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CHOICE OF DRIVER CONTRACT IN ROAD TRANSPORT

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Abstract: An unresolved puzzle in the economics literature is the co-existence of share, fixed-wage, and rental contracts in the organization of similar economic activities. Our analysis of transportation markets in this paper finds that the choice of contract type between owners and drivers of modes of transport depends on risk aversion, the costs of monitoring, access to capital markets, and constraints determined by the level of development and other characteristics of the region and passenger population. Clinical examination of the pattern of driver contracts for minibus firms in the Philippines and Hong Kong supports the conclusion that these general factors and other constraints jointly determine the choice of contract that is consistent with an efficient assignment of drivers and passengers to alternative transportation firms.

Key Words: contract theory, payment systems, bus driver incentives and behaviour.

1. INTRODUCTION

The co-existence of share, fixed-wage, and rental contracts is not adequately explained by existing economic theories of share tenancy or by the more mainstream analysis of principal-agent problems. For example, following Cheung (1969), Mirlees (1974), and Stiglitz (1974), numerous authors have attempted to explain the choice between share tenancy or fixed wage contracts in agriculture by either differences in risk aversion on the part of landowners or differences in monitoring and enforcement costs. Some debate has emerged about which explanation fits the data better (*c.f.* Allen and Lueck, 1995) but this debate has not been resolved. In the competing explanations, there are cases in which the two types of contract co-exist in a given region and period of time, and neither explanation has shed any light on why (or if) having *both* contract types can simultaneously be optimal.

Recent research in owner/driver contracts in small public buses in Hong Kong and the Philippines (Rusco and Walls, 2001, 2004ab) has identified and illuminated the rich differences in the ways drivers are compensated and on the implications these differences have for driver behavior in equilibrium. For example, in the market for small bus transport services, Rusco and Walls (2001) show that rider preferences for risk and the value of time cause sorting over choice of minibus companies. Rider patterns and preferences also may vary across regions, with regard to economic development, prevalence of commuting

workers, etc. Rider preferences toward risk and value of time may also affect the joint value of different driver behavior, fare and route flexibility. A higher degree of economic development with western-style suburbs and commuting situations is correlated with a greater preference for more predictability and lower variance in service, whereas the least developed regions will favor the most flexibility in negotiating fares, due to their low value of time, and flexibility in uses because most individuals have no private vehicles, so that the vehicles may be hired for agricultural and other small business uses.

In our clinical analysis, we observe that the pattern of contracts for minibus firms in the Philippines across urban and rural contexts, and in Hong Kong across poor and rich housing estate termini are consistent with risk aversion, monitoring cost, imperfect capital markets, and social preferences explanations. In contrast to our earlier research in this area, we have stripped away in this paper a lot of the institutional and operational detail, but we retain the essence of our earlier work while focusing on the way contract attributes affect driver behavior.

We provide in this paper an explanation for the co-existence of these three types of contracts between owners and drivers of small public transport in the context of different levels of risk aversion, costs of monitoring and enforcing contractual stipulations, and possible differences in constraints determined by the level of development and physical characteristics of the region—density of population, road infrastructure, and prevalence of alternative modes of transport. Our analysis builds on the recent work of Ackerberg and Botticini (2002) on the co-existence of contract types by examining in the context of transportation markets the conflict between the degree of risk aversion, the cost of transacting, and the role of imperfect capital markets in the determination of the choice of driver contract.

2. CONTRACT THEORY

The theory of contract choice was sired by the Promethean Chinese economist Steven N.S. Cheung (1969) and the details were worked out by his followers. After a suitable period of academic gestation this resulted is a rich literature dealing with the choice of share versus fixed rent contracting in agriculture and more generally with the choice of optimal contracts in the context of risk aversion, moral hazard, costs of monitoring, and heterogeneous tasks and individuals (Mirlees, 1974; Stiglitz, 1974; Allen, 1982; Allen, 1985; Newbery, 1975; Newbery, 1977; Grossman and Hart, 1983; Holmstrom and Milgrom, 1987; Holmstrom and Milgrom, 1991; Holmstrom and Milgrom, 1994; Allen and Lueck, 1995). In most of this literature risk aversion on the part of the tenant (agent) explains the existence of share contracts because such contracts are less risky from the perspective of the agent than are fixed rent contracts. However, because a share contract makes the agent only a partial residual claimant to the fruits of his labor and the land, his effort is commensurately lower and there is an efficiency loss when share contracts are used. This is true of any effort necessary on the part of the land owner (principal)—maintaining the land or any other relevant activity that affects agricultural output and that is not contractually the obligation of the agent. Monitoring and enforcement of contractual obligations can be employed to attempt to mitigate the losses associated with reduced effort, but this is itself costly, so some inefficiency remains.

A fixed wage contract is the least risky from the perspective of the agent but the most risky for the principal. In fact, the three types of contracts discussed in this paper can be placed on a continuum with regard to which party—the principal or agent—bears the most risk. Fixed wage contracts place all the risk on the part of the principal, and also create the weakest incentives for the agent to provide the appropriate level of effort. On the other extreme, fixed rent contracts place all the risk on the agent and give the agent the strongest possible incentive to perform appropriately. Share contracts are in the middle of this continuum, with the risk being shared by principal and agent, and an intermediate incentive for agent effort. The literature dealing with the existence of share contracts does not generally address fixed wage contracts. Obviously, if risk aversion on the part of the agent were the only deciding factor influencing contract choice, fixed wage contracts would be favored over share contracts, leaving an as yet unresolved puzzle as to why we observe share contracts at all.

Allen and Lueck (1995) have argued that transactions costs—including the costs of monitoring and enforcing contracts—explain the choice between share and fixed wage contracts better than risk aversion. In their survey paper they criticize the theoretical prominence of risk aversion and point out that most empirical studies tend to ignore risk preferences, focusing instead on specific incentives, enforcement costs, and transaction-specific assets that constitute the important elements of transactions cost economics. They present evidence from studies conducted for specific industries that distinguish between risk-sharing and transaction costs theories. They find that these studies broadly support the implications of transactions costs theories while being inconsistent with theories relying on risk aversion as an explanation of contract choice.

Following their criticism of the risk explanation of sharing contracts, Allen and Lueck (1999) tested directly the role of risk in choice of contract. In particular, they test the standard principal-agent model with risk aversion as an explanation of contract choice in contemporary North American agriculture using micro-data from individual contracts. Their empirical evidence finds support for the transactions cost explanation of contractual form but finds no support for the risk-sharing explanation. Further discussion of this line of research and the supporting evidence is contained in Allen and Lueck's (2002) recent book on the nature of the farm.

Ackerberg and Botticini (2000, 2002) have shown that both share and fixed rent contracts co-existed historically and argue convincingly that both risk aversion and costs of monitoring and enforcing contracts can lead to the choice of share contracts. In addition, they find evidence that the existence and robustness of capital markets plays a role in determining which contract type is optimal. In an excellent cliometric paper that predates by two years their main theoretical work, Ackerberg and Botticini (2000) examine the choice of contractual form in early renaissance Tuscany. In their research they test three competing hypotheses : First, the risk-sharing hypothesis which makes the argument that in times of labor shortages following the Black Death landlords used share contracts to attract risk-averse tenants. Second, the transactions cost hypothesis which makes the argument that sharecropping was an ideal contract for monitoring tenant effort and protecting valuable farm assets. Third, the imperfect capital market hypothesis which argues that imperfect capital markets led to increased use of share contracts. Their empirical evidence lends support to the transactions cost and imperfect capital market

explanations, while tending to refute risk-sharing explanations. In Ackerberg and Botticini (2002), the authors find evidence of risk sharing in contrast to Allen and Lueck's work. In their model of endogenous matching—a phenomenon not controlled for in earlier papers—principals and agents with similar preferences for risk are led to match and transact using share contracts.

Ackerberg and Botticini have thus resolved a large part of the controversy over the choice of commonly observed contracts between land owners and farm workers. However, their analysis does not explore the full spectrum of contracts. Fixed wage contracts between farm workers and owners are not explored, so a model that explains all choices of contracts has not yet been enunciated. Furthermore, agricultural markets—in as much as the products produced are highly commoditized—are not influenced by consumer preferences to the same degree that markets for differentiated products may be. This is a relevant point for transportation markets because different contract types elicit different driver behavior with regard to driving speed, courtesy, etc. In this way, contract choice indirectly affects the attributes of the good being sold—transport services—and consumers choose which services to buy based on these attributes. In equilibrium, demand for different levels and qualities of transport services play a role in determining which contract types exist. In the remainder of this paper we apply contract theory in our analysis and exploration of differing driver contracts.

3. CHOICE OF DRIVER CONTRACT

Different types of contract between owners of firms and employees co-exist in some transit markets. In addition, there are systematic differences in the prevalence of contract types across regions and countries. For example, in the Philippines, both share and fixed rent contracts exist between owners and drivers of Jeepneys—small transit buses—with share arrangements more prevalent in rural and fixed rent contracts more prevalent in urban markets. In contrast, contracts between minibus owners and transit drivers in Hong Kong are either fixed rent or fixed wage, while in North America and Europe fixed wage is by far the predominant contract type for bus drivers. To understand the role of risk aversion, transactions costs, and capital markets in determining choice of contract type it will be informative to make some observations about how these vary across regions in which we see variation in contract choice.

If the degree of risk aversion on the part of agents explains in part the existence of share contracts, then share contracts should be observed more frequently in areas of higher risk aversion among potential agents. Risk aversion may be more prevalent in poorer regions because people live closer to critical levels of nutrition and shelter. As income levels rise, people tend to become more diversified in their income sources as well as acquiring more types and greater quantities of insurance. If these observations are valid, then there may be a risk aversion component to the explanation for why share arrangements are more prevalent in rural (poorer) areas than in urban settings.

The costs of monitoring and enforcing contractual stipulations can also affect the choice of contract. In general, the lower are the owner's (principal's) costs of monitoring and enforcement, the more attractive are contract types that reduce the risk borne by the employee (agent) and increase the risk borne by the principal. In the extreme, if the owner of a business can at no cost monitor and enforce contracts with employees, in-

cluding the employees' efforts on the job, then—all else constant—there is relatively less of a reason to share risk between principal and agent. As a result, we would expect to see contracts with weaker agent incentives (fixed wage or share contracts) to be more prevalent in circumstances where monitoring and enforcement costs are lower and contracts with stronger agent incentives to be more prevalent when these costs are higher.

With respect to transportation services, the magnitude of transactions costs depends on how vehicles are actually used and the relationship between owner and driver inputs. For example, if vehicles are used more as infrequent rentals (with driver), and if the terms of each use are negotiated between owner and passengers, then the owner likely has more control over how the vehicle is operated and also has a mechanism—a relationship with the passengers—to gather information about the driver's inputs. On the other hand, if the vehicle is used more as a traditional bus service, picking up anonymous passengers along a route, there are fewer opportunities for an owner to observe a driver's behavior. These observations may also play a role in explaining contract choice. In rural areas, where small buses are used for multiple purposes and less for commuting, owners often have interactions with passengers who arrange to rent the bus for a trip or to haul goods. If this is the primary source of income for the owner, then the owner would prefer a contract with a driver (such as a share contract) in which the driver has weak incentives to use the vehicle intensively by driving fast or overloading it, thus conserving the life of the vehicle. On the other hand, if the main source of income is from commuting fares in which the owner has no contact, he may prefer a fixed rent contract because this maximizes the total revenue; drivers with fixed rent contracts utilize vehicles intensively to maximize the residual of fares net of the fixed rent.

For any given set of preferences in which risk aversion is present, the degree of risk aversion can be largely thought of as a function of the ability of the individual to diversify and/or hedge risk, which in turn is a function of how well developed are capital markets. For example, consider a risk averse person who refuses a slightly favorable gamble—say a coin toss where the person wins $100 if heads appears and loses $99 if tails appears. This same individual, if offered 1000 simultaneous identical gambles would surely take the opportunity to win an expected $500 with low variance. However, in the real world, such opportunities are generally not offered gratis: a risk-averse individual must diversify or hedge to achieve an acceptable level of risk and this requires financial capital and capital markets.

Access to capital markets in which individuals can borrow or lend money under competitive terms would also allow individuals to mitigate risk associated with repeated trials of a risky activity. To be more concrete, a small business may borrow in capital markets to survive periods of low receipts and the availability of such capital lowers the overall risk of the business. Therefore, all else constant, one would expect observed risk aversion to be greater and also the prevalence of share contracts to be greater in regions where personal wealth is lower and capital markets are less complete or robust. Conversely, fixed rent contracts would be more prevalent in wealthier regions and where more robust capital markets exist. This, of course, does not explain the absence of fixed wage contracts when share contracts are observed, something that we address below.

The choice of contract between owners and drivers of buses or other forms of transport is

further complicated by differences in customer preferences. For example, passenger patterns vary according to the level of economic development of a region or country and by the prevalence of private vehicle ownership. Through eliciting different driver behaviors, the choice of contract can facilitate a matching between transport services and passenger preferences. Again, these patterns of passenger preferences vary systematically between regions according to level of economic development and income. In poorer rural regions, greater proportions of the population are involved in agriculture and live on the farms they work. As a result, there is a smaller relative demand for commuting type transport services compared to irregular or infrequent transport services—periodic shopping trips, for example.

Finally, when individuals are heterogeneous, less risk averse agents can be expected to match with owners of riskier processes. Controlling for this endogenous matching in empirical models, risk aversion on the part of drivers can coexist with factors related to monitoring and enforcement costs as determinants of the choice of contract.

4. MINIBUS DRIVERS IN ASIA

Recent research by Rusco and Walls (2001, 2004ab) on minibus companies in Hong Kong and the Philippines has identified and illuminated a variety of rich institutional and operational differences in the industrial organization of these firms. Of particular interest is how differences in contractual relationships between owners and drivers has implications for driver behavior in equilibrium. Here, we focus on the choice of driver contract.

4.1 Red Stripe and Green Stripe Minibuses

In Hong Kong, two distinct types of 16-passenger minibuses—those with red stripes and those with green stripes—employ drivers under different contract types. The precise details of the institutional and operational features of these transportation firms are set out explicitly Rusco and Walls (2001) and peripherally in Hall (1996); in the present paper it will be sufficient to say that the red stripe buses employ buses under a residual claimancy contract and that the green stripe buses employ drivers under a fixed-wage contract.

The different types of contract lead to predictably different driver behavior. While red stripe buses provide fast service for commuters during peak periods, the quality of service changes dramatically during the off-peak, becoming much slower and less predictable. Green stripe buses provide service which is much less variable—the number of buses on the route and the timing of departures are regulated and drivers are rewarded for maintaining good service rather than for cramming an extra run into a shift. In addition, red stripe buses are involved in more accidents (per vehicle kilometer travelled and per passenger) than their green stripe counterparts. These different types of service may reflect, in part, differences in the characteristics and preferences of the passengers the two types of minibus serve. Red stripe buses run primarily between lower income housing areas and business centers, while green stripe buses serve more affluent areas. Wealthier people may demand more predictable service and greater safety than less wealthy people because the value of time varies according to income and opportunity. Conversely, people with lower wealth may be willing to spend more time haggling over a fare or searching for a cheaper alternative than are wealthier people. This is also consistent with the observation made

above that the relative proportion of red stripe to green stripe buses in Hong Kong has fallen as the economy has grown.

Overall, different contracts lead to different driver behavior and therefore different levels and types of service. It would appear that the simultaneous use of both contracts in Hong Kong may in fact be a desirable outcome and that fixed rent and fixed wage contracts may both be efficient mechanisms with which to induce the driver behavior that is most valued by society. Why? A persistent feature of transit systems in modern societies is the variability in the demand for transport services across different countries and levels of economic development. In particular, the value of time increases as income levels rise. In addition, recent research indicates that consumers of transport services also prefer lower variability in travel time and that this preference may become more intense as income and therefore the value of time rises (Noland and Small, 1995; Noland et al., 1998; Lam and Small, 2001). The differing driver contracts of red stripe and green stripe drivers support a separating equilibrium in which customers are sorted across bus types according to their values of travel time savings (Rusco and Walls, 2001)

4.2 Urban and Rural Jeepneys

In the Philippines, two types of owner/driver contract also coexist—fixed rent and share contracts for jeepneys in urban and rural Philippines, respectively; institutional and operational details of jeepney transportation are set out in Rusco and Walls (2004a).

A recent empirical analysis of contract choice among jeepney firms in the Philippines reports that firms in urban areas routinely use fixed rent contracts, while rural jeepney firms use the share contract more often (Otsuka et al., 1986). This is interpreted as evidence that both contract forms may be efficient and that only income distributions differ as a consequence of different risk-sharing in the different contracts. Thus, residual claimancy may result in higher welfare under the conditions of an impersonal market characterized by high liquidity typical of an urban context.

The cost to the owner of a jeepney to monitor the driver's behavior may be much lower in rural than in urban areas. For example, a much larger proportion of a rural jeepney's revenues comes from hiring the jeepney and driver out as a private vehicle. Examples of such uses are dropping off or picking up passengers or freight at airports, moving agricultural supplies, and delivering large purchases. Because such services are generally negotiated between owner and customer, the driver does not have as much opportunity to negotiate side deals or carry passengers and freight "off-the-books." In contrast, a driver of an urban jeepney, or one on a regular high traffic route, will have many more opportunities to steal from the owner of the jeepney, making it more costly for the owner to monitor. In this case a fixed rent contract, by making the driver the residual claimant of his effort, eliminates the prospect of stealing and economizes on monitoring resources.

At the same time, the welfare of small rural communities can be higher under the conditions of the Philippine provinces. Again, there are systematic differences in passenger characteristics and preferences between urban and rural areas that may, in part, explain the choice of contract. In the urban setting, passenger traffic is more dense and more uniform across hours of the day than in rural areas. In addition, urban jeepneys are used more intensively as transit buses, while rural jeepneys have many uses, including being

rented as private cars or for hauling freight. Thus, the risk to a driver under a fixed rent contract is greater in the rural areas where passenger traffic is less dense and less predictable. This makes a share contract more valuable. In addition, the share contract, by giving the driver weaker incentives to "hustle" fares, makes the jeepneys more available for infrequent special uses, which is consistent with the jeepney owner's interests.

5. CONCLUSIONS

There is a poorly defined but persistent disagreement about the role of risk aversion versus enforcement cost and transaction-specific assets in explaining the choice of share versus fixed rent or fixed wage contract. On the one hand, most of the theoretical models of contract choice indicate that risk averse agents prefer share contracts over fixed rent contracts and that having entered into such contracts, agents have a greater incentive to shirk than their counterparts under fixed rent or fixed wage contracts. As a result, there is a risk-efficiency trade-off with regard to share contracts. On the other side of the argument, the transactions cost school of thought has ignored the possibility of risk aversion and advocated that the costs of monitoring and prevention of shirking are the determinants of contact choice with the implication that share contracts are more likely to emerge when monitoring and enforcement of contractual provisions are less costly.

Our analysis of transportation markets in Hong Kong and the Philippines finds that the choice of contract type between owners and drivers of modes of transport depends on risk aversion, the costs of monitoring, and constraints determined by the level of development and other characteristics of the region and passenger population. In the case of Hong Kong, the choice of driver contract creates differing driver incentives that support a separating equilibrium in which passengers are sorted across minibus types in relation to their value of travel time savings. In the case of the Philippines, differing intensities of passenger usage across urban and rural areas, as well as differential enforcement and monitoring costs, creates an incentive for increase use of sharing contracts in the provinces as compared to the urban areas. In each geography and market context examined, the flexible choice of contract creates a highly adaptable market organization.

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