction of its billion plus people living in extreme poverty. The question of what factors could improve the economic lives of a large fraction of the world's poor is an important one for economists.

The second, more important reason lies precisely in the fact in the uniqueness of these institutions to India and how different they are from those in Europe. Consider a break up of the world into West (Europe) and East (India). If the underlying problems faced by all economies are the same, why would the West and East relatively isolated from each other in history develop such different institutions? The workings of Western institutions are relatively well understood. But the caste system and bride burning, abandoning widows in the East are not very well understood and to a great extent are viewed as irrational and a sign of backwardness. But do these institutions persist because they solve some problem and serve some purpose or are they truly irrational and/or inefficient? By choosing institutions unique to India, this dissertation will add to the understanding of these institutions. As argued before only when we understand an institution will we be able to understand if and when it will change.

In the next few sections for each institution separately, I discuss the reasons why these institutions are important and also summarize the work that has already been done. The contribution this dissertation makes towards increasing our understanding of these institutions is also highlighted.

1.1. Caste

Chapter 2 focuses on the caste system. There is considerable debate as to the origins of the caste system. Putting a date on the emergence of such a system has still not been achieved. Estimates put the start of the caste system anywhere between 3000 B.C. to 1000 B.C. Some historians believe that it existed as early as the Indus Valley civilization in 3000 B.C., others date it later, to the invasion of the Aryans, approximately 1000 B.C. (Thapar 2002). 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.[3] It is still an important determinant of people's economic choices. (Betancourt and Gleason 1999) find that caste is an important factor in the allocation of publicly provided goods in India. (Munshi and Rosenzweig 2006) finds that the majority of lower castes are still engaged in low productive agriculture and are employed as casual laborers. (Luke, Munshi, and Rosenzweig 2004) shows how belonging to a caste influences career opportunities while increasing social obligations.

The persistence of this system of social stratification for 3000 years of changing economic and social environments is puzzling. 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 chapter 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.

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

The pre-colonial Indian economy was able to sustain a high degree of division of labor and was known for the quality of its goods (Raychaudhuri and Habib 1982) pages 180-181. The Indus Valley Civilization showed evidence of sophisticated economy with a clear differentiation of cultivators, laborers, artisans and the central governing authority (Thapar 2002). Assessment of India's economy after the Indus Valley civilization is mostly qualitative, and drawn from descriptions from the ancient texts and travelers. During the Epic Age (900-520 B.C.) specialization in trade and manufacturing becomes more apparent. For example the carpenter, part of the royal retinue for chariot building was joined by ironsmiths, goldsmiths, potters, weavers, herbalists, ivory carvers. These were encouraged to settle in cities. They did so and formed physically separated groups (jatis) which were occupationally specialized (Keay 1990) page 55. In his discussion of the time period 200 B.C.-300 A.D. he discusses evidence for trade in saffron, muslins, silks, agate, ebony and teak (Keay 1990) page 127. The Gupta period (300-500 A.D.) has trade regulated by influential guilds, which did quality control training etc. They also served as bankers and met regularly in joint councils (Keay 1990) page 145. (Rai 1974) discusses the Indian economy from 300 B.C.. to 600 A.D. Agriculture was the predominant activity early in the time period and trade was mostly local, within the village. There is evidence of a large number of occupations which were usually highly specialized. Over time agriculture loses importance as the primary source of income for a large fraction of the population. Luxury articles like jewelry, cosmetics, architecture sculpture were demanded and supplied in cities. Details on the metal and gem industry indicate a high level of sophistication. Trade across regions and countries was present with areas becoming

known for the high quality of the goods they specialized in. Marco Polo on his travels to India commented on the high quality of the textiles produced (Polo 1854) page 417.

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".[4] According to (Maddison 2003), in 1700 India's share of world GDP was 24.4% compared to Western Europe's 21.9%.[5] The economy of Mughal India was largely agricultural but was noted for the high quality its manufactures. Early European traders found an environment with a high trade volume and a well functioning financial system. The variety of crafts and specialization of tasks in production were much higher in Mughal India than in contemporary Europe. The number of ships at the trading ports carrying goods in and out of India surprised the European travelers (Mukerjee 1967).

A thriving economy needs a strong legal system. However there is not much evidence of a well developed court system (Moreland 1920) page 35. Even the *Manu Smriti*[6] states that the legal authority of the king lies mainly over criminal cases and in the matter of trade disputes he should follow the rulings of the castes ((Buhler 1886) Chapter VIII). Chinese traveler Fa Hian describes the punishments of the Gupta Kings but only mentions instances of criminal punishments (Beal 2004). Even when the king performed his judicial duties they were "badly performed as to interrupt but little the business or pleasures of

[4](Clive, 1756-59:ccii) Clive, Lord 1756-59 Indian Records Series1756-1759. by Samuel Charles Hill. (London: John Murray, 1905)

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

[6]The 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.

the King; and a decision is rather an exercise of arbitrary will and power, than the result of an accurate investigation" (Mill and Wilson. 1848) page 127. There is also evidence that the king's court of justice was not used very often as (Mill and Wilson. 1848) points out "the people are so much accustomed to terminate their own disputes, by their own cunning or force that the number of applications for judicature is comparatively small" page 127.

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.

1.1.1. Literature on Caste:

One consequence of this institution's persistence and complexity is that it has been a subject of much study not just in anthropology and sociology, but in economics as well. The focus is on the persistence of this institution the main prevailing theories are summarized below.

Religious:

The most common explanation given for the caste system is religious sanction. One of Hinduism's holiest and oldest books, the Rig Veda gives divine sanction to the caste system. It states that the universe was created when the gods sacrificed a divine being called *Purusha* . When *Purusha* was consigned to flames, the four main *varnas* (or caste divisions) arose. His mouth became the Brahmans, the priestly caste. The warrior caste, the Kshatriyas arose from his arms. The trading caste, Vaishyas, arose from his thighs and lastly the lowest caste, the Shudras was born from his feet. Building on this, a man called Manu who lived sometime between the second to fifth centuries B.C wrote a book of laws called the *Manu Smriti* which used the story as divine sanction for the caste system.

The main criticism against this theory is that the Indian caste system is too complex with its caste and sub-castes and various rituals to be explained and more importantly, sustained for so long using divine sanction as a reason. Another evidence in contradiction to this is the fact that 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 the caste. If religious sanction was the only reason then people who converted to Islam and Christianity should abandon their castes, but this doesn't happen (Searle-Chatterjee and Sharma 1994). (Ibbetson 1916) discussing the conversion to Islam says "as a fact in the east of the Panjab [sic], conversion has absolutely no effect on the caste of the convert. The Musalman Rajput, Gujjar or Jat is for all social, tribal, political and administrative purposes exactly as much a Rajput, Gujjar or Jat as his Hindu brother. His social customs

are unaltered, his tribal restrictions are unrelaxed, his rules of marriage and inheritance unchanged" page 178. (Ballhatchet 1998) examines this in detail for Catholic conversions. Pope Gregory XV in 1623 allowed Jesuits to live with in the caste system, adopting the customs of the Brahmins. The argument behind this acceptance was the caste system "had no religious implications" (Ballhatchet 1998) pp 8 . This was overturned in 1739 by Pope Clement XII, and in 1744 Pope Benedict XIV ruled that "all Catholics whatever their birth should hear Mass and receive communion in the same church at the same time" (Ballhatchet 1998) pp8. In spite of this decree, churches still had separate seating arrangements, entrances and burial grounds in the church on the basis of caste. More importantly it does not explain the other features of the caste system.

Racial:

The racial theory claims that the advent of the Aryans (invaders from Central Asia) was responsible for the caste system. The Rig Veda story of creation describes the four varnas - Brahmins, Kshatriyas, Vaishyas and Shudras. The word 'varna' used to describe the main caste categories is sometimes translated as color. Some authors[7] use this to interpret the varnas as racial categories. (Risley 1915) says that a tribe if left by itself displays no tendency to be endogamous. However, when a country is invaded by members of another race, as was the case with the Aryan invasion, there is an initial tendency for the invaders to intermarry with the locals, but the racial mixing was not total. Over time, the invaders became the dominant group. The people with the fairest skin, and hence the biggest proportion of Aryan blood, became the highest caste. The rank of the caste was decreasing in percentage of Aryan genes. Hence the need to preserve the genetic

[7]for example (Dutt 1965)

mixture by marrying only within a caste. In this case, he argues that the people of mixed parentage have an incentive to form a closed endogamous group that married within itself or with the dominant group but not with the locals. This is a theory of why we get endogamous closed groups in a society.

As far as genetic evidence goes (Cordaux, Aunger, Bentley, Nasidze, Sirajuddin, and Stoneking 2004) find that paternal lineages of Indian caste groups are primarily descended from Indo-European speakers who migrated from Central Asia ~3500 years ago. Tribal groups seem descended from the original Indian gene pool. They as well as (Bamshad, Kivisild, Watkins, Dixon, Ricker, Rao, Naidu, Prasad, Reddy, Rasanayagam, Papiha, Villems, Redd, Hammer, Nguyen, Carroll, Batze, and Jorde 2001) find that higher caste groups are more similar to Western Eurasians. This in itself is not conclusive evidence that the racial theory holds. (Thapar 2002) claims that pre-Aryan society in the Indus Valley civilization, seems to have a complex social organization. Cultivators, laborers, artisans and the central governing authority seemed to be clearly differentiated. If this was the case then one would expect that the invaders considering joining Indian society would join the upper strata more often. Indian tribes lived outside the fringe of society and as they became assimilated into caste society, they joined lower down on the hierarchy (Hutton 1981). In addition, it cannot be differentiated from evidence that says ancient India had a large number of tribes and groups living in the same locality (Gadgil and Guha 1993).

If this is the story of the origins of the caste system in (Risley 1915), his story for the persistence of this separation to preserve genetic purity is the 'peculiarities' of Indians

(page 265). For some reason Indians and their traditions make them prefer this division. But this is not really explaining the caste system. He gives a reason for why groups are formed and then says they persist because of preferences, which is essentially putting caste into the utility function. It is hard to explain persistence for 3000 years by the peculiarities of the Indian people.

Economic (Occupation):

This hypothesis says that a caste was basically equivalent to a guild. (Roy 2006) discusses how a separate guild was not necessary as the caste fulfilled most functions of the guild. The argument is that when castes first started out they were just names given to groups of people following the same occupation. Over time these groups became closed, endogamous, hereditary groups. (Nesfield 1885) for example argues that the difference between caste and tribe was that the former had a community of function (or occupation) and the latter a community of blood. The reason the Brahmins were able to set the example of hereditary membership was because they were the highest of all functions. (Ibbetson 1916) says the two types of communities: communities of blood and communities of occupation are fused in primitive and separate in advanced societies. The reason this fusion survived in India was because India was because of 'special circumstances'. Ethics and religion were initially studied together to begin with. However in Rome, ethics separated into law and in Greece, religion developed into philosophy. This separation reduced the power of the priests. In India this separation did not occur leading to a large class of priests, who due to necessity had a large number of illiterate people. This reduced their influence which made them fall back on hereditary virtue as the only

possible foundation for their power (Ibbetson 1916) page 111-2. Other castes soon followed the example of the priests. 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.

(Neale 1957) noticed that the caste system governed the exchange of services.[8] Building on this observation, (Klass 1993) proposes that the solution to the division of labor problem that emerged in India was the caste system (page 181). As new occupations arose, groups took control over them and monopolies were created. This is also a guild type of argument where groups form monopolies which result in rents. The caste tried to preserve these rents by restricting marriage, making castes hereditary etc. The features helped maintain distinct boundaries and thus monopoly power. But this is no different from guilds in Europe and he is unable to explain the purity scale. The priestly class may have been ranked first, but by virtue of being first they had the most restrictions on their behavior. This purity was a handicap in many ways as it did not allow them to take advantage of profitable opportunities using the resources in their control. The question remains, why would they handicap themselves thus, using religious purity?[9]

[8]He 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

[9]see (Ambedkar 1916)

One of the first papers in economics to formally model the caste system is (Akerlof 1976). His model has 2 castes (dominant and non-dominant) and 3 types of jobs: skilled, unskilled and scavenging. Producers can produce any 1 of n good using any combination of jobs and labor. Now suppose the social structure is such that it prescribes a job type for each caste. For example, the dominant caste may work only in skilled job and the non-dominant only in unskilled jobs. In addition any consumer buying a good that uses labor in a way different from that prescribed by the caste code will be outcasted. (The only jobs open for outcastes are scavenging). People predict that breakers of the caste code will become outcastes and receive the wages for outcaste labor. With this social structure you can get a caste equilibrium where jobs are allocated according to castes. Workers find that the jobs available to them depend on their label. This will lead to occupational specialization and the caste is sustained as an equilibrium. Akerlof's setting has punishments on the consumer for buying the 'wrong' type of labor. The literature on caste punishments talk about punishments on the consumer for defaulting on a producer. A person is only punished by his own caste if he follows the wrong type of occupation (as a producer). The second time he is punished by his own caste is when he provides a banned service for himself. Again a punishment in his role as a producer. (See discussion and evidence in Chapter 2)

The question remains why would such a social structure arise to begin with? Why would consumers of labor be punished for using the wrong type of labor? (Lal 1988) uses the shortage of labor brought about as a result of settled agriculture as a reason for the origin and persistence of the caste system. He argues that the Aryan invaders found the

native population had an absolute advantage in agricultural skills. This combined with the fact that land was plentiful but labor was short, necessitated some means of ensuring a stable labor supply. A coercive system or any means of indenture was not possible due to be absence of a strong state system and political instability. At the same time they needed a system that would give the natives enough of an incentive to use their skills, instead of melting into the forests or performing their own agriculture. Instead of the feudal system, adopted in the rest of the world, the Aryan invaders came up with the caste system. The caste code prescribed that the only occupation the lower castes could follow was agriculture. Anybody found violating this rule was punished by outcasteing. Since now no one hires lower castes to produce goods and people will not buy it if they do so, the only job available to the natives was to supply labor to the Aryans. This results in the caste system becoming a form of labor tying. The lower castes could not escape and set up their own system because they didn't know the knowledge for the complementary tasks performed by other castes. The other castes had no incentive to join them or share their information because they would be worse off by doing so as they would be outcastes. 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. Even if his argument holds, it would explain the emergence of the system and not the persistence. The factors that explain the rise of the system could be very different from the factors that explain the persistence of the system.

Other theories:

(Gadgil and Guha 1993) considers a novel theory for the origins of the caste system. Their theory is that the caste system was a means of environmental protection. It was a system whereby resource use was parceled out to various castes to reduce inter-caste competition. As each occupation was hereditary, it was in the interests of the caste members to conserve the resource that they had a monopoly over. They give several examples of this, ranging from non-overlapping hunting/grazing areas, to hunting certain species. Religious sanction was used as well as social conventions to reinforce this, with outcasteing being the preferred tool of punishment for violation of the rules. Another theory is that it is a form of oppression. However, as (Hutton 1981) argues, so deeply entrenched a system can hardly be imposed by an administrative measure. For other theories, the reader is referred to (Hutton 1981) Chapter XI

The theory proposed in chapter 2 is a contract enforcement theory of the caste system that builds on the occupational theories above. The above theories miss the economic interactions *between* castes in the caste system and the features of collective responsibility/punishments which is one of the trademarks of the caste system. The model focuses attention on this and uses the fact that the caste system was very closely associated with the exchange of services *across* castes (Neale 1957).

Interactions within a group can be sustained but in the absence of a state provided legal institution, interactions across groups need a means of contract enforcement. The chapter claims that the primary reason for the persistence of the caste system was that it fulfilled the role of a contract enforcement institution. This gives us two things, an economic reason for the persistence of the caste system and a reason for how the pre

colonial economy was able to sustain a high degree of specialization without a strong enforcement system. I offer a model of how the system provided contract enforcement and check for testable implications.

Consider a village economy, where everyone is both a consumer and a producer and the only trade is intra village trade. The central problem in the economy is sustaining trade in services. The consumer approaches a producer for a service. If the producer provides this service, only after the service is provided does he get paid. The consumer chooses between paying and defaulting. If there are no punishments for default since the consumer has received the service, he has an incentive 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. I focus on a particular form of collective punishments. If a consumer doesn't pay a, *all* the members of $a's$ caste refuse to provide the consumer with services in the future. This particular strategy was chosen because it is what is seen in reality.

With this setting the main part of the chapter characterizes equilibria in which trade is sustained with these strategies, showing that with collective punishments contract enforcement can be sustained. The chapter offers three ways to substantiate this way of thinking about the caste system. The first is anecdotal evidence in support of the assumptions and implications of the model. Evidence of collective punishments and the informational capabilities of castes are also provided. 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 chapter shows that these features are implications of the model of contract enforcement. 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 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.

The other theories on the caste system are able to explain one or two of the features of the caste system. The contract enforcement theory in this chapter can explain all the features of the caste system as equilibrium outcomes. Moreover, unlike the other explanations there is a reason why these diverse features are observed – they serve in equilibrium to increase the efficiency of contract enforcement. Thus it offer a comprehensive understanding of the system based on a very simple economic need, the need for contract enforcement.

The equilibrium analysis of an institution is a separate from the question of institutional origin.[10] This chapter 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

[10]see (Greif 2006) for a discussion on this

complementary and provide a reason for why this equilibrium was a focal point.[11] 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.

The chapter 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 considers more than one group of people using collective punishments 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 considered 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 chapter (as far as I can tell) is looking at a number of groups,

[11]There 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). One hint may come from (Marriott 1965), where he finds that the more ethnic groups there are in a particular area, the stronger the caste system in that area. 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.

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 chapter 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 1990), (Acemoglu, Johnson, and Robinson 2001), (Rodrik, Subramanian, and Trebbi 2004)). Private order, non-state provided contract enforcement in the Western world has been explored extensively[12]. The rest of the world is still relatively unexplored. This dissertation adds to this section of the literature by arguing that the caste system functioned as a means of contract enforcement

1.2. Dowry

Chapter 3 focuses on marriage payments. Most societies have or at some point in their history have had marriages accompanied by payments made by one or both sides. These payments can differ across societies on dimensions such as direction, recipient, form and

[12](Greif 2006) for a fuller discussion of the literature.

size. Within a society too there are changes observed over time on some or all of these dimensions.

Payments made by the bride's side are broadly categorized as dowry and payments made by the groom's side are broadly categorized as bride price. Murdock's *World Ethnographic Atlas* has data on the marriage payments of 1248 pre-industrial societies. Of these 67% have bride price and 33 (less than 3%) have dowry. The remaining societies have either exchanges or no marriage payments. Based on a count measure dowry is found in very few societies. However dowry is found in the most populous areas of the world: Europe and Asia. Furthermore, these payments could be made to the parents on the other side or to the couple via the bride or groom. The main research questions are: what factors determine the direction and recipient of these payments and what accounts for differences across societies and for a change in direction of payments over time in a society? The magnitudes of these payments vary substantially across societies and are difficult to generalize, however in the data available they are substantial amounts[13]. The direction of these payments is important as it has implications for the wealth distribution across families and could possibly affect how parents view the birth of a daughter versus a son, which could potentially feed back into social evils like female infanticide, selective sex abortion etc. (Oldenburg 2002) This chapter will not deal with the question of why marriage payments change magnitude holding fixed the direction. I focus purely on the determinants of the direction of payments.

[13]For example for bride price (Papps 1983) finds these payments to be about 8 years of agricultural income for landless laborers. For dowry, (Anderson 2005b) finds payments averaging the annual income of a household. A fuller description of these magnitudes found in various studies is found in (Anderson 2007a).

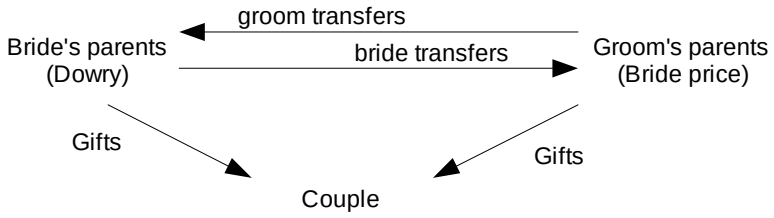

Figure 1.1. Direction of transfers

There are various terms used for these payments depending on direction and recipient. For simplicity the terms used in the chapter are as follows, payments made from the bride's parents to the groom's parents are termed bride transfers and payments from the groom's parents to the bride's parents are termed groom transfers. Payments made from either side to the couple directly are called gifts. To tie this in with the terms dowry and bride price used earlier, total payments made by the bride side are termed as dowry which is the sum of bride transfers and any gifts to the couple. This is expressed diagrammatically in figure 1.1.

Even though dowry and bride price and primarily define by which side pays, there are systematic differences in the recipient across dowry and bride price. This is summarized in figure 1.2. For patrilocal societies, where the bride moves to the groom's family, bride price involves payments from the groom's family to the bride's family (groom transfers) (Anderson 2007a). The other form is what (Goody 1973) calls indirect dowry. It consists of groom transfers and gifts made by the bride's parents to the couple via the daughter. Dowry is usually a situation when only the bride's parents make payments which consist of gifts to the couple via the bride. Dowry could also involve, as is present in India, transfers from the bride's parents to the groom's parents.

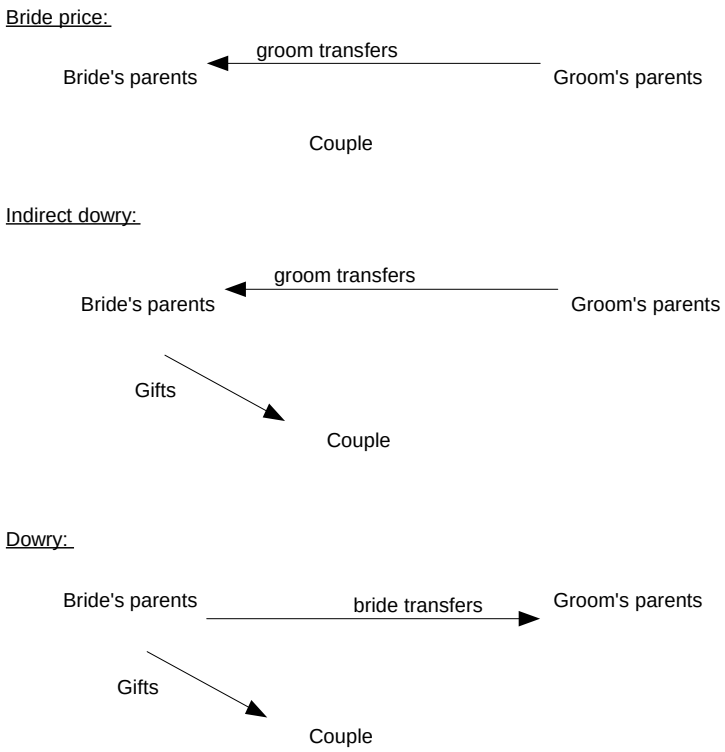

Figure 1.2. Patterns of payments by direction and recipient

In terms of evolution of marriage payments within a society, for patrilocal societies, the general trend is for societies to start out with bride price, move to indirect dowry and if there is a stage 3 is it dowry. In figure 1.1 for payments exchanged between parents, this amounts to initial groom transfers with a transition to bride transfers. In terms of gifts, the change is from no gifts to only gifts by the bride's side.

1.2.1. Literature on Dowry

There is a substantial amount of work done on identifying factors that are correlated with a particular direction of payments. Bride price is often associated with polygynous societies. It is also found predominantly in nomadic and relatively homogenous societies. A strong economic contribution by a female is another factor that is correlated with bride price. Dowry on the other hand is mainly found in monogamous, endogamous, stratified societies with a lower female contribution to labor[14]. These factors have been the primary variables of interest to economists working on dowry.

The prevailing theories of dowries can be thought of as falling into three categories. The first focuses on factors that cause differences in the relative supply of brides and grooms and the competition it induces. Payments arise to clear the market in the presence of an excess supply on one side. The second focuses on the levels of economic heterogeneity (stratification) in a society. The more heterogenous the society the more likely dowry will be observed. The last group focuses on the payments parents need to be given in order to compensate them for the loss incurred when their child gets married.

Consider the theories in the relative supply group. Gary Becker in his seminal work on the family focuses on the relative supply of brides and grooms. In a situation where there is a scarcity on either side and inflexibilities in sharing the surplus within the marriage, dowry will emerge as women compete for scare men and bride-price when the reverse is true (Becker 1991). Competition can arise for many reasons. The main ones focused on in the literature are as follows.

[14]see (Anderson 2007a) for a fuller discussion on the characteristics of bride price versus dowry societies

The first is polygyny, where a man can have more than one wife. (Tertilt 2005) builds on (Becker 1991)'s insight by explicitly considering a model where the demand for women is tied to polygamy or monogamy in society. She builds an overlapping generations model where polygamy is either allowed or banned. Men value women and children in this economy directly as well indirectly through the marriage payments their wives and daughters (as only daughters are bought and sold) could potentially bring in. If polygamy is allowed then if a woman has a price of zero, there is an infinite demand for wives. A positive price emerges to clear the market. With monogamy on the other hand, a woman's loss of fertility in old age becomes the crucial factor. Since women have additional value through their children they need to marry before they get old. This introduces a competition for men and dowry. However it is not clear whether polygamy is truly an exogenous factor. (Jacoby 1995) finds an empirical link between the value of female productivity and the incidence of polygamy. Conditional on wealth, men have more wives when women are more productive.

Another argument is that a change in the relative supply of bride and grooms could also arise due to population growth in conjunction with younger women marrying older men: the "marriage squeeze hypothesis" (Caldwell, Reddy, and Caldwell 1983).(Anderson 2007b) provides a theoretical explanation for why this need not be the case and in fact increasing the marriage squeeze could lead to dowries falling and not rising. The argument is that when there is a marriage squeeze a bride has to be indifferent between waiting a year and getting married now. If not, she would make a transfer to ensure she got married now. With this indifference condition, the higher the probability she has to

wait, the lower the utility from waiting and so she will pay a smaller amount now to get married. (Maitra 2006) works with the model in (Anderson 2007b) and shows how a marriage squeeze could produce dowry inflation even with the indifference condition. Her argument is that when the marriage squeeze takes place the initial jump in dowry payments is very high. Even though the indifference channel in (Anderson 2007b) causes dowries to fall over time, the initial jump is so high that the falling dowry payments could still be higher than the initial level of dowries. The empirical evidence for this hypothesis is mixed. (Rao 1993) finds evidence for the marriage squeeze while (Edlund 2000) using the same dowry data plus measures of sex ratios from a different source finds that it does not hold.

The second category focuses on the level of stratification in a society. Bride price is more characteristic of nomadic, tribal societies. There are also studies that argue that as economies get more sophisticated and stratified dowry starts to make an appearance (Owen Hughes 1978) (Quale 1988). Stratification in these papers is related to differences in asset holdings within society. The higher the degree of inequality in a society, the more stratified it is. Increased stratification is usually assumed to be as a result of the economy modernizing. The link between stratification (or more generally modernization) and dowry is not fully understood. There are two main explanations in the literature. The first is an inheritance argument put forward by (Goody 1973). In unequal societies if the parents care about the wealth and status of their daughter's household they give daughters an inheritance too. Inheritances to both sons and daughters ensure that even a daughter's household can have the same wealth and status as her natal household.

Dowries are nothing but a daughter's inheritance received at the time of her marriage. The additional effect of stratification is that it creates a few very good grooms. Parents use dowries (inheritances) to compete for the best groom. Since the daughter's household's wealth depends on the inheritances of the groom as well, they use dowries to attract the wealthiest groom possible for their daughters. The prediction is that stratified societies will have dowries and these will be inheritances.

He does not give a reason for why parents need to give the daughter her inheritance at the time of her marriage and not at the same time as their sons. This timing is explained by (Botticini and Siow 2003). In their paper, they argue that the crucial factor is how the son's effort affects the parental estate. If the effort levels of the son are important then any distortion in their effort levels reduces the payoff of their parents. The son's efforts get distorted if he inherits only a fraction of his parent's estate as his sister's share in the final value of the estate. In societies where daughters leave the household at the time of their marriage and their effort levels are not as important for the value of the parental estate it is efficient to split the estate early on so that the son is the residual claimant and his incentives are not distorted. This gives a reason for the difference in timing of the inheritance for sons and daughters. However the primary reason for receiving an inheritance is still the same as (Goody 1973) which is increased stratification. This explanation matches the patterns of dowry in Europe, but is unable to match the evolution of payments in India. As in India as location specific benefits have fallen in importance, bride transfers have arisen (see discussion at end of (Botticini and Siow 2003)).

To explain differences in the magnitude of marriage payments, another argument keeps the stratification argument and adds on another layer, namely differences in the heterogeneity of brides and grooms. Modernization changes the relative heterogeneity between brides and grooms because for example, men are better able to take advantage of the benefits of modernization than women (Gaulin and Boster 1990),(Srinivas 1984) Or that men have additional factors like caste which makes them more differentiated than women for the same heterogeneity on the income dimension (Anderson 2005b). These would cause changes in the magnitude of marriage payments, holding fixed the reason for the directions of payments (stratification).

The compensation group focuses on the loss that a family incurs when a child moves from one household to the other. (Boserup 1970) argues that in societies where female labor is an important contribution to household wealth, the bride's family needs to be compensated for the loss of her labor if she moves to the groom's family. This will give rise to bride-price as the groom pays to acquire rights to a female's labor and child bearing abilities. In cases where females do not contribute much, the groom's family needs to be compensated for the upkeep of the bride over her lifetime and this gives rise to dowry. In addition to compensation for a woman's labor, bride price is also viewed as compensation for transferring rights over the woman's children and the larger the number of rights transferred at the time of marriage the higher the bride price (Goody 1973). However one could argue that the value of women is endogenous for a given technology. There is evidence from India that higher castes consider it a status symbol to have their women stay away from labor (Singh 1973).

(Nunn 2005) tries to explain this simultaneous incidence of payments made by both sides of the market by tying it to the outside option of women. Men have a natural tendency to stray and this reduces the incentive for women to enter into marriage as the value of a cheating spouse is lower than the women's outside option. By paying a bride price a man makes a credible commitment not to cheat and a woman has an incentive to get married. However in a society where a woman's outside option is so low that marriage with a cheating spouse is better than no marriage, dowries create the right incentives to stop the man from cheating. However (Bishai and Grossbard 2006) show evidence that bride price payments do not have any effect on the tendency of grooms to engage in extra-marital affairs, but decrease the probability that the bride has an affair.

The model provided in chapter 3 focuses on the benefits from the marriage to the parents. The benefits from a match are usually assumed to be a general function of the types of the agents involved. In this case I separately identify three channels of benefits from the match to the agents. The predictions about differences in direction across societies, will be due to differences in the relative contribution of the various channels of benefits from the match (marriage). There is research showing that the direction and recipient of payments have an effect on the status of women (Zhang and Chan 1999). The results of the model are checked against evidence on how the status of women and in particular of widows changes as the direction of payments change in society. Empirical evidence is also provided.

The primary agents in the marriage market in this chapter will be the parents of the bride and groom. Children are assumed to be identical and are also assumed to marry

whomever their parents choose for them, in a sense these are only arranged marriages. There are three sources of benefits to the parents. These will be described in more detail in Chapter 3. The first is *network benefits* that come from the parents expanding their social network to include the relatives of their child's spouse. A family usually has their own network and a marriage allows for the possibility of bringing new valuable members into this group. Call this channel I. These benefits are independent of the location of the couple as the link is between the larger family units of the couple.

The next two sources of benefits come from the couple directly. They are split on the basis of how the location of the couple affects these benefits. One source of benefits are *location specific benefits* (call this channel III). These would be benefits that arise because the couple lives with a set of parents and provides services like labor, working on the family farm/business. These benefits are a function of the characteristics of the family that the couple lives with. This is assumed because for example, the couple works on the family farm and the benefits are proportional to the size/quality of the farm they work on.

The other source of benefits from the couple is *location independent benefits* (call this channel II). These benefits accrue to *both* sets of parents and do not depend on where the couple lives. When a couple gets married they set up a separate conjugal unit that may or may not be located with a certain set of parents. This conjugal unit creates a marriage surplus. This marriage surplus could be interpreted as the value of the conjugal unit based on the income, asset holdings etc. The important part of this for the model is the benefits this has for both sets of parents.

Total benefits will be equal to the sum of location specific (III) and location independent benefits (I and II) The focus of this chapter will be on the location independent benefits from the couple (channel II) Denote by k $(0 < k < 1)$ the relative contribution of II to total location independent benefits

$$\text{Total location independent benefits} = (1-k)\,\text{I} + k\text{II}$$

When $k = 0$ then the only source of location independent benefits is network benefits and when $k = 1$ the only source of location independent benefits is from the couple's marital surplus. The importance of channel III (location specific benefits) will be denoted by μ $(0 < \mu < 1)$. This gives us

$$\text{Total benefits} = (1-k)\,\text{I} + k\text{II} + \mu\text{III}$$

To separate out payments exchanged between parents and payments to the couple, the marriage market is broken up into two stages. In the first stage, parents compete for the best spouse for their child. Payments at this stage will be exchanged between parents. In the second stage, after matching takes place, parents make gifts to the couple via their son or daughter. At each stage factors determining the direction of net payments will be identified.

Although the bride and groom do not play a role in choosing their spouse, they play a role in determining the payoffs from the match as a couple. Each couple has a unit

of effort/time. They allocate this unit of time between working to increase their marital surplus (channel II) or to work for their parents and increase the location specific benefits to the parents they live with (channel III). Gifts will play a role in determining how they choose to allocate their time.

The main predictions of the model for patrilocal societies about the direction of payments are as follows. Societies where $k = 0$ and $\mu > 0$, that is where location specific benefits are important as well the couple contributes nothing to location independent benefits will have bride price. Indirect dowry will arise when $k > 0$ and $\mu > 0$, that is the couple location independent benefits start to gain in importance but at the same time location specific benefits remain important. Finally, when $k > 0$ and the groom's parents have a bigger impact on the marital surplus of the couple (for reasons like status is inherited through the son etc.) the prediction is that only dowry will be observed.

To explain changes in direction of payments within a patrilocal society over time the prediction about changes in the economy are as follows: It starts as an economy where location specific benefits are important and the only location independent benefits are those from networks (channels I and III). Suppose next that networks start to reduce in importance and parents start to get benefits like old age support etc. from the couple (k increases). In this case, only bride's parents start to make gifts. Transfers by the parents may start tending towards lower groom transfers but this is not necessarily so. This gives rise to a situation of indirect dowry. The last phase is when ($k > 0$) and the only determinant of positive or negative net transfers will be a difference in marginal effects of how the bride's family's characteristics affects the marital surplus versus the

groom's family's characteristics. For example, if the groom's caste affects the status of the household because caste is inherited through the father and caste is important, then we should see bride transfers (and vice-versa for groom transfers).

The model highlights the importance of network benefits and how the changing importance of network benefits can affect the patterns of marriage payments in a society. It emphasizes that a marriage may involve more than just the benefits to the parents from the bride and groom. It could also involve linking the larger family units and the benefits from such a contractual relationship between the families for example for reasons like consumption smoothing, credit etc. The effects of modernization on marriage payments are linked to the source from which parents are able to meet these needs of consumption smoothing, credit etc. If modernizing means that contractual relationships between the larger family units become more difficult and the parents start meeting these needs from the couple then the model predicts the observed pattern of changes in marriage payments in a society.

There are studies (Owen Hughes 1978) (Quale 1988) that argue that as economies get more sophisticated, dowry starts to make an appearance. This chapter offers a way to tie the transition of marriage payments within a society to changes in the economy more particularly, changes from bride price to dowry relying on the composition of marital benefits. This offers a separate channel to explain why modernization affects the presence of and transition to dowry. It also gives us a way of thinking about another role for gifts (distinct from (Botticini and Siow 2003)) which is to affect the incentives of the couple and to make them allocation a higher effort towards increasing their marital surplus rather

than increasing location specific benefits. This channel gives an additional benefit in that it also offers a way to tie marriage payments to the status of widows.

In this chapter, men and women compete for partners and marriage payments result to clear the market. There are no differences in the relative supply of brides and grooms by assumption. This explanation can be considered complementary to the papers that focus on this channel. The predictions for direction do not require the degree of the heterogeneity (inequality) to vary across societies. This is different from explanations like (Goody 1973) who rely on the presence of inequality in a society to explain the presence of dowry. In this explanation, even if there were no inequality as long as the changes in k take place as described above the changes in payment patterns will be observed.

The compensation argument is built into the model too. The model can determine the conditions under which the compensation argument is the major determinant of payments or when the competition effect dominates. Competition plays an important role for net transfers at stage 1. The extent of competition for spouses depends on the relative contribution of networks versus the couple with location specific benefits playing a smaller role. In the case when the reliance on the couple is low the compensation effect dominates and as competition increases the compensation dimension loses importance.

In addition, separating out gifts and transfer payment gives me the coexistence of dowry and bride price in a society. As mentioned above, these could be different payments in different sections of society, or both payments for all sections of society. Consider the first type. The existing literature on dowry chooses one factor to explain the existence

or non-existence of dowry, for example, polygyny, value of women's labor etc. In order to get different payments in different sections of society, one would need these factors to differ across different sections of society. This chapter by looking at transfer payments in a society, and by integrating the compensation argument, allows for the both types of payments to exist in different sections of the same society, with economy wide variables the same for all sections.

With regards to the second type of coexistence, both dowry and bride price for the same marriage, this chapter can offer an explanation different from the one in (Nunn 2005). Here location specific benefits determine compensation which determines transfers and value of the couple's location independent benefits determine gifts. In the case when both these sources are important, we can get both sets of payments for every marriage in the society as a whole.

The rest of the dissertation proceeds as follows. Chapter 2 discusses the castes system as a means of contract enforcement and Chapter 3 deals with dowry and bride price.

CHAPTER 2

The Indian Caste System as a Means of Contract Enforcement

"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

There are two main questions in this chapter. 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 individuals'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 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.[1] 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

[1]This particular strategy was chosen because it is what is seen in reality.

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 chapter characterizes equilibria in which trade is sustained with these strategies, showing that the caste system served as a means of contract enforcement. The chapter offers three ways to substantiate this claim. The first is anecdotal evidence in support of the assumptions and implications of the model. Section 2.1 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 chapter 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 chapter 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 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.

The chapter proceeds as follows: section 2.1 describes the institutional details and the anecdotal evidence in support of the model's assumptions. That is followed by the model

and analysis in section 2.2 and 2.3. Analysis and anecdotal evidence of the implications of the model with regards to the main features of the caste system are covered in section 2.4. Section 2.5 provides empirical support and section 2.6 concludes.

2.1. 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.[2] The set of features used is commonly described as being characteristic of the system. Several sources in the literature (see for 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 :** A caste usually had a monopoly over at least one occupation. Members of a caste usually followed occupations that the caste had a monopoly over. In addition, occupation choices were usually restricted to

[2] "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

an 'allowed' subset.[3] 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. The purity of a caste depended on the number and type of self production restrictions (providing impure services for oneself) and occupational restrictions (providing impure services for sale) undertaken.

(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 individuals's rank was determined by the rank of his caste.[4] Castes placed restrictions on eating and drinking with members of other castes (commensality). 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.[5]

(4) **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.[6]

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[3] "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

[4] In modern day India an individual's status is an amalgamation of his achievements and his caste

[5] (Marriott 1965), (Miller 1975)

[6] That 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

These various features are discussed in greater detail in section 2.4.1. In the model the important assumption about castes will be an informational assumption, members of a caste have better information on fellow caste members than on others. The other important feature of the model is the focus on equilibria with collective punishments for deviations. What follows is anecdotal evidence that motivates the informational assumption of the model and the focus on collective punishments.

2.1.1. Collective punishment

Collective punishments were an integral part of the institution. Punishments were used either within the caste to punish caste members and maintain caste discipline 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 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" (Dubois 1906) pp33.

(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" (page 50). (Blunt 1969) devotes a whole chapter to caste and occupation

gotra name is usually the name of that ancestor. Members of the same gotra are not allowed to marry each other.

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" (page 243). 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" (page 239). In addition there are the following examples, "The Dhobi's of Shahjahanpur city boycotted the Kahars because of a dispute. No Dhobi would wash a Kahar's clothes" (page 342-3) (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 also used to maintain within caste discipline and usually took the form of outcasteing the offender. 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.[7] The reasons for why a caste members were outcaste varied widely across castes, regions and time.[8]

2.1.2. 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 2007) 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.

[7] "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

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

(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" (page 104). (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" (page 49).

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" (Marriott 1950) page 88 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" (Marriott 1950) page 89. 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." (page 35).

One reason for the formation of new castes was geographical mobility.[9] 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 (Blunt 1912) page 349. The informational role of the caste is well understood but has not been used directly to try to explain caste.

2.1.3. Information collection and transmission

Information was collected and transmitted through a body called the *caste panchayat*. The exact details of how the *panchayat*s 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.[10] (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

[9] Different from (Munshi and Rosenzweig 2007) who deal with individual mobility

[10] "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 brethern 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

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 punishments[11]:

(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.[12]. 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.[13] But even as of 1911, they were relatively

[11]For further information the reader is refered 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

[12]only caste council can outcaste/reinstate- see (Hutton 1981)

[13]See (Van de Sand 1976) for details on village panchayats

rare.[14] (Hayden 1999) page 155, 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.[15]

It should be stressed here that the caste *panchayat* ruled on the basis of consensus. There was no external legal code to govern judgements.[16] It took into account the opinions of all the caste members and only when 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".[17]

2.2. Model

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

[14] Census of 1911 Vol I page 395
[15] "No village panchayats as a permanent institution as distinct from caste panchayats" (Dumont 1970) pp172
[16] "There has been no legal code neither has there been any record of legal usage" (Dubois 1906) pp654
[17] (Martens 1912) quoted in (Gait 1913) page 390

2.2.1. 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.[18] Time is indexed by $t = 0, 1, 2, ...$ 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 K occupations of 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.

[18] This assumption is relaxed later on in section 2.4.5

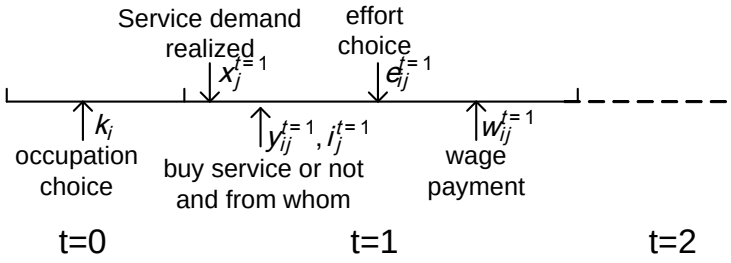

Figure 2.1. Timing of the game

- The consumer then has two choices, he can buy the service from a producer of that service $\left(y_j^t = 0\right)$, 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. $i_j^t \in \left\{i : k_i = x_j^t\right\}$. 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 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[19]

$$w_{ij}^t = w_k(e) := \mu c_k(e) \tag{2.1}$$

The timing of the game is summarized in figure 2.1. At time 0, each individual chooses an occupation. At the beginning of each period $t > 0$, Nature randomly chooses with equal

[19]This assumption is made for simplicity and to focus the attention on consumer default. It can be relaxed and the main results still hold.

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

$$\sigma_i = \left(k_i, \left(e_{ij}^t\right)_{j\in[0,N]}^{t=1,\ldots,\infty}, \left(y_j^t, i_j^t, w_{ij}^t\right)^{t=1,\ldots,\infty}\right) \tag{2.2}$$

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).[20] Assume that the consumer's utility from consuming service k from a producer with effort level e is given by:

$$u_k(e) = b_k(e) + \mu c_k(e) + d \quad \text{for } e > 0 \tag{2.3}$$

[20]Effort is observable and there are no efficiency wage considerations.

This makes the consumer's utility net of wage payments:

$$u_k(e) - w_k(e) = b_k(e) + d. \tag{2.4}$$

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:

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

2.2.2. Information

At the beginning of period t, each individual m in the economy knows the identity, 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 $H^t_{j,c} = 1$ (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 $H^t_{j,c} = 0$. Assume that producer i does not observe anything else about the transactions of consumer j (in particular, his dealings with members of other castes).[21]

2.2.3. Payoffs

Suppose that each player i follows strategy σ_i (as in 2.2). Producer $i's$ lifetime expected profits are equal to

$$E\sum_{t=1}^{\infty}\beta^t\sum_{j:i=i^t_j}\left(w^t_{ij}-c\left(e^t_{ij}\right)\right) \tag{2.5}$$

Recall that the net utility of consumer j is given by equation (2.4). It depends on the effort provision by the producer. The lifetime expected utility of consumer j is equal to:

$$E\sum_{t=1}^{\infty}\beta^t\left[(1-y_i)\left[b_k\left(e^t_{ij}\right)+w_i\left(e^t_{ij}\right)-w^t_{ij}\right]+d\right].$$

2.3. Equilibrium

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

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

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 $\lim_{k\to\infty} \sigma^k = \sigma$, such that $\mu = \lim_{k\to\infty} \mu^k$,where μ^k denotes the beliefs derived from strategy profile σ^k using Bayes' rule. (see (Kreps and Wilson 1982))

As discussed earlier, consider only equilibria with collective punishments. Specifically, focus on equilibria which have the following strategies in the trade subgame:

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:*

$$e_{ij}^t = e_i^* \text{ if } H_{j,c}^t = 0$$

$$e_{ij}^t = 0 \text{ if } H_{j,c}^t = 1$$

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*

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

- *(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.

2.3.1. Equilibrium in the exchange of services subgame t≥1

Consider first the service trade subgame taking occupation choices as given. This part shows that collective punishments are able to sustain trade in services. Consider first the consumer's choice to self produce or buy the service. 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 let

$$e^*\left(k\right) := \max_i \left\{ e_{i.}^{t} : k_i = k \right\}$$

denote the highest possible effort exerted in equilibrium by producers with occupation k. A producer of service k is said to be *active* if his effort is equal to $e^*(k)$. 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:

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

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

$$e_{c'}(k) := \left\{ \begin{array}{cc} \max_i \{e^t_{i.} : k_i = k, i \notin c\} & \text{if } k \notin K_c^{\text{unique}} \\ 0 & \text{otherwise} \end{array} \right\}$$

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.

(Consumer's IC) $\qquad\qquad w_k(e) \leq B_c$

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.[22]

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

[22]This 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.

outside options and hence the bargaining power of the caste, which in turn affects the effort level producers can supply. Consider, for example, 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.*

- *Consumer's strategies are*

$$\sigma_j^C = \left(\begin{array}{c} y_j^t(k) = \left\{ \begin{array}{cc} 0 & \textit{if } P_j^t(k) \neq \emptyset \\ 1 & \textit{otherwise} \end{array} \right\}, \\ i_j^t(k) = \left\{ \begin{array}{c} \textit{uniformly distributed} \\ \textit{across all producers} \\ \textit{who supply this service and} \\ \textit{generate the highest utility} \end{array} \right\} \\ w_{ij}^t(k) = \left\{ \begin{array}{cc} w_k(e_i) & \textit{if } H_{j,c}^t = 0 \\ 0 & \textit{otherwise} \end{array} \right\} \end{array} \right)^{t=1,\ldots,\infty}$$

- *Producer strategies are*

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

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

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

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

Proof. See discussion above □

There are simple corollaries to this analysis. The first deals with the importance of positive bargaining power for a caste. Without it cheating on the caste does not hurt the consumer and he will not pay the producers. The caste needs to have a monopoly over at least one occupation or offer an occupation at a higher effort than everyone else to be able to sustain trade with positive effort. The importance of monopolies for this game will be further discussed in section 2.4.2.

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 $b_k\left(e(k)\right) - b_k\left(e_{\not c}(k)\right) > 0$.*

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 $w_k\left(e_i^*\right) = 0$ for any producer i $k_i = k$. But this means that $e_i^* = 0$. □

The next corollary highlights the implication of the model that all caste members have the same wages.

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.

2.3.2. 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 of size $\frac{N}{K}$. 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:

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

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

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

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 2.4.3 examines the role restrictions on occupation choice by caste can play to allow for unequal bargaining power in equilibrium.

2.3.3. 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:

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

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 outcasteing 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." (O'Malley 1932) page 134. "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." (Hutton 1981) page 89-90. (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 case the *panchayat* would fine the guilty parties." (page 43). There is evidence that caste members in different villages coordinated among themselves to restrict competition and 'divide their labor in mutually profitable ways.' (Marriott 1950) page 77. In (Blunt 1912) the following examples are provided. "In Ghazipur, two Chamars were fines Rs.10 and Rs. 6 for removing deal 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." (page 342)

This concludes the first part of the chapter which sets out the basic model. The problem of sustaining trade in equilibrium is solved using collective punishments. Proposition 3 discusses the equilibrium in the service trade subgame and proposition 7 builds on that

to detail occupation choice at $t = 0$. However so far we just have a system which consists of groups using collective punishments to punish default on producers. To argue that this system is the caste system it will need to match the features laid out in section 2.1. The next part of the chapter does that and in addition shows how these features serve to increase the stability of the system and the efficiency of contract enforcement.

2.4. Implications of the model: features of the caste system

Features of the caste system, namely occupational specialization, purity scale and hierarchy are used in the definition of the caste system in section 2.1. In this section I describe what exactly these features are using anecdotal evidence and then show how they can be obtained as implications of the model of the contract enforcement.

2.4.1. Anecdotal evidence

2.4.1.1. 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 (Buhler 1886) Chapter 1 verses 87-91.

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." (Buhler 1886) Chapter X, 97. 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 the occupations of a higher one, the king shall deprive of his property and banish." (Buhler 1886) Chapter X, 96. 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" (Buhler 1886) Chapter X, 81-99.

2.4.1.2. 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" (Marriott 1969) page 1166. 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" (page 43). (Miller 1975) argues that "some occupations are attributed certain polluting qualities and are identified with the pollutability of certain castes associated with them." (page 82). 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 then having to do it themselves, the higher the ranking of the caste. (Kolenda 1978) page 48 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 (Watercarrier)". 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" of the castes higher in the ranking (page 88). 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" (page 331). (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" (page 132). (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 " (page 310). (Marriott 1950) discusses how the carpenter caste tries to raise their rank by emulating the ceremonies and lifestyles of the Brahmins (page 68).

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." (page 32). (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" (page 244-5).

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" (page 16). (Miller 1975) gives evidence of the case when a change in hierarchy is accompanied by a change in commensal relationships (page 75). 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.

2.4.1.3. 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.[23] 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

[23]Figure 2, page 33

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" (page 91) 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 (Gait 1913), page 371.

This concludes the description of the features of the caste system. To summarize briefly, castes usually had a monopoly over the occupations they performed. Occupations were ranked on a purity scale. The higher castes were not allowed to perform the impure occupations of the lower castes, unless under dire conditions and even then they had to impose constraints on themselves to make following these occupations less profitable. The higher the number of impure services the caste members could get someone else to provide for them, instead of having to perform the service themselves the purer the caste. The ranking of the caste depended on the purity of the caste and changed based on economic and occupational changes.

2.4.2. Occupational specialization

This section examines the role that monopolies play in this economy.[24] Taking occupation choice as given, examine the game in the service trade sub-periods ($t > 0$). As discussed in proposition 7, in an equilibrium without occupational restrictions bargaining power will need to be equal across castes. 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 $b_k(e)'s$, $c_k(e)'s$) make it difficult to analyze the effects of 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

Consider a simple two caste, four occupation example to illustrate the main results of this section. With symmetric occupations the non-unique occupations in a caste play no role in determining the bargaining power of the caste. In this case, having a monopoly is essential if a caste is to sustain trade with positive effort. In figure 2.2 let the vertical lines denote the people in a caste and the letter above them denote their occupations. Caste 1 has no occupations unique to it and in the case a consumer cheats on one of the caste members they have no way of punishing the consumer. Caste 2 on the other hand

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

Figure 2.2. An example illustrating the importance of at least one caste monopoly

can sustain trade with positive effort because if a consumer cheats on any member they lose access to service b.[25]

The effort level in the economy is tied to the bargaining power of the caste. The bargaining 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. Compare the 2 equilibria shown in figure 2.3 . In the first equilibrium one occupations a and b contribute to the bargaining power of caste 1 and 2 respectively. In the second one a and d contribute to the bargaining power of caste 1 and b and c contribute to the bargaining power of caste 2. A higher bargaining power in the second equilibrium corresponds to a more efficient economy. Thus not only is having at least one monopoly necessary to sustain positive trade but the higher the degree of monopolization in the economy the more efficient the economy. The setup ignore the usual negative effects of monopolies and just highlights the positive effects that monopolies play in this setting. 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 across different castes. This would

[25]The diagram has a discrete number of caste members but in the model the population is a continuum

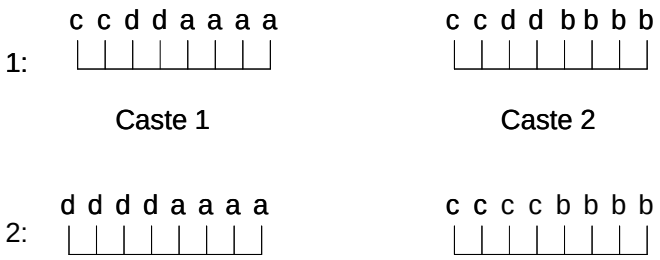

Figure 2.3. An illustration of two possible occupation distributions in equilibrium

imply that monopolies in this economy serve to increase the efficiency with which the system can undertake contract enforcement.

Now consider a more formal argument of the general case with symmetric occupations. Define the set of occupations unique for some caste as $K^{\text{unique}} = \bigcup_c K_c^{\text{unique}}$. 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 $\left[\frac{n_c^{\min}}{N/K}\right]$. With equal bargaining power across castes, the maximum number of occupations unique to some caste is C. $\left[\frac{n_c^{\min}}{N/K}\right]$

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

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 $|K^{\text{unique}}| = C\frac{K}{N} n_c^{\min}$. □

Since 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,* $|K_{\max}^{unique}|$ *can expanded to include* $\left[\frac{K}{C}\right] C$ *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 (2.4.3) discusses the role of purity restrictions that would allow for bargaining power to be unequal across caste allowing improvements in efficiency.

2.4.3. Purity scale

This section examines the role of what are called 'purity restrictions'. There are two parts to this section. The first part tackles the problem of equal bargaining power in equilibrium. As discussed in section 2.3.2 this arises because of the individual's incentive to free-ride on the bargaining power of his caste. Equal bargaining power makes the system very fragile as it could possibly cause the system to collapse should some exogenous factors change the bargaining power across castes. It may also prevent the economy from attaining the efficient equilibrium if it involves unequal bargaining power across castes. The first part of

this section examines how occupational restrictions by caste allows for unequal bargaining power in equilibrium.

The second 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 chapter describe the form these commitments can take, the role they play and the way they can be made credible.

2.4.3.1. Part I - 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. Again consider a simple two caste, two occupation example that illustrates the main results of this section. Suppose there are two castes X and Y and two occupations accountants and sweepers. Suppose in addition that caste X specializes in accountancy services and caste Y in sweeping services. The effort level for each caste will be determined by the following equation

$$w_k(e) = \mu c_k(e) = \frac{1}{1-\beta}\frac{1}{K} b_k(e)$$

There are many ways to build in differences in bargaining power across castes. For example, suppose $c_{\text{acc}}(e) = c_{\text{swe}}(e)\ \forall e$ but $b'_{\text{acc}}(e) = b'_{\text{swe}}(e)\ \forall e$. That is the cost of effort provision is the same for both services but the marginal benefit of effort provision is higher for the accountancy service than it is for the sweeping service. In this case it will imply that $e_{\text{acc}} > e_{\text{swe}}$ and $w_{\text{acc}} > w_{\text{swe}}$. The members of caste X who are all accountants

provide a higher effort and get higher wages than the sweepers in caste Y. Denote the bargaining power of the accountants (sweepers) by B_{acc} (B_{swe}) respectively and notice that $B_{\text{acc}} > B_{\text{swe}}$

The occupation choice of each individual depends on the occupation choices of everyone else. Consider the occupation choice of an individual born into caste X. Everyone else in his caste is an accountant and all the sweepers are in caste Y. If he becomes an accountant, his effort level choice will be determined by the bargaining power of his caste and all the accountants in the economy have the same bargaining power. He will be as good an accountant as everyone else and will have to share the customers with the other accountants. On the other hand, if he becomes a sweeper, the other sweepers will choose their effort choice based on the low B_{swe}, his effort choice for sweeping will be determined by the high B_{acc}. This will make him the only active sweeper in the economy since he supplies the highest effort and he gets all the customers. Thus every individual in the high bargaining power caste has an incentive to deviate and follow the occupations unique to the caste with a lower bargaining power.

The individual belonging to the sweeper caste however never has any incentive to become an accountant. If he does so his effort choice will be governed by the low B_{swe} and he will be the worst sweeper in the economy. This makes his only viable option becoming a sweeper like everyone else in his caste. In order to sustain unequal bargaining power across castes what is needed is a means of making sure the upper castes (high bargaining power castes) do not deviate and follow the occupations of the lower castes. The higher the bargaining power of the caste the more occupations they can profitably follow and

the higher the number of occupations they need to be prohibited from following. What is interesting is that the ranking of the castes is purely occupation based. The higher the number of occupations and the higher the bargaining power of the occupations followed the higher the ranking of the caste. Purity of occupations in this example can be tied to the marginal benefit of effort. The occupation that are more skill intensive or those that have a higher marginal benefit of effort are the occupations with the highest bargaining power and hence the 'pure' occupations in this setting.

In what follows consider one possible way castes are able to enforce these occupational restrictions on their members: namely outcasteing. 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 these free-riders are denied access to the punishment power of their castes they have no incentive to deviate and thus unequal bargaining power can be maintained and 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, $F_{i,c} = 0$.

Outcasteing:

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 outcasteing them. Outcasteing 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 11 (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*

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

  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*

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

.

- *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* $\mu = \{$*with probability* $1, j$ *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), page 104, 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 (O'Malley 1932), page179. For more anecdotal evidence refer to section 2.4.1.2.

Proposition 11 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.

Another possibility is introducing a cost of outcasting. Outcasting involves refusing to punish the consumers who cheat on a free-rider. In reality outcasting also meant that you cut off all social and economic ties with the outcaste even if they are a part of your family. This one could reasonably argue involves some costs. In the setting above there is no cost of outcasting someone and in fact there is a cost of not outcasteing the offender as you would have to give up a profitable interaction with a consumer. The equilibrium is robust to introducing a cost of outcasting which may even be bigger than the cost of not outcasting someone as long as being an outcaste is costly. Consider setting up a equilibrium with penal code strategies (as in (Abreu 1988)) where people who do not punish free riders are themselves punished. This would involve keeping the F label for free-riders and introducing a new label O for people who do not punish people with the label F as discussed. Anyone with the label O is punished in the same way as those with

the label F. As long as the cost of not having access to a caste collective punishment strategy is high enough, outcasteing free riders can be sustained as an equilibrium.[26]

2.4.3.2. Part II - 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:

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

Comparing this to the incentive compatibility constraint without this commitment:

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

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.

[26] A detailed description of this equilibrium is available from the author on request.

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.

2.4.4. Hierarchy and commensality

Based on the argument in the previous section, an individual's purity can 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.

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 2.4.1.2 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 2.4.1.2 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.

2.4.5. Choice of caste: ascriptiveness

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.[27] "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 doing so, but till a few years ago, so did his modern equivalent" (page 230). 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" (page15). 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" (Blunt 1969),page 18. There is nothing in this model that would explain this.

The model so far (except in section 2.4.6) took the distribution of people into castes and the number of castes as given. This assumed the ascriptiveness of the system. Section

[27]Chapter II paragraphs 4 and 5 for example

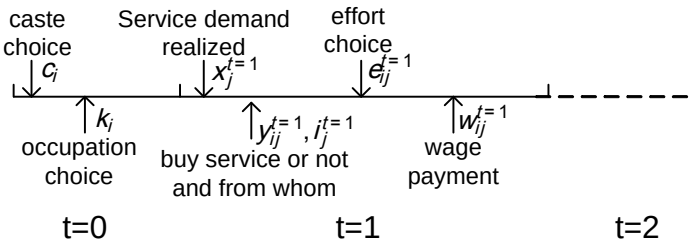

Figure 2.4. Timing with caste choice

2.4.6 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 2.4. 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 12. *Given a number of castes C, consider the equilibrium given in proposition 11. The number of people in each caste is determined by the equal profits across*

castes condition

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

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 11. □

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 (Ogilvie 2004). People have an incentive to change their caste only if there are perceived gains to be had by doing so.[28] From a producer's point of view, one reason why over time one would see incentives for

[28]ability issues are assumed away in this model

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 (2.4.4). 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 2.4.6. 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 11. 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 finds 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 in not a profitable change.

To summarize, the ascriptiveness nature of the caste system is not an 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 it 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.

2.4.6. Castes and population size

The basic model takes the number of castes and the size of each caste as given. This section takes a step back and ask 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 13. *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 change.

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 14. *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

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

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 $B_i\left(N\right)$ and cost by $P\left(\frac{N}{C_i}\right)$ for $i=\{H,L\}$. From the optimality conditions we know that

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

Since

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

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 $C_H \geq C_L$ $\square$

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.

2.5. 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)[29], Cochin (1875) and Mysore (1941). These particular censuses are used because they are the earliest available census that have the approprate 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

[29]I'm very grateful to David Ludden for sharing his Tirunelveli data

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 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)).

2.5.1. 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.[30] 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.[31] There are 18 occupation categories which together with the occupations included in each category are given in table 2.1. Castes were categorized into 23 broad categories. The population of these castes is broken down into 18 occupation categories.

[30] 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.

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

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	Bandymen, 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 2.1. Occupation categories and their contents

In addition for each caste the population, number of houses and number of women is available. Caste data are summarized in table 2.2 and district data are summarized in table 2.3.

Implications from the theory

Castes	Rank (5: highest)	Population mean	Population std dev	Occupation diversity index mean	Occupation diversity index 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
Vaisyas	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
Kshavrakaran	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 2.2. Caste 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 2.3. District data summary

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 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.[32]

The section on castes and population sizes (section 2.4.6) 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 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

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

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 2.1). 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 2005a) 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 2.1 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 following the same occupation and hence do not have a monopoly over those services. This makes castes appear less specializaed 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.

2.5.1.1. Empirical specification. Occupational specialization has two aspects in this chapter. 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 :

$$
\begin{aligned}
diversity_c &= \sum_{k \in K_c} \left(\frac{n_{c,k}}{n_c} \right)^2 \\
n_{c,k} &: \text{number of people in caste } c \text{ following occupation } k \\
n_{c,k} &: \text{number of people in caste } c
\end{aligned}
$$

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:

$$
\begin{aligned}
monopoly_c &= \sum_{k \in K_c} \left(\frac{n_{c,k}}{n_k} \right)^2 \\
n_{c,k} &: \text{number of people in caste } c \text{ following occupation } k \\
n_{c,k} &: \text{number of people in occupation } k \text{ in the district}
\end{aligned}
$$

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 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:

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

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 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:

$$
\begin{aligned}
index_{c,i} &= \alpha + \beta_1 D_i + \beta_2 C_i + \beta_2 E_{i,c} + \varepsilon_{ic} \\
&\quad where: \\
D_i &: \text{District } i \text{ characteristics} \\
C_c &: \text{Caste } c \text{ characteristics} \\
E_{i,c} &: \text{District-caste interactions}
\end{aligned}
$$

2.5.1.2. 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 2.4. 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

Dependent variable: Combined index of occupation diversity

	Basic	Property monopoly	Cccupation 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	6.47	7.25	6.18	6.01	6.57	7.59	10.41	8.47	11.70
population in caste	[5.85]***	[5.05]***	[5.64]***	[5.76]***	[5.08]***	[4.00]***	[3.85]***	[4.08]***	[3.84]***
Fraction in cultivation	-1.68	-2.41	-1.36	-0.90	-1.92	-2.55	-0.31	1.02	0.48
	[1.79]*	[2.28]**	[1.47]	[0.93]	[1.83]*	[2.34]**	[0.32]	[0.76]	[0.36]
Degree of monopoly		-0.49			0.43	0.41			0.57
over property		[0.33]			[1.69]*	[1.24]			[1.79]*
Degree of monopoly		1.04							
over property square		[0.50]							
Caste rank				-0.07	-0.04			-0.03	-0.02
				[2.69]***	[0.95]			[1.48]	[0.77]
Occupation bargaining			-0.18		-0.15		-0.07		-0.06
power			[2.77]***		[1.34]		[1.27]		[0.72]
Fraction of pop* Rank								-1.54	-1.29
								[1.96]*	[1.24]
Fraction of pop*							-3.83		-2.69
occupation b.p.							[2.30]**		[1.04]
Fraction of pop*						-5.08			-0.52
monopoly over property						[0.50]			[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 2.4. Relationship between caste factors and the combined index of occupational diversity

occupational diversity in a caste (table 2.5). 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

Dependent variable: Diversity index of occupation diversity

	Basic	Property monopoly	Cccupation rank	Social rank	All three	fraction of district population Property	Occupation	Rank	All
District	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fixed effects									
Fraction of district	-0.423	-0.348	-0.620	-0.77997	-0.806	-0.290	-1.990	-1.150	-2.031
population in caste	[2.91]***	[1.68]*	[3.72]***	[4.54]***	[3.43]***	[1.01]	[4.24]***	[3.88]***	[3.86]***
Fraction in cultivation	-1.657	-1.682	-1.434	-1.057	-1.017	-1.657	-1.774	-1.346	-1.520
	[5.74]***	[4.92]***	[4.41]***	[3.13]***	[2.33]**	[4.85]***	[6.35]***	[4.07]***	[3.78]***
Degree of monopoly		0.040			0.067	-0.110			0.117
over property		[0.11]			[0.48]	[0.72]			[0.70]
Degree of monopoly		-0.259							
over property square		[0.44]							
Caste rank				-0.052	-0.051			-0.057	-0.048
				[3.68]***	[2.53]**			[3.78]***	[2.00]**
Occupation bargaining			-0.121		-0.042		-0.155		-0.079
power			[3.12]***		[0.78]		[3.64]***		[1.20]
Fraction of pop* Rank								0.232	0.135
								[1.47]	[0.70]
Fraction of pop*							1.242		1.065
occupation b.p.							[3.20]***		[1.92]*
Fraction of pop*						-0.305			-1.752
monopoly over property						[0.20]			[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 2.5. Relationship between caste factors and the diversity index of occupational diversity

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.

2.5.2. Castes and population size

Belonging to a caste is costly because of informational considerations and this cost is rising in caste size (see section 2.4.6). 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 (Tinnevelly), 1823[33]. Tirunelveli is situated in the present day state of Tamil Nadu. The dataset consists of 152 census villages in four contiguous taluks.[34] 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.[35] For further data details see (Ludden 1996) and references therein. The summary of various data items is given in table 2.6. The relation between castes and populations size is given in figure 2.5 2.5

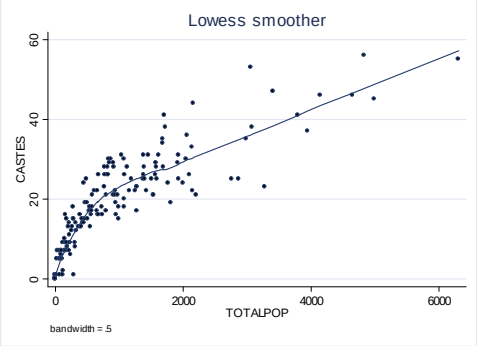

Figure 2.5. Castes versus village population in Tirunelveli, 1823

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

[33]I am very grateful to David Ludden for sharing these data with me.

[34]see (Ludden 1996) for data details

[35]The 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.

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 2.6. Summary statistics for Tirunelvelli 1823

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

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 2.7. Summary statistics for Mysore 1941

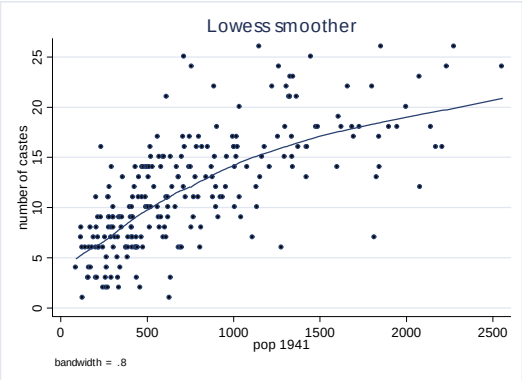

Figure 2.6. Castes versus village population in Mysore, 1941

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 2.7 . The relation between castes and populations size is given in figure 2.6.

2.5.2.1. Empirical specification. 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 faction 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 2.8 and 2.9 . 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.

$$\begin{aligned} \log C_i &= \alpha + \beta_1 \log Pop_i + \beta_3 fracwet_i + \beta_4 fracwet_i^2 \\ &\quad + \beta_5 density_i + \beta X_i + \varepsilon_i \end{aligned}$$

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

2.5.2.2. 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 2.8, 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 2.9), 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

Dependent variable: log of castes

	Basic	Agricultural productivity	Wealth	Schools per capita	Customs	Market activity	Occupations
log population	0.545	0.545	0.587	0.531	0.543	0.545	0.483
	[14.46]***	[18.60]***	[13.32]***	[14.35]***	[13.96]***	[13.71]***	[11.27]***
fraction irrigated	0.785	0.649	0.668	0.946	0.787	0.926	0.803
	[1.70]*	[1.81]*	[1.47]	[1.99]**	[1.68]*	[1.98]**	[1.58]
fraction irrigated sq.	-0.741	-0.941	-0.631	-0.858	-0.746	-0.803	-0.729
	[1.15]	[1.70]*	[1.00]	[1.32]	[1.14]	[1.28]	[1.06]
Population density	-0.186	-0.259	-0.201	-0.185	-0.186	-0.210	-0.189
	[1.77]*	[2.39]**	[2.24]**	[1.79]*	[1.76]*	[2.32]**	[1.96]*
no. of sub-villages	-0.011	-0.010	-0.013	-0.011	-0.011	-0.009	-0.009
	[3.07]***	[3.00]***	[3.31]***	[3.36]***	[2.99]***	[2.48]**	[2.44]**
Agricultural productivity		YES					
Customs					YES	YES	
Market size						YES	
schools per capita				78.404			
				[2.99]***			
Occupations separately							YES
Wealth of village			YES				
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%

Table 2.8. Regression results for 1823 showing castes are positively correlated with population size

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

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	0.571	0.617	0.569	0.558	0.551
	[13.21]***	[12.58]***	[12.76]***	[12.51]***	[12.84]***	[12.01]***
fraction irrigated	1.313	1.271	1.241	1.285	1.270	1.306
	[3.96]***	[3.52]***	[3.55]***	[3.49]***	[3.73]***	[3.29]***
fraction irrigated sq.	-1.220	-1.175	-1.159	-1.200	-1.186	-1.349
	[3.30]***	[3.09]***	[3.08]***	[3.05]***	[3.15]***	[2.99]***
Population density	-0.005	0.022	-0.004	-0.006	-0.004	0.001
	[0.50]	[0.74]	[0.29]	[0.56]	[0.46]	[0.14]
Bulls per acre		-0.215				
		[1.32]				
Water works per acre		0.097				
		[0.84]				
Interior village					-0.075	-0.048
					[1.33]	[0.75]
Fraction of income on						-1.694
remittances						[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 2.9. Regression results for 1941 showing castes are positively correlated with population size

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 tiled houses 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.

2.5.2.3. 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 2.10 and 2.11. 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

Dependent variable: Number of people per caste

	Basic	Agricultural productivity	Wealth	Schools per capita	Customs	Market activity	Occupations
log population	0.016	0.017	0.018	0.016	0.016	0.015	0.018
	[10.22]***	[11.28]***	[10.49]***	[10.69]***	[10.07]***	[9.62]***	[9.14]***
fraction irrigated	-50.768	-43.502	-48.104	-57.946	-49.106	-56.084	-46.829
	[1.50]	[1.74]*	[1.41]	[1.63]	[1.42]	[1.57]	[1.19]
fraction irrigated sq.	48.568	61.055	51.073	53.053	47.289	49.231	43.863
	[1.08]	[1.52]	[1.07]	[1.16]	[1.04]	[1.09]	[0.87]
Population density	10.551	14.402	10.546	10.687	10.524	12.182	10.844
	[2.42]**	[2.11]**	[2.60]**	[2.53]**	[2.38]**	[3.61]***	[2.69]***
no. of sub-villages	1.122	0.895	0.959	1.116	1.082	1.009	1.006
	[3.71]***	[2.90]***	[3.20]***	[4.05]***	[3.61]***	[3.35]***	[3.33]***
Agricultural productivity		YES					
Customs					YES	YES	
Market size						YES	
schools per capita				78.404			
				[2.99]***			
Occupations separately							YES
Wealth of village			YES				
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 2.10. Robustness check for 1823: Number of people per caste positively correlated with population size

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

Dependent variable: Number of people per caste

	Basic	Agricultural productivity	Wealth	Literacy	Outside exposure	
log population	0.03	0.03	0.03	0.03	0.04	0.04
	[6.70]***	[6.51]***	[5.81]***	[7.34]***	[7.66]***	[7.20]***
fraction irrigated	-67.23	-56.68	-62.96	-58.60	-61.57	-61.00
	[1.59]	[1.34]	[1.40]	[1.15]	[1.37]	[1.11]
fraction irrigated sq.	57.83	53.14	54.60	51.46	52.84	58.63
	[1.17]	[1.12]	[1.07]	[0.92]	[1.02]	[0.90]
Population density	-0.02	0.28	-0.39	0.51	-0.09	-0.47
	[0.03]	[0.08]	[0.33]	[0.38]	[0.10]	[0.53]
Bulls per acre		7.69				
		[0.43]				
Water works per acre		-15.45				
		[1.24]				
Interior village					9.30	8.76
					[1.46]	[1.17]
Fraction of income on						30.42
remittances						[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 2.11. Robustness check for 1941: Number of people per caste positively correlated with population size

zeros. The first stage R^2 is .13, F-stat=10.95.[36] Using this in a 2SLS regression (table 2.12)., reduces the population coefficient to 0.54% (which is the same as the 1823 number).

[36]The instrument passes the weak instrument test of (Stock and Yogo 2003)

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		1.32
		[3.90]***
fraction irrigated sq.		-1.25
		[2.98]***
Population density		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

Table 2.12. Instrumental variable for 1941: regression results showing castes are positively correlated with population size

There is some increase in castes due to migration but the effect of population still remains strong.

The empirical evidence presented serves to substantiate the implications of the theory model. 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.

2.6. Conclusions

Institutions are a key determinant of economic outcomes because they affect an 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 affects a large fraction of people in the developing world. Nehru, writing on the eve on Indian independence summed it up well when talking about adopting economic policies and 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."[37] The caste system is difficult to define. Its exact form shows remarkable fluidity over time and place. However what has remained persistent for over 3000 years is the system a form of social stratification that has a set of characteristics. Because of its complexity, it has often proved difficult to analyze and conceptualize. However, we know that it has real effects on the economy. To sufficiently understand the effects, the reasons for the effect and the mechanism of transmission a model is invaluable. This chapter provides a model of the caste system.

The central problem in the economy is contract enforcement. The consumer needs to be stopped from defaulting on the producer after he has received a service from the producer. Of all the possible equilibrium the focus is on those where the defaulter is collectively punished. He is refused services by all the members of the producer's caste. The reason for this is because it is what is seen in reality. The first part of the chapter shows that with these collective punishments trade can be sustained in equilibrium. However

[37](Nehru 1946) pg 244

what makes the caste system the caste system is its characteristic features. The second part of the chapter shows that if punishments are collective then the characteristic features of the caste system like occupational specialization, purity scale and hierarchy are equilibrium outcomes. In fact these features serve to increase the efficiency of contract enforcement giving a reason for why they exist at all. The ascriptive nature of castes is found to have no efficiency considerations but can be shown to affect caste rents. Reasons for why this is observed may be tied to a caste's attempts to preserve rents.

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. This implication is tested using data from Tirunelveli (1823) and Mysore (1941) and found to be consistent with patterns in the data. 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.

This chapter should not be interpreted as saying that the caste system was free of inefficiencies. In fact features like monopolization, restricting occupations by caste may cause inefficiencies in the economy on other dimensions which are not considered in this chapter. It also cannot answer the question of why this equilibrium was chosen in the Indian subcontinent and nowhere else. The caste system starts too early in history to do anything more than conjecture about these reasons. The focus is on understanding the

reasons for the persistence of the system and why we see the system needs the features that define it. In contrast to all the other theories of the caste system the chapter offers a model of the system, based on a simple economic insight (contract enforcement) that offers a coherent view of all the features of the caste system and not just a few.

CHAPTER 3

Dowry and Bride Price: The Role of Location Independent Benefits from the Couple

The main research questions in this chapter are: what factors determine the direction and recipient of marriage payments and what accounts differences across societies and for changes in direction and recipient of payments over time in a society? The primary agents in the marriage market in this chapter will be the parents of the bride and groom. Children are assumed to be identical and are also assumed to marry whomever their parents choose for them, in a sense these are only arranged marriages. The reason for focusing on the parents and not the children is because as (Becker 1991) points out if it is purely a question of surplus accruing to the spouses, a division of surplus within the marriage can be achieved (barring any inflexibilities in sharing) without payments being necessarily exchanged. In most societies marriage payments are large[1] and the couple is still young enough probably to not have enough of their own assets to make these transfers and rely on their parents. One could think of altruism as a reason why parents would care about the match of their child and that is why they are willing to make such large payments. But when payments reach the magnitude of a multiple of annual household income this becomes less believable. In this model the parents pay because they benefit from the match and payments are a way of transferring utility from one side to the other.

[1](Anderson 2007a)

Adding in the intra-household bargaining process between children and parents in the choice of the spouse is an interesting question but one that I abstract from.

The benefits from a match are assumed to be a general function of the types of the agents involved. I separately identify three sources of benefits from the match to the agents. The predictions about changes in direction over time will be due to changes in the relative contribution of the various sources of benefits from the match (marriage).

The sources of benefits to the parents depend on the location of the couple. There are three sources of benefits to the parents, which can be broadly classified into location specific benefits and location independent benefits. Consider first location independent benefits. The first component is *network benefits* that come from the parents expanding their social network to include the relatives of their child's spouse. A family usually has their own network and a marriage allows for the possibility of bringing new valuable members into this group. In Figure 3.1 this would corresponding to channel I. Social networks are important for the larger family unit because they provide help with things like consumption smoothing in the presence of bad shocks, a source of credit, a means of searching for jobs, better information etc. For example in (Watson 1981) a marriage creates a link between all the women of the bride and groom's parent's households who perform functions like providing labor in times of need etc. (Dekker and Hoogeveen 2002) for example consider bride price payments in rural Zimbabwe and find that networks are an important source of insurance against risk. (Rosenzweig and Stark 1989) find evidence that families use marriages as risk sharing, consumption smoothing strategies. In terms of the model this is assumed to depend only on the characteristics of the parents (which

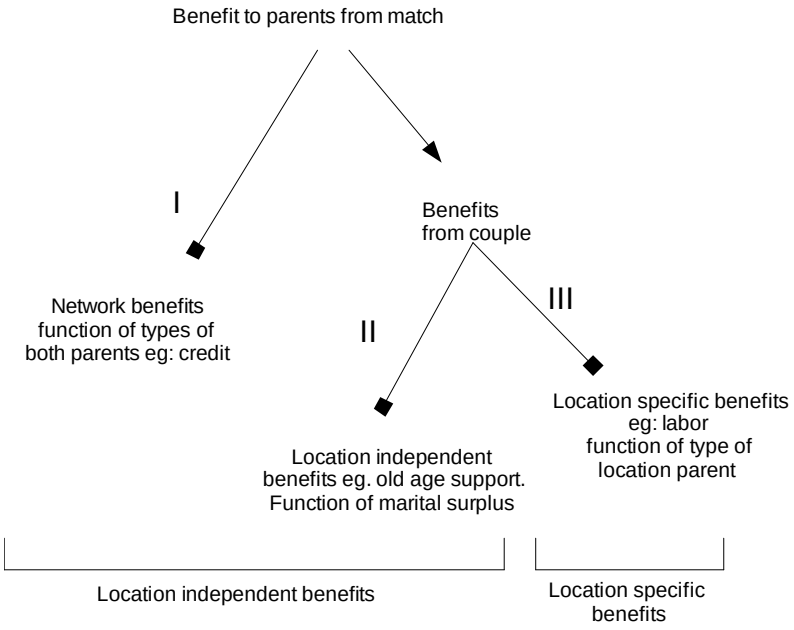

Figure 3.1. Break up of benefits from match to the parents

indirectly are assumed to contain information on the value of the family's network) and not on the individual bride and groom or the new household the couple sets up. These benefits are independent of the location of the couple as the link is between the larger family units of the couple.

The other second source of location independent benefits is from the couple directly (channel II in Figure 3.1). These benefits accrue to *both* sets of parents and do not depend on where the couple lives. When a couple gets married they set up a separate conjugal unit that may or may not be located with a certain set of parents. This conjugal unit creates a marriage surplus. This marriage surplus could be interpreted as the value of the conjugal unit based on the income, asset holdings etc. It may also have value arising from factors like grandchildren etc. The important part of this for the model is the benefits this

has for both sets of parents. For example, the conjugal unit can provide insurance, credit, old age security, extra labor to both sets of parents if required. The fact that it a son's or a daughter's household should not affect the parent's ability to draw on the couple's household in times of need. For example in (Caldwell, Reddy, and Caldwell 1983) they talk about how the bride's parents benefit from the couple even though they live in the city away from the parents. The bride's parents send their younger children to the urban household for further studies, the couple provides assistance to the bride's parents in old age etc. What is important too is that the benefits from this channel are proportional to the value of the couple's separate household and not on any assets/property they may hold jointly with the other set of parents. A recent New York Times article talks about the emotional and financial support that parents receive from their daughter's household and how this could be strongly preferable to that received from their sons.[2]

An argument could be made that both sets of parents do not have equal access to these benefits. For example if the couple lives with the groom's parents then old age support, care during illnesses etc. could be easier for the couple to provide for the groom's parents than for the bride's parents. The further away the bride's parents live the more difficult it becomes for them to access the couple in times of need. This will lead to location affecting the provision of these benefits. This can be incorporated into the analysis and will not change the logic/predictions of the model except to make location more important in determining the direction of flows. To keep the logic simple we assume that these benefits accrue to both sides of the match equally.

[2] *Where Boys Were Kings, a Shift Toward Baby Girls by* Choe Sang-Hund . The New York Times, December 23, 2007

Another argument that could be made is that this channel picks up "affection" for daughters as well as sons when parents care for their child's welfare. Even if parents do not get any benefits from the couple that does not live with them, they could care about the welfare of their child and this channel could be picking that up. If this was truly affection then to get the parents only making gifts to their daughters rather than their sons one would need to argue that parents only have affection for their daughters and not their sons. Unless one adds in another dimension like incentives as (Botticini and Siow 2003) have done. In addition, the parents should care about the couple's total assets which include any common assets/property they may have use of. However this channel only focuses on the solely owned property/assets of the couple.

The third and last set of benefits is *location specific benefits* (channel III in Figure 3.1). These benefits are specifically those that arise when the couple lives with a set of parents and works on the family farm/business. This does not include benefits like old age security, care in time of illness etc. All these benefits will be captured by channel II. This is specifically the extra income generated for the parent's household when the couple works on/with the parent's farm/property/assets. This in a sense comes from the occupation choice of the couple. They could choose to work outside the family firm or join the family business. Should they join the family business the parents earn location specific benefits. This channel is highlighted for example in (Botticini and Siow 2003). These benefits are a function of the characteristics of the family that the couple lives with. This is assumed because for example, the couple works on the family farm and the benefits are proportional to the size/quality of the farm they work on.

Total benefits will be equal to the sum of location specific (III) and location independent benefits (I and II) The focus of this chapter will be on the location independent benefits from the couple (channel II in Figure 3.1). The two sources to location independent benefits may vary in their importance over time. For example in some societies the benefits from the networks are most important and in others the benefits from the couple. To capture this variation across societies consider $k \in [0, 1]$ such that

$$\text{Total location independent benefits} = (1 - k)\,\mathrm{I} + k\mathrm{II}$$

Assume this k to be the same for both sides and exogenous for a given society. For a given f, X the higher the k the higher the importance of the couple. If $k = 1$ then the only source of location independent benefits is X and if $k = 0$ the only source is f. In a sense k captures the relative importance of the couple to location independent benefits from the match. The effect of parameter k on the direction of payments will be explored. Another way to think about it is as follows. Suppose the parents have a need, for example, for credit. They can meet this need by drawing on either the larger family network of their child's spouse (channel I) or directly on the child's household (channel II) or some combination of both. The parameter k denotes the relative importance of these two sources in meeting this need.

The importance of channel III (location specific benefits) will be denoted by μ $(0 < \mu < 1)$. This gives us

$$\text{Total benefits} = (1 - k)\,\mathrm{I} + k\mathrm{II} + \mu\mathrm{III}$$

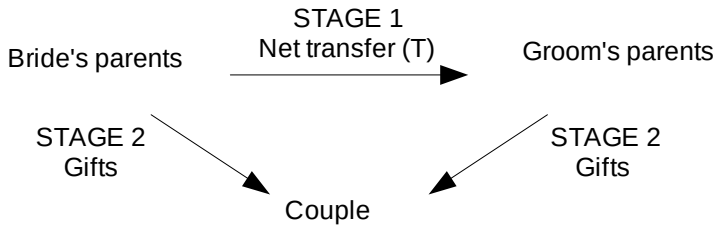

Figure 3.2. Transfers and gifts by stage

To separate out payments exchanged between parents and payments to the couple, the marriage market is broken up into two stages (shown in figure 3.2). In the first stage, parents compete for the best spouse for their child. Payments at this stage will be exchanged between parents. In the second stage, after matching takes place, parents make gifts to the couple via their son or daughter. The justification for the timing is based on the observations that payments exchanged between parents are usually made at the time the match is arranged and before the actual marriage ceremony. For the gifts on the other hand, these are usually taken by the bride and groom to their marital home which takes place after the marriage. Although they could potentially be negotiated before the marriage takes place the actual payment takes place after the marriage (Goody 1973). At each stage factors determining the direction of net payments will be identified. The next step will be to focus on factors that could give us the transition described earlier in chapter 1.

Although the bride and groom do not play a role in choosing their spouse, they play a role in determining the payoffs from the match as a couple. Each couple has a unit of effort/time. They allocate this unit of time between working to increase their marital surplus (channel II) or to work for their parents and increase the location specific benefits

to the parents they live with (channel III). It could also be interpreted as an occupation choice: work on the family farm which directly benefits the parents or work outside to enrich the couple's household only and indirectly benefit the parents. Gifts will play a role in determining how they choose to allocate their time. The gift in the model has two effects. The first is a direct effect, which is to increase the marital surplus of the couple. This increases the utility of the parents through channel II directly. The second is an indirect effect. It helps to divert incentives away from the groom's parent's estate to the conjugal estate. Evidence that this is true can be found in (Goody 1983). He says that the effect of the parents giving the daughter a dowry (gift) serves to draw attention away from the 'conjugal bond' which in his case will be the couple working on the inheritance the groom's family receives and focus it instead on the link with the couple and the bride's kin (Goody 1983), page 256. In colonial Brazil, productive assets given as dowry were given with the intention of setting up a new household, important to the bride's family (Metcalf 1990).

There is research showing that the direction and recipient of payments have an effect on the status of women (Zhang and Chan 1999). The results of the model are checked against evidence on how the status of women and in particular of widows changes as the direction of payments change in society. Empirical evidence is also provided.

3.1. Model

Consider a model of a marriage market, where you have brides and grooms on opposite sides of the market.

3.1.1. Primitives

There is a continuum of bride and groom parents (denoted by i, j respectively), each of measure N. The objective of the marriage market is for one bride to match with one groom[3]. The decision making agents in the model are the parents of the individuals in the matching market. Each agent has the option of remaining unmatched. Denoted the outside option of the bride's parents of having their daughter remain unmarried by O^B and the outside option of the groom's parents of having their son remain unmarried by O^G. This captures the contribution of the unmarried child to household income. Suppose in addition that this outside option is independent of the type of the parent and so all types have the same outside option[4].

The brides and grooms are all identical[5]. The parents however differ in their characteristics. The characteristics of the parents are denoted by a one dimensional variable $\gamma(C, I) \in [\gamma_L, \gamma_H]$ that is the 'type' of the agent, which is common knowledge. The higher the γ of the agent, the more valuable the agent is to the other side. This in reality could be a proxy for wealth, status etc. Denote the distribution of these characteristics by η over$[\gamma_L, \gamma_H]$ for both the bride and groom's parents. Assume the distribution function η is such that the distributions of γ are continuous with non-zero density over the entire convex support[6]. In general one could allow for these supports and distributions to differ

[3]Polygamy and an age structure of the population of brides and grooms are not present. This shuts down the demand and supply of potential brides channel that determines the type of transfers.
[4]This can be relaxed to allow for the outside option to depend positively on the type. With appropriate conditions on the rate of growth of the outside options compared to the complementarities, it will not change the analysis.
[5]This could be relaxed for a richer story but the intuition would still remain the same.
[6]This will ensure differentiability of the matching function later on

across brides and grooms[7]. But since the focus is on the characteristics of the parents and children are identical it is hard to argue that the distribution of characteristics differs by side. Any differences in effect of characteristics by side will be captured by the benefit function. Increasing stratification (inequality) in society will be an increase in the support of γ but the effect is the same on both sides of the market.

Denote the net transfer made by bride i to groom j by T_{ij} and the gifts made by the bride and groom's parents to the couple by $b^B, b^G \geq 0$ respectively. Denote by $e \in [0,1]$ the allocation of time by the couple towards increasing their marital surplus X. The rest $(1-e)$ goes towards increasing the location specific benefits of the match to the parents whom the couple primarily lives with[8].

Denote by $p \in \{0,1\}$ the location of the couple's marital home. This is taken as exogenously given. If $p = 1$, the couple primarily lives with the groom's parent's kin (patrilocal societies) and $p = 0$ the couple primarily lives with the bride's parent's kin (matrilocal societies). Since location specific benefits will be important, one could argue that location of the couple could potentially be an important part of marriage negotiations and thus endogenous. Anthropologists have tried to identify the factors correlated with the location decisions of the couple (patrilocal versus matrilocal). The earliest theories focused on gender differences in the division of labor. The prediction is that a high

[7]This would be important for explanations of dowry inflation due to differences in the relative supply of high quality grooms. (Anderson 2005b) for example focuses on this dimension to explain the rise in dowry payments. But the aim of the model is to explain direction and not growth in payments given direction.

[8]The incentives of the bride and the groom are not considered separately. The assumption is that the entire time allocation of the household is 1 and they have to choose how to spend this time.

relative contribution of men compared to women to subsistence favors patrilocal residence. However there is no consistent empirical support for this prediction and factors correlated with location decisions have been difficult to identify. See (Korotayev 2001) for a review of the empirical and theoretical literature. Since most of the societies in reality are patrilocal the main results will only focus on patrilocal societies. An avenue for future research is understanding what factors make a society patrilocal.

Consider now the three sources of benefits to the parents from the match of their children. The benefits to the parents have two major sources: location specific and location independent benefits. Channel III captures the location specific benefits of the match, denoted by L. It captures the benefit the parents get from having the couple work on their estate. It is assumed to be a function of the parental characteristics and the allocation of time the couple puts towards increasing the location specific benefits $(1-e)$. This is captured by $L\left(\gamma^B, 1-e\right)$ for the bride's family and $L\left(\gamma^G, 1-e\right)$ for the groom's family The importance of channel III (location specific benefits) will be denoted by μ $(0<\mu<1)$. The higher μ the more important location specific benefits will be for the parents for a given γ and e.

Location independent benefits have two sources: network benefits and the couple. Channel I captures the network benefits. Denote this by function $f\left(\gamma^B, \gamma^G\right)$. The network benefits are a function of the types of the parents. Assume in addition that this function is the same for the bride and the groom's parents. That is, the value of the network for a given set of types $\left(\gamma^B, \gamma^G\right)$ is the same regardless of whether it is the bride's parents who incur these benefits or whether it is the groom's parents who incur these benefits.

Denote by X the marital surplus of the couple. This surplus is assumed to be a function of the parent's types, the total gifts received $\left(b = b^G + b^B\right)$ and $e : X\left(\gamma^B, \gamma^G, e, b\right)$ where $X'_s \geq 0$ for $s = \{\gamma^B, \gamma^G, e, b\}$, $X''_{be} \geq 0$. Channel II captures the contribution of the couple to location independent benefits. The two sources to location independent benefits may vary in their importance over time. For example in some societies the benefits from the networks are most important and in others the benefits from the couple. As discussed earlier, to capture this variation across societies consider $k, \mu \in [0, 1]$ such that

$$\text{Total location independent benefits} = (1 - k) f + kX$$

$$\text{Total benefits} = (1 - k) f + kX + \mu L$$

Consider the benefits to the couple from the match. The benefits to the couple have two sources of benefits. The first is their marital surplus X. They get the whole X in all societies.[9] The second is the benefit they get from working on the family farm of the set of parents they live with. Assume that the benefit from this source is the same as the location specific benefits to the parents. Since the location specific benefits to the parents accrue to the parents because of the couple working on the farm it is reasonable to assume that the benefits to the couple are also proportional to this (μL). It is also equivalent to assuming that the couple inherits the farm they work on. They choose e to maximize their total benefits.

[9]There could be confusion about how the couple gets the whole X and the parents get kX. The best way to think about this is that the parents receive a benefit that is proportional to the value of the couple's own estate X and the couple gets the whole X.

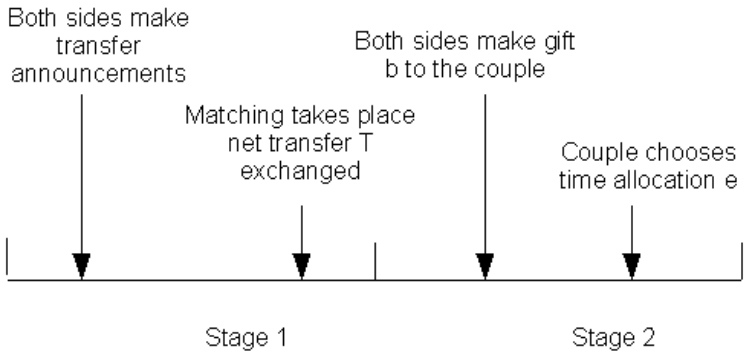

Figure 3.3. Timing of the game

Timing:

The game consists of two stages. In stage 1 both sides make announcements of non-negative transfers they are willing to make to their match. What matters for the analysis is the net-transfer for each match (T). Based on the net transfers matching takes place according to the matching function $M(i) = j$. Each agent has the option of remaining unmatched and receiving their outside option. At stage 2 both the bride and groom's parents make gifts $b^s, s = \{B, G\}$ to the couple following which the couple chooses their time allocation e (figure 3.3).

3.1.2. Payoffs

The total payoff to the parents is denoted by U. There are three sources of benefit from the match. The first is the benefit coming from direct links with the match family parents (f). The second is the benefit coming from the child's marital surplus (X) that is independent of the location of the couple. Thirdly, the contribution of the couple that comes purely from the location of the couple (L). Total benefits are additively separable in these three

sources. The parameter k denotes the relative contribution of the two sources that do not depend on location. Denote the payoff to bride's parents (i) when their daughter matches with the $j's$ son by

$$U^B\left(\gamma_i^B, \gamma_j^G\right) = (1-k) f\left(\gamma_i^B, \gamma_j^G\right) + kX\left(\gamma_i^B, \gamma_j^G, e, b\right) \tag{3.1}$$

$$+ (1-p)\mu L\left(\gamma_i^B, 1-e\right) - T_{ij} - b^B \tag{3.2}$$

where T_{ij} is the net transfer made by bride's parents i to groom's parents j. If the couple does not live with the bride's parents then $p = 1$ and the only sources of benefit are those independent of location which are weighted by k. However, when $p = 0$, in addition they get the benefit $\mu L\left(\gamma_i^B, 1-e\right)$ that comes from the couple working on their estate.

Similarly the total payoff to groom $j's$ parents when their son matches with $i's$ daughter is given by

$$U^G\left(\gamma_i^B, \gamma_j^G\right) = (1-k) f\left(\gamma_i^B, \gamma_j^G\right) + kX\left(\gamma_i^B, \gamma_j^G, e, b\right) \tag{3.3}$$

$$+ p\mu L\left(\gamma_j^G, 1-e\right) + T_{ij} - b^G \tag{3.4}$$

Denote the payoff of the couple by C. The couple's only decision is how to allocate their time. Their benefit depends on their marital surplus X and the location specific benefits of the parents μL. The payoff to the household established when $i's$ daughter

matches with $j's$ son by

$$\begin{aligned} C\left(\gamma_i^B, \gamma_j^G\right) &= X\left(\gamma_i^B, \gamma_j^G, e, b\right) \\ &\quad + (1-p)\,\mu L\left(\gamma_i^B, 1-e\right) + p\mu L\left(\gamma_j^G, 1-e\right) \end{aligned}$$

Assume in addition that there are strict complementarities in type for the parents. That is if there are two bride types $\gamma_1^B > \gamma_0^B$ and two groom types $\gamma_1^G > \gamma_0^G$, the following inequalities hold (given k, p)

$$U^B\left(\gamma_1^B, \gamma_1^G\right) + U^B\left(\gamma_0^B, \gamma_0^G\right) > U^B\left(\gamma_1^B, \gamma_0^G\right) + U^B\left(\gamma_0^B, \gamma_1^G\right)$$

$$U^G\left(\gamma_1^G, \gamma_1^B\right) + U^G\left(\gamma_0^G, \gamma_0^B\right) > U^G\left(\gamma_1^G, \gamma_0^B\right) + U^G\left(\gamma_0^G, \gamma_1^B\right)$$

In addition, assume that the payoffs for the lowest types are such that for all $k \in [0,1]$

$$\begin{aligned} &2\left[(1-k)\,f\left(\gamma_L^B, \gamma_L^G\right) + kX\left(\gamma_L^B, \gamma_L^B, b, e\right)\right] \\ &+ (1-p)\,\mu L\left(\gamma_L^B, 1-e\right) + p\mu L\left(\gamma_L^G, 1-e\right) \;\geq\; O^G + O^B \end{aligned}$$

These will ensure that in the matching process below, all types will always prefer to be matched rather than remain unmatched.

3.2. Marriage Market Equilibrium

Before discussing the equilibrium, some definitions are needed. The first of which is feasibility. It says that the matching function assigns only one groom to each bride and that the payoffs from matching are at least as good as the outside option of the agents.

Definition 15. *Matching M is said to be* feasible *if for any subset of groom's parents $E \subseteq N$,*

$$Measure^B \left(M^{-1}(E)\right) = Measure^G(E).$$

and the equilibrium transfers and expenditures $\{T^*, e^*\}$ for all i, j satisfy

$$\begin{aligned} U^B\left(\gamma_i^B, \gamma_j^G\right) &\geq O^B \\ U^G\left(\gamma_i^B, \gamma_j^G\right) &\geq O^G \end{aligned}$$

The next condition is stability. It ensures that no two agents can get at least the same benefit (with at least one strictly better off) by matching with each other instead of matching with the person the matching function assigns them.

Definition 16. *The matching function M is stable if there does not exist any bride parent h, groom parent k and transfer $\hat{T}$ such that with this transfer*

$$\begin{aligned} U^B\left(\gamma_h^B, \gamma_k^G\right) &\geq U^B\left(\gamma_h^B, M\left(\gamma_h^B\right)\right) \\ U^G\left(\gamma_h^B, \gamma_k^G\right) &\geq U^G\left(M\left(\gamma_k^G\right), \gamma_k^G\right) \end{aligned}$$

and at least one of the inequalities is strict.

Definition 17. *Equilibrium is a sub-game perfect Nash equilibrium with matching function M and transfer payments T such that M with T is feasible and stable.*

With the basic framework established, the game is solved backwards starting from Stage 2. Again, although the results can be proved for both patrilocal and matrilocal societies, since the societies in reality are predominantly patrilocal, the discussion and results focus on the case of $p = 1$.

3.2.1. Gifts and effort allocation (Stage 2)

Consider the time allocation choice of the couple. They choose e to maximize their benefit

$$e^* = \arg\max\{X\left(\gamma_i^B, \gamma_j^G, e, b\right) + \mu L\left(\gamma_j^G, 1-e\right)\}$$

The first order condition will be given by

$$X'_e = \mu L'_{1-e}\left(\gamma_j^G\right)$$

The couple chooses their time allocation such that the marginal benefit from both sources is the same.

Taking this into account, the parents then have to decide on the gifts they have to make to the couple. At this stage they have already matched and take their partner as given when deciding how much of a gift to give. Both sides make their gift decision

simultaneously and their gift is a best response to the other parent's gift as the couple's optimal e depends on the total gift received $\left(b^B + b^G\right)$. Notice the role that the location of the couple plays in a parent's gift decision. A higher gift increases the value of the marital surplus. To the extent that this changes the incentives of the couple to change their optimal e^* the gift decision of the parents depends on the location of the couple.

Consider the gift decision for the parents that have the couple living with them. The total gift b that maximizes their benefit (subject to their match) satisfies the following first order condition

$$k\left[X_b' + X_e' \frac{\partial e}{\partial b}\right] = \mu L_{1-e}' \frac{\partial e}{\partial b} + 1$$

Thus given the gift of the other side, their best response is to provide the remainder. For the set of parents that do not have the couple living with them however their total gift b that maximizes their benefit (subject to their match) satisfies the following first order condition

$$k\left[X_b' + X_e' \frac{\partial e}{\partial b}\right] = 1$$

Thus given the gift of the other side, their best response is to provide the remainder. Notice that if $L_{1-e}', \frac{\partial e}{\partial b}, \mu \neq 0$ this introduces a difference in what the parents would like the total gift to the couple to be. In particular if $L_{1-e}', \frac{\partial e}{\partial b}, \mu > 0$, the parents who obtain the location specific benefits will prefer a smaller gift as a higher gift increases the allocation of the couple towards their own marital surplus and away from the location specific benefits. However since gifts always have to be non-negative, this pushes us towards a corner solution. In this case, the only parents that make a gift will be the parents who the couple does *not* live with.

$k=0, \mu>0$	$k>0, \mu>0$	$k>0, \mu=0$	$k=0, \mu=0$
No gifts	Only bride's parents give gifts	Both sides give equal gifts	No gifts given

Table 3.1. Gifts for patrilocal societies

Notice also the role of k. The gift will only be positive if $k > 0$. If $k = 0$, the couple's marital surplus does not affect the parent's benefit at all and since making a gift is costly, the parents choose a zero gift. The higher the importance of the location independent benefits of the couple (the higher the k) the higher the marginal product of the gift to the parents benefit and the higher the gift, all else equal.

If location specific benefits are unimportant ($\mu = 0$) or the couple's effort does not affect location specific benefits $\left(L'_{1-e} = 0\right)$ then there is no difference by side (bride or groom) for the parents. Both have the same preferences for the size of the gift and the gift could be shared between them. Abstracting away from the factors that could affect this sharing of gift, I assume that the both sides make equal gifts to the couple. This is summarized in the proposition below

Proposition 18.

- *If* $k = 0$, $b^G = b^B = 0$
- *for a given match* $\left(\gamma^B, \gamma^G\right)$, *and where* b *satisfies* $k\left[X'_b + X'_e \frac{\partial e}{\partial b}\right] = 1$ *if* $k > 0$
  - *and* $\mu L'_{1-e} \frac{\partial e}{\partial b} > 0$ *then* $b^G = 0, b^B = b$
  - *and* $\mu L'_{1-e} \frac{\partial e}{\partial b} = 0$ *then* $b^G = b^B = \frac{b}{2}$

Proof. see discussion above □

The predictions can be summarized in table 3.1

In this case, the only time when no gifts will be made will the case when $(k = 0)$ the non-location benefits from the couple do not affect the parent's benefit. Since gifts are costly, parents make no gifts if they gain no extra benefit from it. In the case when location specific benefits are important $(\mu > 0)$, for $(k > 0)$ we are in a corner solution where the bride's parents always want a higher total gift than the groom's parents and so they are the only one who pay a gift. Only when location independent benefits are unimportant $(k > 0, \mu = 0)$ do both sides pay a gift as their incentives are aligned.

To explain differences in gifts given to the couple (via either the bride or the groom) across societies the model requires differences in k and μ. Consider differences in marriage payments across Africa and Europe. In Africa, payments are primarily bride price in nature and the couple gets no gifts from either side apart from very small token gifts brought by the bride (Goody 1973). The current literature says that reliance on kin networks is a distinguishing feature of dowry and bride price societies. Bride price societies, more than dowry societies, have the important benefits coming from an expansion in the networks through marriage (Anderson 2007a).

For Europe consider the discussion of the evolution of the family in (Goody 1983).What he finds is in general a shift from the extended kinship networks to a conjugal family unit. The evolution was such that the broader kinship group lost power and the monogamous family group constituted the basic social group. Together with this is a general trend towards daughters receiving gifts at the time of marriage. He interprets this as increased stratification causing gifts. In this framework increased importance of couple versus kin networks is important. As kinship networks fail, the parents depend more heavily on their

children for location independent things like old age support etc. In this case they have an incentive to make sure the daughter's family even though she moves away is wealthy.

The other explanation in the literature to explain gifts at the time of marriage primarily from the bride's family come from (Goody 1973) and (Botticini and Siow 2003). In (Goody 1973), families always care about the welfare both sons and daughters $(k > 0)$. His story is about stratification. In short his prediction is if $\gamma_i = \gamma_j$ for all i, j then you will see no gifts. With heterogeneity in $\gamma' s$ gifts from the bride's side will arise. In this model, whether the $\gamma' s$ are the same or heterogeneous doesn't matter for the prediction of gifts from the bride's family. All that is required is $k > 0$.

He says gifts are a daughter's inheritance which they receive at the time of marriage but is unable to explain the timing. (Botticini and Siow 2003) focus on the timing and they highlight the decision to split the estate of the parents. If a couple's incentives are important then you want them to inherit the whole estate. In the case when the parents care about both sons and daughters and sons incentives are important you want to split the estate early and give the daughter her inheritance at the time of her marriage. Their argument of incentives is similar to the one presented here however the difference is in the reason for giving the daughter's their gift. In this chapter it is to divert the couple's effort away from the location specific benefits of the groom's family, given that the inheritance pattern are such that the couple always inherits the estate of the parents they live with. (Botticini and Siow 2003) consider an intra-family decision process where dowry gives the daughter her share at the beginning so that the residual claimant, the son living with them has the right incentives to exert effort. The common factor is that location specific

benefits are important. These explanations could be viewed as complementary. In this setting if $k > 0, L'_{1-e} = 0$, (Botticini and Siow 2003) would predict no gifts and this chapter would predict equal gifts from both sides.

Consider the evidence presented in (Nazzari 1990) on the evolution of dowries as a gift in Sao Paulo 1600-1770. What she finds is that initially when location specific benefits are very important because the couple worked for the family estate, parents of sons were loathe to let their sons get married. In order to get married, a son had to have enough of his own land to be able to set up a household. Parents in this case would give their daughters large dowries consisting of land and slaves and other factors important to set up a new household to enable the groom to marry. They gave their sons nothing when they got married. However over time as location specific benefits start to lose ground because of the decline in agriculture, sons and daughters both received gifts to enable them to start up a household and the emphasis became on matching contributions of the bride and groom. In this framework of the model, this exercise would hold k constant and gradually decrease μ. The prediction that this would result in a movement from gifts by only the wife's family to a situation with gifts by both families is borne out in her study.

One question that could be raised here would be the parent's incentives to give gifts to children who leave the household for reasons other than marriage, for example to become priests or nuns? In this setting as long as the parents had some benefit from these children in terms of old age support etc., they always have an incentive to supply them with gifts to enable them to provide these services. However since the priest or nun child doesn't have to make a distortionary effort choice, parents do not differentiate by gender and

give children of both sexes (priests and nuns) a gift when they leave. This is a similar prediction to the one in (Botticini and Siow 2003) but for different reasons.

This brings us to a discussion of stage 1 where parents compete for the best match of their children.

3.2.2. Matching (Stage 1)

Stage 1 is the matching stage where bride and groom parents compete for the match that maximizes their benefit given what happens in the second stage. At the matching stage each side first makes announcements of the transfer they are willing to make and based on these announcements, matching takes place. This is essentially a competition for the best brides and grooms and the net transfer that results will be the price that clears the market.

I focus on assortative matching. With strong complementarities, perfect assortative matching is efficient (Becker 1991). Consider in particular a matching function M that matches brides and grooms in the following way: A bride of type γ_i^B is matched with a groom of type γ_j^G who is chosen randomly from amongst the grooms at the same percentile as the bride in the distribution of types i.e. $\eta\left(\gamma_j^G\right) = \eta\left(\gamma_i^B\right)$

$$M\left(\gamma_i^B\right) = \eta^{-1}\left(\eta\left(\gamma_i^B\right)\right)$$

By behaving like a higher type a bride can improve her match by

$$M'\left(\gamma_i\right) = \frac{\eta'\left(\gamma_i\right)}{\eta'\left(M\left(\gamma_i\right)\right)}$$

The assumptions on the distribution functions η[10] ensure that the matching function is differentiable. Since I've assumed identical supports and distributions this will imply that $M'(\gamma_i) = 1$ and $M(\gamma) = \gamma$. Denote the associated net transfers from bride to groom with such a matching function by $T(\gamma_i)$. Suppose for now that this net transfer function is continuous and differentiable. Later on I will show that this is the case. Also note that the assumptions on the payoffs ensure that even the lowest types will prefer to match then remain unmatched. A discussion on how changing the outside option affects this is considered later.

For this matching function to be stable there should not exist any pair and a transfer that makes then no worse of (and one of them strictly better off) by matching with each other. The proposition below shows what the transfer scheme should look like in order to ensure that the assortative scheme outlined above is stable.

Proposition 19. *Suppose the matching function is assortative and is given by* $M\left(\gamma^B\right) = \eta^{G-1}\left(\eta^B\left(\gamma^B\right)\right)$. *With the net transfer function described by the following differential equation, the matching is stable:*

$$T'\left(\gamma^B\right) = k\left[\frac{\partial X}{\partial \gamma_G} - \frac{\partial X}{\partial \gamma_B}\right] - \frac{db^B}{d\gamma_G} + \frac{db^G}{d\gamma_B} + \mu L'_{1-e}\frac{de}{d\gamma_B}$$

with boundary condition given by $T\left(\gamma_L^B\right) = \alpha \in \mathbb{R}$

[10]continuous with non-disappearing density over a convex support

Proof.

$$U^B\left(\gamma_i^B,\gamma_j^G\right)=(1-k)\,f\left(\gamma_i^B,\gamma_j^G\right)+kX\left(\gamma_i^B,\gamma_j^G,e,b\right)-T_{ij}-b^B$$

$$\begin{aligned}U^G\left(\gamma_i^B,\gamma_j^G\right) &= (1-k)\,f\left(\gamma_i^B,\gamma_j^G\right)+kX\left(\gamma_i^B,\gamma_j^G,e,b\right)\\ &\quad +\mu L\left(\gamma_j^G,1-e\right)+T_{ij}-b^G\end{aligned}$$

The match is not stable if there exists a γ_k^B and γ_l^G and a transfer $\hat{T}$ such that

$$\begin{aligned}U^B\left(\gamma_k^B,\gamma_l^G,\hat{T}\right) &\geq U^B\left(\gamma_k^B,M\left(\gamma_k^B\right),T\right)\\ U^G\left(\gamma_k^B,\gamma_l^G,\hat{T}\right) &\geq U^G\left(M^{-1}\left(\gamma_l^G\right),\gamma_l^G,T\right)\end{aligned}$$

with one of the inequalities strict. From the benefit functions this implies that

$$U^B\left(\gamma_k^B,\gamma_l^G,\hat{T}\right)\geq U^B\left(\gamma_k^B,M\left(\gamma_k^B\right),T\right)$$

$$\begin{aligned}&(1-k)\,f\left(\gamma_i^B,\gamma_j^G\right)+kX\left(\gamma_i^B,\gamma_j^G\right)-\hat{T}-b^B\left(\gamma_i^B,\gamma_j^G\right)\\ \geq\ &(1-k)\,f\left(\gamma_i^B,M\left(\gamma_k^B\right)\right)+kX\left(\gamma_i^B,M\left(\gamma_k^B\right)\right)\\ &-T\left(\gamma_k^B\right)-b^B\left(\gamma_k^B,M\left(\gamma_k^B\right)\right)\end{aligned}$$

$$\begin{aligned}\Rightarrow\ \hat{T}\leq{}&(1-k)\left[f\left(\gamma_i^B,\gamma_j^G\right)-f\left(\gamma_i^B,M\left(\gamma_i^B\right)\right)\right]\\ &+k\left[X\left(\gamma_i^B,\gamma_j^G\right)-X\left(\gamma_i^B,M\left(\gamma_i^B\right)\right)\right]\\ &+T\left(\gamma_i^B\right)-b^B\left(\gamma_i^B,\gamma_j^G\right)+b^B\left(\gamma_i^B,M\left(\gamma_i^B\right)\right)\end{aligned}$$

$$U^G\left(\gamma_k^B, \gamma_l^G, \hat{T}\right) \geq U^G\left(M^{-1}\left(\gamma_l^G\right), \gamma_l^G, T\right)$$

$$\begin{aligned}
& (1-k)\, f\left(\gamma_i^B, \gamma_j^G\right) + kX\left(\gamma_i^B, \gamma_j^G, e, b\right) \\
& +\mu L\left(\gamma_i^B, \gamma_j^G\right) + \hat{T} - b^G\left(\gamma_i^B, \gamma_j^G\right) \\
\geq\ & (1-k)\, f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + kX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, e, b\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + T\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -b^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right)
\end{aligned}$$

$$\begin{aligned}
\Rightarrow\ & \hat{T} \geq (1-k)\, f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) \\
& +kX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, e, b\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + T\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -b^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) \\
& -(1-k)\, f\left(\gamma_i^B, \gamma_j^G\right) - kX\left(\gamma_i^B, \gamma_j^G, e, b\right) \\
& -\mu L\left(\gamma_i^B, \gamma_j^G\right) + b^G\left(\gamma_i^B, \gamma_j^G\right)
\end{aligned}$$

with at least one of the inequalities strict. A sufficient condition to ensure that this does not occur is

$$\begin{aligned}
& (1-k) f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + kX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, e, b\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + T\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -b^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) - (1-k) f\left(\gamma_i^B, \gamma_j^G\right) \\
& -kX\left(\gamma_i^B, \gamma_j^G, e, b\right) - \mu L\left(\gamma_i^B, \gamma_j^G\right) + b^G\left(\gamma_i^B, \gamma_j^G\right) \\
\geq\ & (1-k)\left[f\left(\gamma_i^B, \gamma_j^G\right) - f\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] + \\
& k\left[X\left(\gamma_i^B, \gamma_j^G\right) - X\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] \\
& +T\left(\gamma_i^B\right) - b^B\left(\gamma_i^B, \gamma_j^G\right) + b^B\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)
\end{aligned}$$

Consider a deviation where type γ^B tries to make a match with the groom assigned to type $\gamma^B + \epsilon$, *i.e.*$M\left(\gamma^B + \epsilon\right)$. A sufficient condition to ensure that this cannot happen is given by

$$
\begin{aligned}
& (1-k)\, f\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+kX\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& +\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+T\left(\gamma^B+\epsilon\right) \\
& -b^G\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)-(1-k)\, f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right) \\
& -kX\left(\gamma^B, M\left(\gamma^B+\epsilon\right), e, b\right) \\
& -\mu L\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+b^G\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right) \\
\geq\ & (1-k)\left[f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-f\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +k\left[X\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-X\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +T\left(\gamma^B\right)-b^B\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+b^B\left(\gamma^B, M\left(\gamma^B\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
& T\left(\gamma^B+\epsilon\right)-T\left(\gamma^B\right) \\
& \geq (1-k)\left[f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-f\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +k\left[X\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-X\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& -b^B\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+b^B\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& -(1-k)\, f\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)-kX\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& -\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+b^G\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& +(1-k)\, f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+kX\left(\gamma^B, M\left(\gamma^B+\epsilon\right), e, b\right) \\
& +\mu L\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-b^G\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)
\end{aligned}
$$

The same way, in order to ensure that the match of type $\gamma^B, M\left(\gamma^B\right)$ has no incentive to match with the bride of type $\gamma^B + \epsilon$ the following needs to hold

$$
\begin{aligned}
& (1-k) f\left(\gamma^B, M\left(\gamma^B\right)\right) + kX\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& +\mu L\left(\gamma^B, M\left(\gamma^B\right)\right) + T\left(\gamma^B\right) - b^G\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& -(1-k) f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - kX\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
& -\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) + b^G\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
\geq\ & (1-k)\left[f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - f\left(\gamma^B+\epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& +k\left[X\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - X\left(\gamma^B+\epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& +T\left(\gamma^B+\epsilon\right) - b^B\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) + b^B\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
& (1-k) f\left(\gamma^B, M\left(\gamma^B\right)\right) + kX\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& +\mu L\left(\gamma^B, M\left(\gamma^B\right)\right) - b^G\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& -(1-k) f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - kX\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
& -\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) + b^G\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
& -(1-k)\left[f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - f\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)\right] \\
& -k\left[X\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - X\left(\gamma^B+\epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& +b^B\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) - b^B\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
\geq\ & T\left(\gamma^B+\epsilon\right) - T\left(\gamma^B\right)
\end{aligned}
$$

Putting them together and substituting in the fact that the distributions of γ are the same for bride and groom's parents and functions f are the same for both sides. With continuous types as $\epsilon \to 0$ this translates into

$$\frac{dT\left(\gamma^B\right)}{d\gamma^B} = k\left[\frac{dX}{d\gamma_G} - \frac{dX}{d\gamma_B}\right] - \frac{db^B}{d\gamma_G} + \frac{db^G}{d\gamma_B} + \mu L'_{1-e}\frac{de}{d\gamma_B}$$

Again using the fact that the distributions of γ are the same for bride and groom's parents and functions and the functions b, X are the same for both sides, this reduces to

$$\frac{dT\left(\gamma^B\right)}{d\gamma^B} = k\left[\frac{\partial X}{\partial\gamma_G} - \frac{\partial X}{\partial\gamma_B}\right] - \frac{db^B}{d\gamma_G} + \frac{db^G}{d\gamma_B} + \mu L'_{1-e}\frac{de}{d\gamma_B}$$

□

Proposition (19) describes the slope of the transfer function. But the actual transfers are determined by the boundary condition as well. Now consider how the boundary condition is determined.

The transfers for each type are determined by the extent of competition for each type. Since every type is aiming to be matched with a higher type, the payment each type (γ) makes is determined in part by the most the type below it is willing to pay to match with γ's partner. With assortative matching, the lowest types are always matched to each other. For the lowest type there is no competition from below. There needs to be a constraint apart from competition to determine what the net transfer would be.

The bride's outside option is given by O^B and the groom's by O^G. The assumptions on the payoffs ensure that the lowest types always find it profitable to match. The maximum transfer the lowest type bride's parent is willing to make is given by their individual rationality constraint

$$T\left(\gamma_L^B\right) \leq (1-k)\, f\left(\gamma_L^B, \gamma_L^G\right) + kX\left(\gamma_L^B, \gamma_L^G\right) - O^B - b^B$$

and the minimum transfer the lowest type on the groom's side is willing to accept to enter into a match with the highest type is given by

$$T\left(\gamma_L^B\right) \geq O^G - (1-k)\, f\left(\gamma_L^B, \gamma_L^G\right) - kX\left(\gamma_L^B, \gamma_L^G\right) - \mu L\left(\gamma_L^G\right) + b^G$$

The net transfer for the lowest type needs to lie within these bounds. Where exactly within these bounds it lays is an open question. There are many ways of dealing with this. One of the simplest is to assume a sharing rule of β over the surplus determined by Nash bargaining. The higher the β the higher the bargaining power of the groom's side and the higher the share of surplus they get. This would make the boundary condition $\alpha = T\left(\gamma_L^B\right)$ for a given k, p given by

$$\begin{aligned} \alpha &= \beta\left[(1-k)\, f\left(\gamma_L^B, \gamma_L^G\right) + kX\left(\gamma_L^B, \gamma_L^G\right) - O^B - b^B\right] \\ &\quad + (1-\beta)\left[O^G - (1-k)\, f\left(\gamma_L^B, \gamma_L^G\right) - kX\left(\gamma_L^B, \gamma_L^G\right) - \mu L\left(\gamma_L^G\right) + b^G\right] \end{aligned}$$

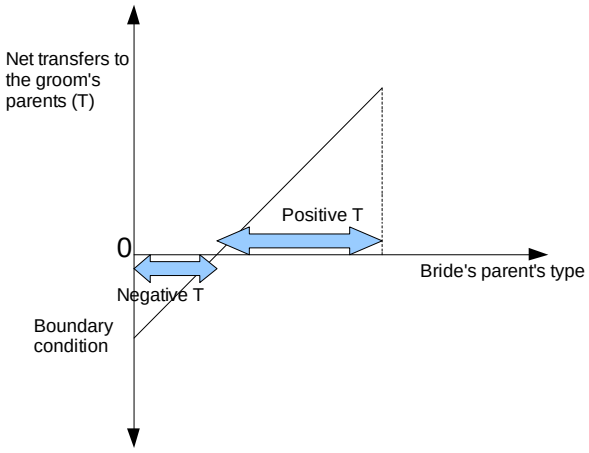

Figure 3.4. An example of a transfer function in the economy

Depending on the parameters, we could be in a case where $\alpha < 0$ where the groom's side needs to give the lowest type on the bride's side an incentive to enter into a marriage with the lowest type groom's family. For $\alpha > 0$, the lowest type groom's family would need to be paid α to get them to agree to a match with the lowest type of bride's family. To make things even simpler consider the specific case of $\beta = 1/2$. In this case

$$\alpha = \frac{1}{2}\left[O^G - O^B + b^G\left(\gamma_L^G\right) - b^B\left(\gamma_L^B\right) - \mu L\left(\gamma_L^G\right)\right]$$

As highlighted by (Boserup 1970) the value of the bride and groom to their natal families play an important role in determining the direction of the net transfer flows. In this framework, it will play a role by determining the boundary condition, the rest determined by the slope function. It also allows for cases when both types of payments (positive bride transfers and negative bride transfers) in the economy as demonstrated in figure 3.4.

Corollary 20. *Consider patrilocal societies,* $p = 1$ *and suppose* $X''_{e\gamma_B} = 0$ $\left(\Rightarrow \frac{de}{d\gamma_B} = 0\right)$

- *If* $k = 0$,
  - *and* $\mu > 0 : T\left(\gamma^B\right) = \frac{1}{2}\left[O^G - O^B - \mu L\left(\gamma_L^G\right)\right]$ *for all* γ^B
  - *and* $\mu = 0 : T\left(\gamma^B\right) = \frac{1}{2}\left[O^G - O^B\right]$ *for all* γ^B
- *If* $k > 0$
  - *and* $\mu > 0$:
    - $\alpha = \frac{1}{2}\left[O^G - O^B - b^B\left(\gamma_L^B\right) - \mu L\left(\gamma_L^G\right)\right]$
    - $T'\left(\gamma^B\right) = k\left[\frac{\partial X}{\partial \gamma_G} - \frac{\partial X}{\partial \gamma_B}\right] - \frac{db^B}{d\gamma_G}$
  - *and* $\mu = 0$:
    - $\alpha = \frac{1}{2}\left[O^G - O^B\right]$
    - $T'\left(\gamma^B\right) = k\left[\frac{\partial X}{\partial \gamma_G} - \frac{\partial X}{\partial \gamma_B}\right]$

Proof. By direct examination of

$$\begin{aligned} \alpha &= \frac{1}{2}\left[O^G - O^B + b^G - b^B - \mu L\left(\gamma_L^G\right)\right] \\ T'\left(\gamma^B\right) &= k\left[\frac{\partial X}{\partial \gamma_G} - \frac{\partial X}{\partial \gamma_B}\right] - \frac{db^B}{d\gamma_G} + \frac{db^G}{d\gamma_B} + \mu L'_{1-e}\frac{de}{d\gamma_B} \end{aligned}$$

□

The predictions of the model for a patrilocal society where $\frac{de}{d\gamma_B} = 0$ are summarized (sufficient conditions) in table 3.2. In the case when $k = 0, \mu > 0$, no gifts are made because X does not affect the parental benefit. In this case $\frac{dT\left(\gamma^B\right)}{d\gamma^B} = 0$ and the slope plays no role in determining transfers. The net transfers in the economy will be wholly

$k=0,\mu>0$	$k>0,\mu>0$
$T=\alpha\,(<0)$	$T'>0$ if $\left(X'_{\gamma_G}-X'_{\gamma_B}\right)>\frac{db^B}{d\gamma_G}$ $\alpha<0$
$k=0,\mu=0$	$k>0,\mu=0$
$T=\alpha\simeq\left[O^G-O^B\right]$	$T'>0$ if $\left(X'_{\gamma_G}-X'_{\gamma_B}\right)>0$ $\alpha\simeq\left[O^G-O^B\right]$

Table 3.2. Net transfers for patrilocal societies

determined by the boundary condition and if O^B is high enough, women are valuable to their parents, and location specific benefits are high enough $\left(\mu L\left(\gamma_L^G\right)\text{ high}\right)$ then the only transfers in the economy will be transfers from the groom's family to the bride's family.

For fixed μ as the importance of the couple location independent benefits increase, there are two effects on the competition. The first is through the gift $\left[\mu L'_{1-e}\frac{de}{d\gamma_B}-\frac{db^B}{d\gamma_G}+\frac{db^G}{d\gamma_B}\right]$ and the second through the way the parents affect the marital surplus $\left(\frac{\partial X}{\partial\gamma_G}-\frac{\partial X}{\partial\gamma_B}\right)$ depending on this the slope could increase or decrease and the transfers could vary accordingly. In particular if the slope is positive we could get positive bride transfers for the high types and negative bride transfers (groom transfers) for the low types (as demonstrated in figure 3.4). In the limit case for $k>0,\mu=0$, now the boundary condition is close to zero and the slope is purely determined by $\left(\frac{\partial X}{\partial\gamma_G}-\frac{\partial X}{\partial\gamma_B}\right)$. If this is positive we have bride transfers in the economy.

To understand the exact shape of the transfer function consider the bride's parents decision about the size of transfer they offer in the marriage market. Given their match they can always try to increase their utility by matching with a higher type than what they are assigned. The maximum they are willing to pay will be the extra benefit gained

from matching with the higher type, the marginal benefit of a higher match. However in order to get the higher type groom's parents to match with them the size of the transfer needs to be at least as high as the benefit the groom's family gives up by marrying down. So the bride who is matched to this higher type of groom needs to give the higher type of groom no incentive to deviate and marry lower down. Strong complementarities ensure that the higher type bride's family is able to do so. The groom's family makes a similar calculation. Putting these two together gives us a the slope of the transfer function.

The slope of the transfer function will be positive or negative depending on which side has the higher marginal benefit. If the bride's family gains more from matching with a better groom than the groom's family gains from matching with a better bride, transfers to the groom will be increasing in the bride's type. The intuition for this comes from the competition from below for a given type. The more the lower type is willing to pay for your groom's family (because they gain a lot, relative to the loss of the groom from matching down) the more you will have to pay for your groom's family.

To the extent that location independent benefits affect the effort choice of the couple, they affect the gift decisions. Since gift decisions affect location independent benefits, location specific benefits (channel III) indirectly affects the slope at stage 1. In this chapter we assume that there is no difference in valuation of network by side. Both sides value a better network in exactly the same way. If this is the case then this channel contributes nothing to determining the direction of payments. If this was the only contribution to location independent benefits (channel II is zero) then the only determinant

of direction would be the boundary condition, and location specific benefits through gift considerations.

Consider now the boundary condition, that is the transfer exchanged by the two lowest types. With assortative matching the two lowest types always match. There is no competition from below and so they need another condition to determine what the net transfer they exchange will be. This is where the location specific benefits will matter (channel III in Figure 3.1). When a child of a family leaves the home to join their spouse's home their family loses their contribution to household income. For example, the extra labor they contribute to the household farm etc. In this case, since the spouse's family gains the location specific benefits they may need to compensate the other family for this loss. If for example the couple moves to the groom's household, the bride's family needs to be compensated for the loss of her labor and so the net transfer to the groom's side will be negative, leading to bride price for the lowest type and vice-versa for dowry in the lowest type.

Now consider the second source of differences in location independent marginal benefits from the couple's marital surplus. In this case, differences in how the parents of each side directly and not through gifts affects the marital surplus of the couple is important. The marginal benefit of getting a better groom's family for the bride's family is the effect the groom's family has on the marital surplus (income of the couple). If for example, the groom's family name/caste is an important determinant of the couple's wealth (relative to the bride's), then getting a better groom's family is better for the bride's family because their daughter's household will be better able to provide them old age security. Linking

to a better bride's family does not make the groom's family much better off and so their marginal valuation is smaller. Thus, differences in how each set of parents affect the marital surplus of the couple translates into differences in marginal utilities by side which leads to the slope becoming an important determinant of direction of payments. But this channel only matter when k is low enough or when the contribution of the couple to location independent benefits is high enough.

Competition however could be affected by the gift decisions at stage 2. If a high type bride's family gives a higher gift then the groom's family benefits from this as the benefits from the marital surplus of the couple increases (channel II). This makes a groom's family less likely to match with a lower type, reducing the transfer the high type bride needs to make to the high groom to stop them from matching However if a higher type of bride makes the couple more likely to invest in the marital surplus (as marital surplus is affect by the parent types directly) then this increases the incentive of the groom's family to match downwards. The net effect of this could increase or decrease competition for the grooms families. But this channel is important only when location specific benefits are important.

Bride transfers are a particular problem in India recently, which was not the case in Europe. (Anderson 2003) for example ties this to the fact that caste (inherited through the father) is a very important determinant of a family's status/wealth. This would make $\left(\frac{\partial X}{\partial \gamma_G} - \frac{\partial X}{\partial \gamma_B}\right) > 0$ in the model and hence we have bride transfers occurring.

Bride price $(T < 0, b = 0)$	Indirect Dowry $\left(T < 0, b^B > 0\right)$	Dowry $\left(T > 0, b^B > 0\right)$
$k = 0, \mu > 0$	$k > 0, \mu > 0$ and $\left(X'_{\gamma_G} - X'_{\gamma_B}\right) \leq 0$	$k > 0$ and $\left(X'_{\gamma_G} - X'_{\gamma_B}\right) > 0$

Table 3.3. Bride price and Dowry

3.2.3. Bride price and Dowry

Consider now putting the two stages together to predict the presence of dowry (payments made by the bride's side) and bride price (payments made by the groom's side). As discussed before bride price when observed is usually in the form of transfers from the groom's parents to the bride's parents $(T < 0, b = 0)$. Indirect dowry when observed consists of transfers from the groom's parents to the bride's parents together with the bride's parents making gifts to the couple via the bride $\left(T < 0, b^B > 0\right)$. Only dowry is observed in a society when transfers flow from the bride's family to the groom's family in addition to the bride family making gifts to the couple via the bride. The predictions of the model for patrilocal societies (sufficient conditions) to get these three cases can be summarized by table 3.3

The main thesis of the chapter is that a transition to the couple becoming the most important source of location independent benefits (k increasing) can explain the transition from bride price to indirect dowry (groom transfers + bride parent gifts) to dowry. There are studies (Owen Hughes 1978) (Quale 1988) that argue that as economies get more sophisticated, dowry starts to make an appearance. Suppose that the effect of modernization is that the source of location independent benefits from the match for the parents starts shifting from the network to the couple themselves followed by a decrease

in location specific benefits. This would imply that the trend for patrilocal should be towards dowry. This offers a separate channel to explain why modernization affects the presence of and transition to dowry.

The fact that the benefits from a child's marriage comes from the network links is well understood. (Dekker and Hoogeveen 2002) for example consider bride price payments in rural Zimbabwe and find that networks are an important source of insurance against risk. (Rosenzweig and Stark 1989) find evidence that families use marriages as risk sharing, consumption smoothing strategies. It is also truer of bride price societies compared to dowry societies. It is another factor that differentiates bride price and dowry societies (Anderson 2007a).

Is there evidence that modernization shifts the location independent benefits from the larger kin network to the smaller family unit? For Bangalore, India, (Shenk 2005) examines the differential effects of kin network and parental characteristics on the characteristics of their child and the child's spouse. She finds evidence that family autonomy increases as parents move into a wage based economy. The professional parents also rely on outside credit more than their kin network to finance wedding expenditures. This is one indicator of the relative reliance on kin networks. In a follow up paper (Shenk 2007) she find that professional parents are also more likely to pay dowry while bride price is restricted to the poorer uneducated families earlier (less wage based economy) in time.

(Watson 1981) compares the marriage payments for different classes of the same Teng lineage in the village of Ha Tsuen in Hong Kong's New Territories. There are two classes of

the same lineage: peasants (tenants) and landlords. The marriage ceremonies are exactly the same for both classes but they differ in the payments made. There is village exogamy and so the bride always come from outside the village. Both the tenant class and the landlord class maintain links to affines, but the nature of these links differ. For the tenant families the main link to their affines was maintained by the women of the larger family unit of both sides. A couple (through the bride) formed a link through which both sides could draw on the female network on the other side for goods and services, especially in time of need. The landlord class was different. This access to the larger kin network through the bride was a very small part of the benefits from the marriage. The landlords used marriages to choose specific families to align themselves. The relationship was less dependent on the larger affine kin network and more on the smaller family unit. What she finds is that payments in the tenant class are bride price in nature while payments in the landlord class were dowry like in nature with dowry providing the first clear recognition of the new, but yet embryonic economic unit. This is evidence of indirect dowry when location benefits are important.

For India, dowries have been rapidly increasing and selection into the system is rising. This seems to be mainly of the bride transfer variety rather than the gift variety (Anderson 2005b). The prediction is that this occurs because parents get large benefits from the match and this is concentrated on the couple channel. Location benefits seem to be reducing in important too as the most valuable grooms are those living in the cities, away from their families. If one thinks of the location independent benefits from a match as insurance provision that as kin networks break down as a source of insurance, in the

absence of an outside insurance mechanism the children become an important source of insurance and old age support. Evidence that this is the case is provided in (Munshi and Rosenzweig 2007) for example. They argue that the caste network is an important source for credit. the advent of modernization causes this network to break down as the highest incomes select out of the system. The argument here would be that those that select out of the network insurance are more likely to rely on other sources (say children) and thus are more likely to have dowry. There is evidence showing that the families with the higher incomes are more likely to be in a dowry system versus the poor (who still rely on kin networks) who have bride price (Tambiah 1973).

Further evidence for this channel is provided in (Caldwell, Reddy, and Caldwell 1983). They discuss selection into the dowry system by sections of society engaging in bride price payments. Their main hypothesis is about the role of hypergamy and the marriage squeeze. However they also discuss how the links between families have reduced importance while the benefits from the couple have risen. They contrast the experience of North India versus South India. In the north, the emphasis on networks was low and dowries emerged. The south because of its emphasis on networks[11] did not have dowry but over time as networks reduced in important, dowry starts to arise[12]. The two major changes they note are first a transition to a dowry system and second a reduction in the proportion of all marriages between close relatives. Studies on dowry take as exogenously given that marriages with close families result in lower dowries without explaining why this is so (Kuhn, Mobarak, and Peters 2007). In this setting one could interpret marrying

[11](Dumont 1983)
[12](Malhotra, Vanneman, and Kishor 1995), (Miller 1981)

close relatives as an endogenous way of choosing the highest payoff from the match. If the network is the largest source then choosing to marry within the network would be an optimal response to maximizing the payoff from this source. However when the couple becomes more important then the need is to choose the best match to maximize the payoff from that channel. The reason the people in their study sample give for marrying outside the close relative circle is that heterogeneity within the group has increased. If as discussed in (Munshi and Rosenzweig 2007) heterogeneity results in weakening kin networks this could be naturally interpreted as a reduction in the benefits arising from networks. (Kuhn, Mobarak, and Peters 2007) find similar effects for a natural experiment in Bangladesh. As the risk levels of a family decrease they are less likely to marry a biological relative. If a reduction in risk reduces the benefits from an network then the focus is on the benefits arising from the children.

3.3. Status of widows

The model assumes three sources of benefits for the parents: network benefits, location specific benefits from the couple and location independent benefits from the couple. The predictions of the model deal with the relative importance of the location independent benefits from the couple versus the other two sources. Let us examine location specific benefits more closely. In the model, the location specific benefits come from having the couple work on the parental estate. The parental assets are location specific in that they belong to the parents the couple lives with. The couple may work on these assets and derive some income from them but they belong to the parents. The couple may inherit these assets upon the death of the parents and then they become part of the assets of

the couple's household. But till the point ownership passes to them they belong to the parents. Inheritance of these assets by the couple is an important component of the argument in (Botticini and Siow 2003). They say that having the sons living with their parents (couple in the model) inherit is an efficient way of giving the couple an incentive to work effectively on the farm. The focus here is particularly on patrilocal societies where the bride moves to live with the groom's kin.

This distinction is important because location specific assets have an impact on the direction and recipient of marriage payments. The model relates the relative contribution of the three sources of benefits to marriage payments. The importance of location specific assets has an impact on inheritance patterns and one way to check the validity of the model is to relate the relationship between inheritance patterns and marriage payments. The focus will be particularly on the inheritance patterns of widows in patrilocal societies. When her husband dies, the question is what assets does the widow get control over all and how are these assets differentiated between location specific assets and any assets the couple may have self accumulated? In particular the conditions under which young widows will be abandoned are examined.

The reasons for focusing on widows, particularly young widows, are twofold. First if inheritance patterns are patrilinear, then the death of the husband raises the question does the widow inherit the location specific property? If the widow is young it is more likely that the groom's parents are still alive. In the model the parents are important players and thus their incentives can be considered. If the widow is older, then her parents and her husband's parents are presumably dead and the analysis is on the relationship between

her kids and her, or the relationship between the bride and her siblings which would be a different issue. A young widow is also a valuable resource to the groom's parents. So the question of how these valuable resources are treated is an interesting one.

Secondly, widows are an extremely vulnerable group. In India they are often deprived of effective control over their property, evicted from their homes, and victims of violence at the hands of the male relatives of their husband to intimidate them into giving up their property (Giri 2002). Abandoned with no assets, they usually live in home for widows (clustered in religious centers like Varanasi) under deplorable conditions and subject to sexual exploitation (Chowdhary 1998). The number of very young widows is strikingly large with the Census of India, 1991 putting the estimate of widows below the age of 15 at thirty thousand. What makes the situation of Hindu Indian widows unique is that it is the only country in the world still to practise widow burning (called sati)[13] with a few cases reported sporadically. Second, strict social norms on the behavior of widows, ownership of assets, remarriage, combine to make the widow one of the worst treated people in society (Chen 2000).

Consider the total value of the couple's household. The wealth of the couple's household has two sources. The first is the marital surplus of the household (X). These would be assets that the couple has self-accumulated or received at the time of their marriage in the model. In reality, these would be all assets that the couple directly own before the death of the husband. The second component will be the location specific benefits of the

[13]There are accounts of widow burning among Scandinavians, Slavs, Greeks, Egyptians, Chinese, Maoris and some Native Americans (Stein 1978)

match, channel III (L). These as discussed earlier are not under the direct ownership of the couple, but presumably since they live with and work for the parents they derive some income from this source as well as possibly inherit this at the end of the parents' lives.

A couple's household wealth is

$$X\left(\gamma_i^B, \gamma_j^G, e, b\right) + \mu L\left(\gamma_j^G, 1-e\right)$$

As discussed earlier in the model, after the marriage takes place and the gifts are received, the couple chooses their effort level allocation between working on location specific benefits and marital surplus.

$$e^* = \arg\max\{X\left(\gamma_i^B, \gamma_j^G, e, b\right) + \mu L\left(\gamma_j^G, 1-e\right)\}$$

The first order condition will be given by

$$X'_e = \mu L'_{1-e}\left(\gamma_j^G\right)$$

If $\mu, L'_{1-e} > 0$ only the bride's family gives a gift as they always want a larger gift than the groom's family, who bear the negative effect a gift creates on the location specific benefits.

Consider what happens when the husband dies. When the husband dies, the woman re-evaluates her effort choice as now the value of the two sources of benefits may have changed. The gift has already been given so that does not change incentives. However to the extent that the death of the husband causes a decrease in the marital income of the

couple X, this may distort her incentives. Suppose $X''_e < 0$ and widowhood results in a loss of family income, specifically the income coming from the groom. So $X\left(\gamma_i^B, \gamma_j^G, e, b\right)$ now loses the benefit coming from γ_j^G and becomes $X\left(\gamma_i^B, 0, e, b\right)$. In this case the widow's optimal effort allocation is given by e_w

$$e_w^* = \arg\max\{X\left(\gamma_i^B, 0, e, b\right) + \mu L\left(\gamma_j^G, 1-e\right)\}$$

The difference between e and e_w depends on X'_e changes when γ_j^G is set to 0. Suppose

$$X'_e|_{\gamma^G=0} > X'_e|_{\gamma^G=\gamma_j^G}$$

This would imply that the marginal benefit of effort on the household's own assets (X) increases. This makes the widow reallocate more effort towards her own assets compared to the assets of the husband's family. This could happen because the value of household assets falls and with $X''_e < 0$ the marginal benefit of effort rises. Or another way of looking at is $X''_{e\gamma^G} < 0$ when the husband is alive, the same increase in effort has a smaller effort on the marital surplus, or having a man around and putting more effort are substitutes in the marital output. This implies

$$e_w > e$$

Under this case, a further distortion in the effort choices of the widow takes place from the view point of the groom's family. She invests relatively more effort in her own household that she and her husband did as a couple. (Sharma 1980) describes how a widow's control over location specific property is an important consideration from the

groom's family. The groom's family would like to appropriate these assets from the bride because her incentives to use the property are not optimal from the groom's family's point of view.

In this case what is the value of the widow to the groom's family? Depending on how young she is and how much the couple have been able to invest in the marital surplus, they get the location independent benefits from the match kX. Also they get the location specific benefits the woman now makes with the new effort choice (e_w). Abandoning a widow will cause a loss to the groom's household of

$$\text{Loss} : kX\left(\gamma_i^B, \gamma_j^G, e_w, b\right) + \mu L\left(\gamma_j^G, 1 - e_w\right)$$

Abandoning in this case would dispossessing a woman of her location specific property. Their benefit from this is

$$\text{Gain} : \mu L\left(\gamma_j^G, 1 - e\right)$$

They will abandon the widow if the net gain from doing so is positive

$$\mu L\left(\gamma_j^G, 1 - e\right) - \mu L\left(\gamma_j^G, 1 - e_w\right) - kX\left(e_w\right) > 0$$

An alternative way of thinking of this is to allow the groom's parents to force the widow to provide the appropriate effort levels under the threat of abandonment. In this case the effort distortion would not matter. However suppose that another way that widow are disadvantaged, especially young widows, is in the way they are able to manage their property. If conditions in society are such that women find it difficult to access

resources that would ensure an efficient management of property, which can be the case in male dominated societies then this would make

$$
\begin{aligned}
& L'_{1-e}|_{\text{widow}} < L'_{1-e}|_{\text{couple}} \\
\Rightarrow \quad & \mu L\left(\gamma_j^G, 1-e\right) - \mu L\left(\gamma_j^G, 1-e_w\right) > 0 \\
& \text{even if } e_w < e
\end{aligned}
$$

Predictions:

The predictions of the model will tell us that widows are more likely to be abandoned or dispossessed of location specific property if

- Location specific benefits are important. This would happen when we have bride price as well as the gift part of dowries only from the bride's side. When the groom receives a gift too, at the time or before marriage then dispossession is not seen.
- $e_w - e$ is high: In this case, the effort distortion caused by the woman's incentives will have a large effect on the location specific assets.
- X, k is small: When the location independent benefits of the couple are smaller then the loss to the family from abandoning the widow is smaller and the effort distortion dimension dominates. In this case the widow is actually worse off when dispossessed because her own assets that she has to survive on are very small as X is low when k is low.

- Customary or legal institutions make difficult for a woman to secure her rights to retain control over location specific assets. Abandonment is more likely because the groom's family can get a higher fraction of the location specific benefits with the higher effort level. In other cases the groom's family cannot by force or other means get control of the location specific assets In this case the groom's family would like to keep the bride with them else they lose the location specific assets the widow controls and discourage widow remarriage. Prohibitions on widow remarriage are usually associated with women retaining control over location specific assets (like land, property etc.) considered the property of the lineage and not of individuals (Srinivas 1977), (Stein 1988). Even when giving the option to re-marry some Indian women choose not to because remarrying means they give up the right to control the husband's assets (Chen 2000) page 88. One way of a widow receiving support is through her sons who take control of the location specific assets (Dharmalingam 1994). .

The next question set of incentives to consider are the bride's parent's incentives. If the groom's parents dispossess the bride, consider what the gain to the bride's family of is having the widow live with them. The bride's parents get kX in any case. If the bride returns, then her contribution will be a labor one where she works on the family estate. She still retains control over her marital surplus X. Since this is now lower because of the death of her husband, her incentives to work on the bride's family estate will be the same as her incentives to work on the groom's family estate. That is her effort choice will be

determined by

$$e_w^* = \arg\max\{X\left(\gamma_i^B, 0, e, b\right) + \mu L\left(\gamma_j^B, 1-e\right)\}$$

If the groom's parents find it profitable to abandon her, so will the bride's parents. Unless she is willing to stay on in the household without working on the estate.

(Chen 2000) does an in-depth analysis of the situation of widows in rural India. Her book is based on cross state, income and caste studies of widows. Widows in south India are better off than those in the north. Widows in the south are more likely to live in their natal village, have control over their natal families land, be looked after their natal families and engage in paid work. This is mostly because marriages in south India tend to be between close kin and matrilinear/matrilocal.

What is interesting is that all over India there is a very low correlation between a woman's economic status as a married woman and her economic status as a widow. She is better able to maintain control over he husband's estate if she has sons and is older (Chen 2000) chapter 5. If the husband's family values the woman's labor, income etc. they sometimes force the widow to live with them against her will (Chen 2000) page 207. Very few of them return or want to return to their natal homes and only do so if they are childless or destitute. The extent to which she is welcomed home depends on their contribution to household income (Chen 2000) page 213. A surprising number of women choose to live with other widows (Chen 2000) page 240.

Indian law differentiates between ancestral property and self-acquired property. For the parents, ancestral property is the property they inherit from their parents and any

self-acquired property they have contributed to the joint family estate. In this setting, ancestral property would correspond to location specific assets. Sons get a greater share of ancestral property while the parents are free to make a will detailing the disposal of self-acquired property. A widow usually keeps control over any self accumulated assets of the couple. Traditional custom in India allows for widows to keep control of her husband's ancestral property as a guardian only if she has sons who will inherit the property. Or if she has only daughters, she gets a maintenance from the lands (Mayer 1960) (Agarwal 1994). These rights however are widely violated in practise. (Misra and Thukral 1998) find that the ability of widows to exercise this right depends on whether she has sons or not. Even when ownership has been established, control lies elsewhere (Misra and Thukral 1998) page 224. When she is denied her property this is mostly by her in-laws, step-children and even sons. The most common reason for doing so is mismanagement by the widow (Chen 2000) page 275.

A key feature of Indian inheritance patterns if the principle of joint ownership of land in patrilocal communities. This is often extended to joint management of family land. The groom's family gets particularly concerned if the widow insists on taking over management of the husband's land or farming the land herself (Chen 2000) page 285. If they insist on farming the land themselves they face pressure from the husband's family to let them take over management and risk, harassment and possibly violence (Minturn 1993). The women who take independent control over their husband's lands are the ones most likely to face violence at the hands of their in-laws (Agarwal 1994). The Hindu Succession Act of 1956 gave women equal inheritance rights, however inheritance usually follows local customs.

Women are usually prevented from owning or controlling land based on the belief that men are better at cultivation (Mudbidri 2004) page 47-48. Apart from mismanagement by widows the other concern is that they will sell the land. One could interpret selling the land to settle debt incurred due to funeral expenditures etc. as evidence of using location specific benefits to finance X. There is evidence than widows do sell more land than average and this is usually to cover the costs of the husband's illness, death and funeral (Chen 2000) page 287. There is evidence that the practise of sati or widow burning is tied to property concerns of a similar nature (Stein 1988). Marriages between a widow and her husband's brother (levitrate) were common in the Ancient Mediterranean world, and in the Islamic world (Goody 1983) page 60. The emphasis being that the reason for doing so was to provide the husband with an heir. This is also true of upper castes in India as a way of keep control of the widow's property (Chen 2000) page 276.

A recent study on the status of widows in Vrindavan and Varanasi (Giri and Khanna 2002) , India focuses on widows abandoned by the groom's family in religious centers. These women live in deplorable conditions and often their only means of income is begging. 43.75% of those in rehabilitation homes in Vrindavan were widowed when they were below the age of 30 with 4.58% widowed below the age of 15, indicating a large number of young widows. A large fraction of them have bank accounts (73.75%) and receive pensions (76.25%), indicating some marital surplus (X) which they are able to retain control over. About half of them in Vrindavan and a third in Varanasi were from joint families. What is interesting is that the incomes of the husbands at the time of death were in real terms considered an "acceptable standard of living", with some of them relatively rich. About

half the widows are there were married to land laborers and potentially their poverty could be attributed to the fact that the income of their household has something to do with their state. However of the widows surveyed a third belonged to business families where location specific benefits would be important.

In Bangladesh the woman's control over her husband's lands depends on the patterns of ownership. If her husband owns the land, she has control over the land as a guardian for her sons. However if the property is jointly held with the husband's father and brothers she loses any rights to the property (Sarkar and Banerjee 1998), page 224. There is pressure to transfer control of the land to her in-laws if she has young sons. If she is very young and without children she will not only be disinherited but forced to leave (Sarkar and Banerjee 1998) page 213.

This pattern of widows maintaining limited control of location specific assets seems to be a common pattern in other countries too. African societies are predominantly bride price societies (Goody 1973). According to the model these would be because location specific benefits are high and the location independent benefits from the couple are very low. This would make the problem of removing widows from controlling location specific assets even more of a problem. In pre-colonial Africa, wives did not inherit the land when the husbands died because land was communally owned, but she was given control over the husband's share to live off. However increasing modernization and poverty has lead rise to customs where the widow is denied this (Owen 1996), page53. For Nigeria, (Schildkrout 1986) examines the experiences of a group of Muslim Hausa widows in Kano. If a widow chooses not to remarry she has the right to stay in her husband's

home and raise their children there. She has the right to hold property and manage the inheritance of her sons till they come of age. However the husband's brother has a duty to oversee the property to make sure the widow does not 'misuse' or 'squander the property (Schildkrout 1986), pages 75-6. Similar examples can be found in (Potash 1986) for other African societies with the extent to which the widow has control over the property of her husband varying.

(Metcalf 1990) describes the control women of the properties class had over property in colonial Brazil. By law, women held clearly define rights to property as heirs and wives. Married women technically co-owned the marital property but the husband controlled it. Upon widowhood a woman got half the community property of the marriage with the rest divided between her children. If she had minor children, as a general rule she was not permitted to administer their inheritance, unlike a widower who could. If they did they would have to pledge their own property as surety and not remarry. The reason given is the 'frailty of reason' of widows and their inability to manage what they own. A widow, because she controlled some property could act more independently than a single woman but the law prevented her from assuming the rights of men with regards to control over this property. She faced challenges by men who tried to usurp her power, especially when she controlled the inheritances of her young children.

The evolution of widows and control over their property in sixteenth century Muscovy is examined in (Kleimola 1992). Dowries were productive assets given to the couple through the woman to help establish a new household. When her husband died, she would

get her dowry together with any property she inherited specifically from her husband. Widows with children became administrators of the entire estate until they came of age, unless she remarried, in which case she lost control over the children's inheritance. She retained remarkable freedom in managing the estate. Around 1620 things start to change. The widow started to lose control over her husband's ancestral or 'service lands' that is lands that were inherited by the husband that came from his family and that was worked upon by the others in the groom's family. They received a maintenance allowance on the condition it was not to be sold, mortgaged or given away as dowry. The sources are silent about the reasons for the considerations underlying a decree to this effect. However it took place at a time when the goal was to restore state authority to its power and prestige. Taking away control of the land from the 'dead hand' of the church or the 'dead end' of women put the land under control of men who could use it more efficiently and the funds would help fund the state.

(Goody 1983) examines the development of family and marriage in Europe. He finds that in northern Italy during the tenth century, women received a dowry and sons inherited upon the death of the father. A widow could keep the gifts given to her at marriage. She usually stayed in her husband's house and was sometimes designated administrator of his estate. The more control the wife had over the groom's family estate the worse it was for his family (page 256).

The above evidence suggests that regardless of society, if a widow's incentives are not aligned exactly as they were when the husband was alive, there is an attempt to dispossess them. This may lead to actual dispossession when the effort distortion is high enough.

One could think of grown up sons having the same incentive structure of their fathers and so a woman with grown up sons is more likely to retain control over the husband's property. This means that young widows are particularly disadvantaged and in countries like India where the marriage age is still relatively young. Young widows are particularly susceptible to being abandoned even though they are more productive than older widows.

In this case, when the groom's family is able to appropriate the bride's location specific assets, the wealth/status of a widow is a direct function of X. How much of X they can maintain control over depends on an intra-family bargaining decision which is abstracted from. In this case, the evolution of X or more importantly the relative contribution of X to household wealth will be the variable of interest. The argument presented above has k (the importance of the couple for location independent benefits) and μ (the importance of location for total benefits) as the important determinants of payment directions. For $k = 0$ and $\mu = 1$, the marital surplus is the lowest. The reason is they receive no gifts and they put no effort into enlarging the marital surplus, all the effort goes towards location independent benefits. The marital surplus is increasing as k increases. The reason for this is through the gift channel. As k increases, the bride's parents start to make gifts and this increases marital surplus. In addition the couple starts to divert effort away from location specific benefits towards increasing their marital surplus. The next step is to examine the effect of μ. As the importance of location specific benefits fall for a fixed k, the couple puts more effort into enlarging their marital surplus. The marital surplus is the highest when channel II or the couple location independent benefits are the only

contributors to match utility for the parents. In this case the couple puts their entire effort into increase their marital surplus and they receive gifts from both sides. This together with the abandonment decisions of the groom's parents gives us that the groom's parents abandon the widow precisely when the marital surplus is the lowest and so the widow is particularly destitute on her own. Explaining why abandoned widows in India have to resort to begging and prostitution even though the families they may have come from are relatively wealthy. (Vlassoff 1990) finds that widows for whom location specific assets are not an important determinant of marital wealth are better off than those living with their sons.

The other factor to consider is what happens when location specific benefits are unimportant. The model would predict that in this case the groom's family would have no incentive to dispossess the widow. For the widows who belong to families that do not own land, their welfare depends on the extent to which they take over their husband's occupation or find another suitable occupation to follow. For India there is not much evidence of these widows being harassed by their in-laws or being dispossessed of their family assets (Chen 2000).

Focusing on widows also has another benefit of serving to distinguish the incentives of the couple mechanism of the couple in this chapter from the one in (Botticini and Siow 2003). Both these mechanisms emphasize the fact that the parents who have the couple living with them want them to have the correct incentives to work on the parental estate. Any distortion in these effort levels would give the parents an incentive to strip a widow of her property. However in (Botticini and Siow 2003) this becomes more important

when dowry is present. The incentive to abandon widows becomes more important when only dowry is present. In this model this is more important when location specific benefits are important (μ is high) regardless of k (location independent benefits from the couple) because the gift decision has already been made. When $\mu > 0, k = 0$ the pattern of payments in the model is bride price and when $\mu > 0, k > 0$ indirect dowry is more likely. Compared to the prediction in (Botticini and Siow 2003) abandoning widows becomes more important when pure dowry is not present. This is consistent with the anecdotal evidence described above where widow abandonment is important in African societies with bride price.

3.4. Empirical Evidence

In order to test the predictions of the model one would need either to observe a country over time which has changes in the direction and recipient of marriage payments or a cross section of societies with a variation in the direction and recipient of marriage payments. This chapter uses a cross country data set to examine to predictions of the model.

3.4.1. Data and methods

The Ethnographic Atlas is a database on 1,268 societies coded by George P. Murdock and published in successive installments in the journal *Ethnology*, 1962-1980. It gives ethnographic codes and geographical coordinates for all these societies[14]. The complete

[14]A summary volume of the Atlas was published as a book by the University of Pittsburgh Press in 1967. It contained the data on 862 of the better-described societies in each of 412 cultural clusters of the world. Many people confuse the subset with the complete sample. Murdock continued to add more societies to the Ethnographic Atlas after 1967. More importantly, he continued to make corrections to previously published codes. There are numerous cases where values printed in the 1967 volume were

version of this data was published in *World Cultures Journal*, Vol 15, No 2. This data set is the biggest cross country data set that has roughly comparable anthropological data on societies. It is widely used in anthropology for a wide range of topics to conduct cross country analysis. Papers like (Harrell and Dickey 1985), (Goody 1973), (Shenk 2007) and references therein have used it to specifically check for society wide characteristics that are correlated with the presence of dowry in a society. Economists (for example (Botticini and Siow 2003), (Nunn 2005), (Anderson 2007a) and reference therein) looking for factors correlated with dowry have used tabulations from versions of this Atlas .

This data set only has information on the direction of marriage payments and not on the recipient. It also does not have any information on the average size of marriage transfers. There are data sets available on the magnitude of bride price/dowry payments for families/ regions in particular societies, but these are difficult to get into a form that can be comparable across countries. Since the concern is with predicting the presence of dowry a cross country data set like this with information on the social characteristics is particularly useful even without a sense of average payments or whether they are increasing or decreasing in type.

A probit analysis is performed to predict the probability of dowry in a society

$$dowry_i = \Phi \left(\begin{array}{c} \alpha_0 + \alpha_1 \text{complex}_i + \alpha_2 polygyny_i + \alpha_3 women\ value_i + \\ + \alpha_5 couple_i * sons\ inherit_i \\ + \alpha_6 (1 - couple_i) * location_i \end{array} \right)$$

changed in a later Ethnology installment. The data used incorporates all these changes over the years and is a complete, corrected version of the Ethnographic Atlas.

where Φ denotes the cumulative normal distribution function associated with a probit specification. Since dowry has a strong regional component, the errors are clustered by geographical region. Since most of the predictions of the literature for dowry refer to patrilocal societies and most of the societies in the data are patrilocal, all non-patrilocal societies are dropped.

The dependent variable $dowry_i$ is the probability that society i has marriage payments that flow from the bride's side to the groom's side (dowry). This variable is measured with an indicator that takes the value 1 if the society has dowry and 0 if there is bride price or bride service or token bride price. The other possible categories are absence of any consideration, sister or female exchange and reciprocal gift exchange. Indirect dowry would possibly fall in these categories but it is impossible to identify precisely. The goal of the analysis is to identify the societal characteristics that lead to dowry or bride price so societies with these other types of marriage payments are dropped from the sample.

The independent variables are the factors that would influence the presence of dowry in a society. The complex_i variable is an indicator variable that takes the value 0 if societies are homogenous or are divided into to at most two socioeconomic classes. A more complex differentiation into classes correlated in large measure with extensive differentiation of occupational statuses is given a value of 1. This variable is meant to capture the inequality (stratification) in a society and is equivalent to an increase in the range of types in society, that is the length of $[\gamma_L, \gamma_H]$ in the model. The analysis in the model holds the level of stratification fixed and does not have any predictions as to whether stratification increases or decreases the likelihood of dowry. As (Goody 1973) for example argues, a higher level

of stratification will be positively correlated with dowry as stratification makes parents more likely to give their daughters a dowry to ensure that their household has a status at least as high as that of her natal household.

The presence of polygyny in a society is captured by the variable $polygyny_i$. It is an indicator variable that takes the value 1 when marriages in a society are polygynous and 0 if they are monogamous. This is used to capture the supply and demand for bride argument as a determinant of the price of a bride. The literature should predict that it is a negative predictor of dowry. This channel is not present in the model and is controlled for.

The next variable $women\ value_i$ is meant to capture the compensation argument for dowry. If a bride is valuable to her family, the loss of a bride due to her marriage and movement to the groom's family means that her family needs to be compensated for her loss. It should be a negative predictor of dowry. It is classified based on the contribution of women to agriculture. Since these are pre industrial societies, primarily agriculture based, the contribution of women to agriculture is important as emphasized by (Boserup 1970). It is an indicator variable that takes the value 0 if men contribute more than women to agriculture and 1 if the contribution is equal, equal but differentiated and women contribute more. In this model it should be more important when $k = 0$ and not necessarily in general.

The argument in (Botticini and Siow 2003) says that for patrilocal societies where incentive efforts for sons versus daughters are important, a society will endogenously

choose to have sons inherit and give their daughters their inheritance through a dowry. So if incentives are important, this will be captured by sons inheriting which should be a positive predictor of dowry. The $sons\ inherit_i$ variable is an indicator variable that takes the value of 1 when only sons inherit land and 0 if daughters or other relatives inherit land.

The main results depend on two parameters in the model. The first is k, the importance of the couple versus the family network for total location independent benefits from the match. The second is μ the importance of location specific benefits to the family the couple lives with. These measures are unfortunately not directly available in the data. I use the following proxies to capture this idea.

First consider the proxy for k. Societies in the data set are classified based on words societies use to describe familial relationships. It was proposed by anthropologist Lewis Henry Morgan. There are six main types: Hawaiian, Sudanese, Eskimo, Iroquois, Crow: and Omaha. The Eskimo (versus the others) system places no distinction between patrilineal and matrilineal relatives, instead focusing on differences in kinship distance (the closer the relative is, the more distinguished). The system also emphasizes lineal relatives. All other relatives are grouped together into categories. It uses both classificatory and descriptive terms, differentiating between gender, generation, lineal relatives (relatives in the direct line of descent), and collateral relatives (blood relatives not in the direct line of descent). The system is largely used in bilineal societies where the dominant relatives are the immediate family (Goody 1970). Since it emphasizes linear decent I treat it as the case when the primary source of location independent benefits is the couple. If networks

are more important then the words used to describe kinship relationships would put more emphasis on them. The variable $couple_i$ is an indicator variable which takes the value 1 when the kinship term used is Eskimo and 0 otherwise.

Next consider the proxy for μ. This variable should capture the importance of the location specific benefits of the couple to the parents. The variable $location_i$ is an indicator variable. If a family is organized such that married sons live with their parents in a common household this variable takes the value of 1. If on the other hand, if when a child gets married they set up a separate household (nuclear family) it takes the value of 0. A society where married sons set up separate households may be patrilocal. In this case the couple's household is very close to the groom's parents but is still treated as a separate household which makes decisions independently. It is also classified as 0 if the household is a large extended family with many not just children but cousins and other relatives part of the same household. In this case the location specific benefits of the couple could be small. This is a very imperfect measure of location specific benefits and in fact biases us from finding any results.

The $sons\ inherit_i$ is also to capture the differential impact of parental characteristics on the marital surplus. The predictions of dowry in the model depend on the term $\left(X'_{\gamma^G} - X'_{\gamma^B}\right)$. The implicit assumption is that this term is more likely to be positive when sons inherit. These variables are summarized in Table 3.4

In brief, the predictions of the model are as follows:

- Bride price is more likely when $k = 0$ and $\mu > 0$

Variable	Obs	Mean	Std. Dev.	Min	Max
Dowry	1248	0.03	0.16	0	1
Polygyny	1231	0.85	0.36	0	1
Complex	1085	0.07	0.26	0	1
Value of women	952	0.76	0.43	0	1
Sons inheriting	831	0.41	0.49	0	1
Patrilocal	1080	0.81	0.39	0	1
Location specific benefits	1239	0.48	0.50	0	1
Couple contribution	934	0.19	0.39	0	1

Table 3.4. Data description

- Indirect dowry is more likely when $k > 0$ and $\mu > 0$
- Only dowry is more likely when $k > 0$ and $\left(X'_{\gamma^G} - X'_{\gamma^B}\right) > 0$

Since data on indirect dowry is not available, only dowry and bride price are considered. The model would imply that the predicted sign of $couple_i * sons\ inherit_i$ is positive and the predicted sign of $(1 - couple_i) * location_i$ is negative.

3.4.2. Results

Consider the results in Table 3.5. The supply/demand for brides through polygyny predicts that the sign on polygyny should be negative. This is consistent with the results as polygyny is a strong negative predictor of dowry. The compensation argument of (Boserup 1970) says that the value of women should always be a negative predictor of dowry. The value of women argument is not present in the data as the marginal value is mostly zero and insignificant implying that the compensation argument is not very important for the whole sample. This is consistent with the predictions of the model

Marginal effects are reported for the probit analysis
Dependent variable is dowry in all regressions

	Base	Couple contribution	Location Specific	Interaction effects	
				couple	location
	1	2	3	4	5
complex	0.13***	0.08***	0.13***	0.09***	0.08***
	(-6.99)	(-4.76)	(-6.76)	(-5.96)	(-5.69)
polygyny	-0.13***	-0.14***	-0.13***	-0.14***	-0.14***
	(-3.1)	(-3.15)	(-3.15)	(-3.04)	(-3.04)
value of women	0	-0.01	0	-0.01	-0.01
	(-0.26)	(-0.84)	(-0.66)	(-0.74)	(-1.41)
Inheritance by sons	0	0.01	0.01		0.01
	(-0.42)	(-0.37)	(-0.56)		(-0.61)
Couple contribution		0.02			
		(-1.19)			
Location specific benefits			-0.01		
			(-1.15)		
couple*inheritance				0.03*	
				(-1.72)	
(1-couple)*location					-0.02*
					(-1.67)
Observations	437	347	437	347	347

Robust z statistics in parentheses
*significant at 10%;** significant at 5%; *** significant at 1%
Errors clusters by geographical region

Table 3.5. Probit results identifying the factors affecting the probability of dowry

which says the compensation argument is important only when the couple is unimportant and location specific benefits are high enough.

The argument in (Goody 1973) says that as a society gets more stratified, women get inheritances in the form of dowry to enable them to maintain the status of their family. This argument would imply that the effect of stratification is positive as stratification causes dowry. The results in Table 3.5 show that complex is a strong positive predictor of dowry. In the model this argument would say that as the length of $[\gamma_L, \gamma_H]$ increases, gifts increase which is not a prediction of the model. The model holds constant the level

of stratification as the range of γ does not change. (Botticini and Siow 2003) argue that the sign on *sons inherit* is positive. The direct effect of sons inheriting is positive in the results but not significant in the regression.

The current literature says that although reliance on kin networks is a distinguishing feature of dowry and bride price societies[15] there is no theoretical reason for it alone to affect the probability of dowry, which is borne out in the data. However as argued in the model the benefits from the couple by itself should not predict only dowry in a society as it could also predict indirect dowry. To get only dowry one would need the couple to be important and in addition $\left(X'_{\gamma^G} - X'_{\gamma^B}\right) > 0$. Table 3.5 the coefficient on this interaction term is positive and significant.

The second prediction of the model deals with the prediction of bride price. If location specific benefits are important and the couple is unimportant, then bride price is more likely. The coefficient on $(1 - couple_i) * location_i$ is negative as predicted and significant. These results match the predictions of the model.

3.5. Conclusion

This chapter addresses the question of what predicts the direction and recipient of marriage payments in a society? The main channel considered is the relative contribution of the couple to location independent payoffs from the marriage of a child and the interaction with location specific benefits. In this chapter, men and women compete for partners and marriage payments result to clear the market. Competition plays an important role

[15](Anderson 2007a)

for net transfers at stage 1. The extent of competition for spouses depends on the relative contribution of networks versus the couple with location specific benefits playing a smaller role. In the case when the reliance on the couple is low the compensation effect dominates and as competition increases the compensation dimension loses importance. The prevailing explanations tie the increase in competition as a determinant to the increase in stratification. This gives us a way of reconciling the two arguments holding constant the relative heterogeneity in a society. It can also explicitly talk about when one channel is more important than the other in determining the pattern of payments. Since it shuts down channels that other papers have identified as important like polygyny, gifts etc., this explanation can be considered complementary to these approaches as it offers another channel that affects the marriage market transfers.

The main variable of interest in the chapter is couple location independent benefits as a primary source of benefits from the match. The main thesis of the chapter is that a transition to location independent benefits from the couple as compared to location specific benefits can explain the transition from bride price to indirect dowry (groom transfers + bride parent gifts) to dowry. There are studies (Owen Hughes 1978) (Quale 1988) that argue that as economies get more sophisticated, dowry starts to make an appearance. This chapter offers a way to tie the transition of marriage payments within a society to changes in the economy more particularly, changes from bride price to dowry relying on the composition of marital benefits. Suppose that the effect of modernization is that the source of location independent benefits from the match for the parents starts shifting from the networks to the couple themselves followed by a decrease in location

specific benefits. This would imply that the trend for patrilocal societies should be towards dowry. This offers a separate channel to explain why modernization affects the presence of and transition to dowry. It also gives us a way of thinking about another role for gifts which is to affect the incentives of the couple and to make them allocation a higher effort towards increasing their marital surplus rather than increasing location specific benefits. This channel gives an additional benefit in that it also offers a way to tie marriage payments to the status of widows.

The limitations of this approach is that is cannot address the question of given a pattern of payments in a society what causes a change in the magnitudes of payments. Other papers like (Anderson 2003), (Caldwell, Reddy, and Caldwell 1983) approach this question directly. It can offer a reason for why competition gets more intense over time as the competition channel get more emphasized but this is not explicitly addressed. Since it shuts down channels that other chapters have identified as important like polygyny etc., this explanation can be considered complementary to these approaches. It offers another channel that affects the marriage market transfers.

The effect of child characteristics is not considered as children are assumed identical. However if the child's characteristics are more important when the major benefit is from the couple, it offers a reason for why over time as societies transition into the dowry system, the bride and groom's characteristics are more important determinants of marriage payments than the parental characteristics (Shenk 2007), (Anderson 2005b). Empirical evidence for these predictions is provided using a cross country data set on the patterns of

payments across countries. The predictions of the model are borne out in the statistical analysis carried out. Further evidence is provided from other country specific studies.

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