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Triadic Power Relations with Production, External Markets and Multiple Agents

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Magnus Hatlebakk

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University of Bergen, Norway

magnus.hatlebakk@econ.uib.no

Abstract: We discuss whether Basu's (1986) model of triadic power relations is robust to generalizations where we allow multiple landlords, merchants and laborers. In the special case of one landlord and multiple merchants we show that the landlord's threat towards any laborer becomes credible even in the original stage game model. For the case of multiple landlords we need to generalize more recent solution concepts. We add realism by allowing the laborers' reservation utilities to vary with the costs of trading in external markets and the characteristics of the laborers. We allow production by landlords and merchants, as well as Cournot competition among merchants. In equilibrium the rural wages are a function of the number of landlords and merchants, the characteristics of the laborers and distance to external markets. We estimate the model, using household survey data from Nepal, and find strong support for the triadic model.

* This work was done while I was a visitor at Department of Economics, Cornell University. Thanks go to Kaushik Basu who first suggested the possibility of a generalized model. I have also benefited from discussions with Espen Villanger who has been, independently, researching on multiple-agent triadic models, though for a completely different empirical setting. I owe him the single-landlord multiple-agent result that is used in Proposition 1. Thanks also go to Pitamber Chettri and participants at the Cornell development seminar. The research has been supported by the Research Council of Norway.

1. Introduction

Rural economic transactions are often conducted within complex and stable social and economic environments where individual welfare may heavily depend on transactions with a few agents, who in turn might interact among themselves. Powerful agents may benefit from such intertwined relations by way of making one transaction dependent upon the outcome of other transactions. Basu (1986) applies a three-player model to describe how this kind of interdependent, triadic, interaction may explain why people voluntarily accept coercive contracts. He constructs the example of a landlord who compels a laborer to accept a wage below his ordinary reservation wage. The landlord achieves this by ensuring that if the laborer does not accept the wage offered by the landlord, then the local merchant will refuse to trade with the laborer. The merchant in turn, complies with the threat because the landlord will otherwise refuse to trade with him.

The credibility of the landlord's threat has been questioned, see Naqvi and Wemhöner (1995), and strictly game theoretic versions of Basu's model have later been formulated by Basu (2000) and Hatlebakk (2000). Basu adds a coordination game to the extensive stage game described above, where the landlord can trigger the Pareto inferior equilibrium outcome as a punishment. Hatlebakk (2000) on the other hand, proposes an infinitely repeated game, where the merchant gets part of the extortionary profit that is the result of the collusive equilibrium, and the landlord can trigger the stage game equilibrium as punishment. While these contributions discuss the robustness of the triadic model in a game theoretic sense, the present paper discusses the robustness with respect to generalizations of the model. We add realism to the model not only to check whether the theoretical conclusions hold, but also to make it suitable for empirical tests.

If the triadic model actually has explanatory power, we would expect the model to apply to the local labor market within a village. For each village we need to allow for the possibility of multiple landlords and merchants, and in doing so we need to specify the interaction between these agents. We let the landlords produce and supply a local product, paddy, which they sell to the merchant. The merchant's profit is due to his low transaction cost of selling paddy in the external market, as well as a production income from processing paddy into rice, which is sold at the local market. Merchants operate as Cournot oligopolists in the local market for rice. The laborers within the village get take-it-or-leave-it offers from the landlord, which make them indifferent between the offer and their outside option. The basic idea of the triadic model is to show that the outside option is a relative term, which is determined either by the rejection of the labor-contract, or by the rejection of the labor-contract and the local purchase of rice. In the empirical analysis, we also allow the outside option to depend on the laborer's transaction costs in the external markets, as well as individual characteristics of the laborer.

The triadic model is clearly a simplification of the complex social and economic interactions within village economies. As for any principal-agent model, the assumption of a single laborer is not essential. Competition among multiple laborers would potentially make them worse off, but in the triadic model there is no room for further reduction in utility. Thus the landlord may offer any laborer his absolute reservation wage, as described by the triadic model. On the other hand, if there are few laborers, one might argue that the principal-agent model is less relevant. This issue has been investigated by Bell (1989), and will not be discussed here. In our model the laborers get take-it-or-leave-it offers, which may differ between laborers, but the number of laborers does not play a role in the model.

In section 2 we will identify the subgame perfect equilibrium in the triadic model first for the case of a single landlord and multiple merchants and then for the case of multiple landlords and merchants. We shall see that in the former case, the landlord's threat towards the laborer becomes credible even in the basic stage game. This is because the landlord can divert his trade to the non-deviating merchants. In the latter case we indicate how the subgame perfect solutions in Basu (2000) and Hatlebakk (2002) generalize to the multiple agent case.

We assume that multiple landlords simultaneously offer coercive labor contracts followed by a threat as in the standard triadic model. The threat is credible as long as a deviating laborer will be punished by any merchant. This punishment is in turn credible if a deviating merchant will be punished. The generalization of Basu (2000) implies that all landlords and merchants take part in the final coordination game, and will thus be punished whenever the inferior equilibrium is triggered. The generalization of Hatlebakk (2002) implies that every landlord trades at favorable terms with each merchant.

In section 3 we discuss alternative factors that may effect rural wages. Section 4 presents the data, and the econometric methodology. Section 5 reports the descriptive statistics and the estimates for a reduced form wage-model, using LSMS-data from Nepal. Section 6 concludes.

2. The multi-agent triadic model

Basu (1986) describes how a landlord may convince a laborer to accept a wage below his ordinary reservation wage by using a threat that involves a third agent, who is a merchant in the model. The threat of not being able to trade with the merchant reduces the reservation wage to a level that Basu defines as an extortionary wage. We will extend this triadic model to the case of multiple landlords and merchants. Competition among multiple laborers, on the other hand, will have no effect, since even a single laborer will accept his extortionary reservation wage.

In section 2.1 we prove that the Nash equilibrium described by Basu (1986) is subgame perfect in a model with one landlord and multiple merchants. We thus have a third approach to the issue of subgame perfectness in the triadic model. In section 2.2 we allow for multiple landlords. In that case we have to generalize the subgame perfect solutions provided by Basu (2000) and Hatlebakk (2002).

Before we introduce the model, we will comment on notation. Our notation is based on Basu (1986), but when we discuss subgame perfectness we define a simplified set of notation, which is the same as in Hatlebakk (2002).

2.1. The case of one landlord and multiple merchants

We study a village that consists of a landlord, an oligopoly of homogenous merchants, and multiple (*M*) homogenous laborers. A laborer's absolute reservation utility is the utility *U(r, n*) he entails if he does not interact with the other agents, that is, if he rejects (*r*) the labor contract offered by the landlord, and no merchant is trading with him (*n*). That utility level is determined by his behavior in the external goods and labor markets, when he maximizes the utility function $U = \hat{w}l - \hat{p}_x x + \phi_1(x) - \phi_2(l) - c_1 - c_2$, with respect to consumption x and labor effort l, where $\hat{w}$ is the competitive (urban) wage, $\hat{p}_x$ is the competitive price for the consumption good x (rice) in an external market area, c_1 is the fixed cost of transportation (for the housewife) to that market area, and c_2 is the fixed cost of commuting (for the husband) to the (urban) labor market. The model can be easily extended to allow for heterogeneous tastes, which may depend on household characteristics. We may also allow the laborer to run a small farm, which adds to the reservation utility, as long as the household is still a net-supplier of labor.

Assuming that utility $\phi_1(x)$ is an increasing and concave function of consumption *x*, and disutility $\phi_2(l)$ is an increasing and convex function of labor effort *l*, and also assuming an internal solution, the laborer may identify his optimal labor supply and goods demand in the external markets, which in turn determine the absolute reservation utility *U(r, n)*.

The transportation cost implies that the laborer will be willing to pay a higher price and accept a lower wage if he rather operates in the local markets. We will now describe how the price p_x of *x* is determined in the local market. On the demand side, any laborer maximizes his utility $U = wl - p_x x + \phi_1(x) - \phi_2(l)$ with respect to *x*, and subject to his labor contract (*w, l*), which, as we will see below, will be such that the laborer decides not to operate in external markets. From each laborer's optimization problem, we find his ordinary demand curve $x = x(p_x)$, and thus the aggregate demand curve $X=X(p_x)$, and the inverse demand curve $p_x = p(X)$.

On the supply side, the merchants purchase an input *y* (paddy) from the landlord, and process a part y_x into the consumption good by way of the production function $\bar{X} = f(y_x; k), f' > 0, f'' < 0$, and sell the residual in the external market. In the case of a competitive local goods market, each merchant would process the y_x that maximizes the utility (profit) $W = p_x f(y_x;k) - p_y y_x + (\hat{p}_y - p_y - c_w)(y - y_x)$, where $\hat{p}_y$ is the price of *y* in the external market, p_y is the local price, and c_w is the marginal transaction cost for the merchant of trading in the external market. We assume that the landlord has an even higher marginal cost c_l of trading, and is thus willing to sell at the external price, less his marginal cost, such that we have $p_y = \hat{p}_y - c_l$. This is a simplification, which implies that the landlord has no market-power towards the merchants.

A merchant's profit thus becomes $W = p_x f(y_x;k) - (\hat{p}_y - c_w) y_x + (c_l - c_w) y$, and the first order condition with respect to y_x is $p_x f'(y_x; k) = \hat{p}_y - c_w$, which means that the optimal input of y_x, and thus his production $\bar{X}$, will increase in p_x. Adding over the merchants, the aggregate supply curve will be upward sloping, and we may identify the equilibrium quantity *X* and the corresponding price p_x. We will assume a Cournot game between the merchants, which will be presented below, but let us first present the landlord's decision regarding the supply of y, which in turn determines the merchants' income from external trading.

Later we will see that the landlord offers each laborer a take-it-or-leave-it contract (w, l), which will be on the laborer's reservation utility curve in the w-l space. The particular reservation utility will be discussed in detail below. But we know that it will be below the laborer's external market supply curve, due to the transaction cost. The reservation utility curve may thus be interpreted as a "supply" curve, which is conditioned on the reservation utility. Subject to the labor-contract, we may aggregate over all laborers, and write L for the total labor input and W for the total labor cost. The landlord also has a fixed capital input K, and production Y is determined by the production function $Y = F(L; K)$, where $F' > 0$, $F'' < 0$. The price was determined above as $p_y = \hat{p}_y - c_l$, and the landlord's profit is thus fully described by $V = p_y F(L;K) - W$, where $W = wL = wMl$. The landlord knows that w is a function of l for each laborer along his reservation utility "supply" curve. Taking this into account the landlord maximizes profit in the same way as an ordinary monopsonist, but subject to the conditional "supply" curve for each laborer, and we may identify the optimal L and W from the landlord's point of view, and thus the optimal production Y. We denote the resulting profit as $V(w, T)$, where w (we suppress l) represents the labor contract (or the set of individual contracts), and T denotes that he trades with the merchants.

In equilibrium the landlord will split Y equally between the homogenous merchants, such that each merchant will have an exogenous input of y. A merchant's profit is determined by $W = p_x f(y_x;k) - y_x(\hat{p}_y - c_w) + (c_l - c_w)y$, where the latter part, and also the marginal cost of purchasing y_x is exogenous. From this function we may identify the optimal demand of y_x. However, we will rather solve the dual problem of identifying the optimal supply of $\bar{X}$. We simplify the presentation by considering only the variable part of the profit function, and write the inverse of the production function, as $y_x = f^{-1}(\bar{X})$. Then we have $W = p_x(X)\bar{X} - f^{-1}(\bar{X})(\hat{p}_y - c_w)$ $= p_x(X)\bar{X} - C(\bar{X})$. That is, each merchant chooses his sales $\bar{X}$, subject to a cost function $C(\bar{X})$, and the inverse demand function $p_x = p(X)$, where X equals $\bar{X}$ times the number of merchants. This is a standard Cournot model, which can be solved for the equilibrium values of $\bar{X}$ and p_x. The equilibrium outcome for each merchant we write as *W(T, t)*, which denotes that he trades with the landlord (*T*), as well as with the laborers (*t*).

Now, we need to define the payoffs for the case where the merchants are punishing a deviating laborer. Whenever the punishment works, no merchant will trade with the laborer, and he is effectively excluded from the market during the punishment. That means that the effective demand curve for *X* shifts slightly to the left, and we may identify the new Cournot equilibrium, where all merchants have a small reduction in profit. We denote the new profit as *W(T, n)*, where *n* denotes that a laborer is punished.

If one merchant does not take part in this punishment, then the laborer gets to trade, and we are back in the original Cournot equilibrium. It thus exists a small benefit for the deviating merchant (as well as the others), from not complying with the landlord's threat. Now, the landlord may respond by punishing the merchant who actually trades with the laborer, by diverting the supply of *Y* to the other merchants. In that case, we assume that the deviating merchant is still able to take part in the Cournot game, by producing rice from his stock of paddy, and he will thus also provide the deviating laborer with rice. The original Cournot equilibrium is thus sustained. However, without his share in *Y*, the merchant will have less paddy available for external sales, and his profit will be significantly smaller than *W(T, n)*. We write this punishment profit for the deviating merchant as *W(N, t)*, where *N* denotes that the merchant does not trade with the landlord, and *t* means that the merchant trades with the deviating laborer.

The landlord's profit from punishing the merchant we denote as *V(r, N)*, where *N* means that he punishes the deviating merchant, and *r* means that the laborer has rejected the wage contract. Note that the landlord may deliver paddy himself in the external market at the transaction cost c_l, which in turn determines the local price as described above. With the landlord being paid his reservation price, the merchants must carry any transaction cost of the trade with the landlord, which we may incorporate in the cost-function $C(\bar{X})$. As a consequence, the landlord will be indifferent with respect to the number of merchants with whom he trades[1]. However, since there is a possibility for out of equilibrium behavior by the others, he will weakly prefer to trade with all merchants in equilibrium, to have the option of

[1] If the landlord rather has some bargaining power in the local market for paddy, then the transaction cost may matter, and consequently also the number of merchants with whom he trades. In that case the landlord may decide to trade with only one merchant to minimize transaction costs, but with all merchants having the same probability of being the one. This possibility was pointed out by a participant at the Cornell development seminar.

punishing any deviator. As a result, the cost of punishing the merchant is zero, which we symbolize by the notation $V(r, N) = V(r, T)$.

The laborer, on the other hand, cannot be replaced, meaning that the labor input is reduced to $L = (M - 1)l$ in case the contract is rejected, and production, and thus profit, will be lower. With many laborers, this effect is small, but we will still have $V(r, N) < V(w, N)$. In the same manner we will have $V(r, T) < V(w, T)$.

Let us now turn to the payoff for a laborer. For the sake of comparison, we will first define the ordinary reservation wage, and then the extortionary reservation wage, with the latter being the focus of Basu (1986). The triadic model of power presented by Basu actually describes a way of reducing the laborer's reservation wage from the ordinary to an extortionary level[2]. The laborer's ordinary reservation utility is defined by $U_1 = \hat{w}l - p_x x + \phi_1(x) - \phi_2(l) - c_2$, where x is his optimal purchase from a village merchant, and l is his optimal labor supply in the external labor market.

Now, the landlord will offer a labor contract (w, l), that makes the laborer indifferent between the contract and U_1. Assuming optimal adjustments of x, the available contracts, along the reservation utility frontier, are defined by the utility function $U = wl - p_x x + \phi_1(x) - \phi_2(l) = U_1$. The function defines an upward-sloping "supply" curve, which is conditioned on the ordinary reservation utility U_1. Among the contracts along the curve, the landlord will offer the one that maximizes his own profit. The landlord will thus maximize profit in the same manner as an ordinary monopsonist, but subject to a conditional labor "supply" curve, where the laborer will be at his reservation utility. The optimal contract we denote (w_1, l_1), which is the ordinary take-it-or-leave-it offer from a Stackelberg monopsonist. Below we will suppress the notation for the labor input and denote the contract as w_1. We will also denote U_1 as $U(r, t)$, which means that the laborer is trading with the merchant, but not with the landlord.

[2] As a footnote we may define two basic kinds of power, the power some agents have to influence other agents reservation utility, and the power some agents have to influence the distribution of a surplus (above the reservation utilities). Triadic power relations, non-voluntary transactions, and redefinition of entitlements are examples of the first kind, monopoly and bargaining power of the second.

The contribution by Basu (1986) was to show that the laborer has actually an even lower reservation utility, which gives the landlord the opportunity to offer a contract where the laborer is worse off than with w_1. If not only the landlord, but also the merchant refuses to trade with the laborer, then he will have the utility $U(r, n) = U_0$, which is determined by the choices of x and l in the external markets, which maximize his utility $U = \hat{w}l - \hat{p}_x x + \phi_1(x) - \phi_2(l) - c_1 - c_2$. Note that we may interpret this as either the utility the laborer has when household members have to travel outside the village to trade and work, or the utility of permanently moving the entire household (the migration cost will be the sum of the two transaction cost parameters). Note that we have $U_0 < U_1$, since there is a transaction cost c_1 of trading in the external market[3].

Thus, the merchants leave a surplus for the laborers, which the landlord will observe. Basu demonstrates that the landlord may subtract that surplus as well. In the same manner as for the ordinary reservation wage, the available contracts are now defined by the utility function $U = wl - p_x x + \phi_1(x) - \phi_2(l) = U_0$. The function is an upward sloping conditional "supply" curve, which defines a set of contracts of the type (w, l) that all give the utility U_0. Among these contracts the landlord offers the one that maximizes his profit, and we denote the extortionary contract as (w_0, l_0), which we in short will refer to as the extortionary wage w_0.

As mentioned in the introduction, the threats that are necessary to sustain the extortionary wage, are not automatically credible, and we will now turn to this issue. We will demonstrate that the extortionary contract will be offered and accepted in the subgame perfect equilibrium of Basu's (1986) original stage game, when we allow for multiple merchants. The special case of a single landlord and multiple merchants is thus a third way of making the threats credible[4]. The specific timing of the actions will be the same as in Naqvi and Wemhöner (1995), who brought up the issue of credibility in Basu's model. We have added production processes at the appropriate stages of the game. Figure 1 illustrates the game for the case where the landlord offers w_0, and we only include payoffs for the equilibrium outcome. The

3 Note that the two reservation utility levels would not differ if the merchants also gave all-or-nothing offers to the laborers. But then they would have to collude on a price, as well as a quantity for each laborer. We find Cournot (or competitive) merchants to be more realistic, and in that case there will be extra surplus even for the laborers.

4 See the introduction for a short presentation of the two approaches presented by Basu (2000) and Hatlebakk (2002).

laborer and the merchant in the figure can represent any of the multiple laborers and merchants in the model. The figure is parallel to Figure 1 in Naqvi and Wemhöner (1995).

The timing and the available actions of the game are defined as: 1) The landlord makes a wage offer w_i to each laborer. 2) Each laborer accepts (*a*) or rejects (*r*) the offer, and production of *Y* takes place. 3) The Cournot oligopoly of merchants produce and sell *x*, using inputs from their stocks, to each laborer (*t*) or they exclude the deviating laborer (*n*). 4) The landlord sells *y* to each merchant (*T*) or excludes the deviating merchant (*N*).

Figure 1, about here.

Below we will need to write strategies that are conditional on previous actions, and we write sequences of actions as in the example (w_i, *r, t, N*) denoting the case where the landlord offers w_i to a laborer, the laborer rejects the offer, the laborer gets to trade with a merchant, and the landlord punishes that merchant by not trading with him.

Proposition 1 implies that Basu's (1986) Nash equilibrium is subgame perfect in the case of one landlord and multiple merchants. In the proof we check whether the strategy set is the best response (which means that no player will deviate) at all nodes in figure 1. The reader may check that the equilibrium outcome becomes (w_0, *a, t, T*), which is the Nash equilibrium presented by Basu (1986).

Proposition 1

Consider a triadic model with one landlord, multiple merchants, and multiple laborers with payoffs as defined above, where $V(r, N) = V(r, T) < V(w_0, T)$, $W(N, t) < W(T, n)$, *and* $U(w_0, t)$ *is infinitesimal better than* $U(r, n)$, *then the following strategy profile constitutes a subgame perfect Nash equilibrium of the stage game described above, which is illustrated in figure 1:*

Landlord's strategy: Offer w_0, *and play N after the sequence (r, t), and T otherwise.*

Merchants' strategy: Play n after r, and t otherwise.

Laborer's strategy: Play r after $w_i < w_0$, *and a otherwise.*

Proof: Starting at the top of the game-tree in figure 1, the landlord will not offer a lower wage, because it will be rejected, and $V(r, T) < V(w_0, T)$, and he will not offer a higher wage because w_0 will be accepted. The laborer will not reject w_0 since he will be punished by the merchant, and $U(w_0, t)$ is infinitesimal better than $U(r, n)$. If he accepts, then the merchant will trade, because it is his myopic best response. If the laborer rejects, then the merchant will punish the laborer, because he otherwise get punished by the landlord, and $W(N, t) < W(T, n)$. If the merchant does not punish the laborer, then the landlord will punish the merchant because $V(r, N) = V(r, T)$. Otherwise the landlord will play T, since it is his myopic best response. ||

Now we may summarize. We have constructed an empirically realistic model, which exemplifies what we believe to be a quite general result. That is, in the case of multiple third parties, the costs of deviation and punishment can be forced upon the deviating third party, since the principal can rather interact with one of the other agents at no cost. Another example of this structure is the model developed by Villanger (2002) simultaneously with us, where he studies the game between a donor and a recipient country regarding the conditionality of foreign aid, where international companies are the third parties.

2.2. The case of multiple landlords and multiple merchants

The case of a single landlord discussed in the previous section is a special case. In many villages there will be more than one landlord with demand for labor. Proposition 1 does not apply in this case. There will be no subgame perfect equilibrium in the original stage game, because any deviating merchant may now trade with one of the other landlords in the case where a landlord attempts to punish the merchant. To formulate a game, where Basu's outcome is subgame perfect, we have to make sure that all landlords will take part in the punishment of a deviating merchant. We now first describe the necessary generalization of the model from the previous section. Then we generalize the solutions described by respectively Basu (2000) and Hatlebakk (2002).

We assume that all landlords have the same characteristics as the one in the previous section. This means that any landlord may deliver Y at the external market at the marginal cost c_l. We assume, as in the single landlord case, that the price of Y will be the smallest possible price, $p_y = \hat{p}_y - c_l$. Thus, competition among landlords will not change the characterization of the equilibrium price. Assuming the same production function, we apply the same notation for each landlord's payoff as in the previous section. Thus, we have the same underlying model, and it remains to identify subgame perfect solutions where the extortionary wage is supported. As said, we will apply simple generalizations of Basu (2000) and Hatlebakk (2002), and we will thus not provide complete specifications of the games and the results.

Hatlebakk (2002) realizes that the extortionary wage w_0 creates an extra surplus compared to the ordinary reservation wage w_1. The set of landlords may now let the merchants take part in the extra profit by way of favorable contract terms. In the present model that would mean to give a permanent rebate on *y*, by setting $p_y < \hat{p}_y - c_l$. This strategy is sustainable, since in case of any deviation by a merchant, or a landlord, the stage game outcome will be triggered, and become the equilibrium for infinite periods. In our model, the stage game outcome will be the ordinary reservation wage. We thus apply a standard folk-theorem result for the merchant-landlord game, where the merchants and landlords are able to collude on the threat towards the laborers. The number of colluding agents does not matter for the result, and we have a simple extension of Proposition 1 in Hatlebakk (2002).

Note that the favorable contract is by way of a reduced uniform price p_y that all merchants pay. This has the equilibrium effect that production *X* increases, and the laborers will be better off in the goods market. This effect is still not likely to offset the extortionary wage.

In the case of Basu (2000) the threat towards the merchant is sustained by way of a coordination game among the merchant and the landlord, which replace the trading decision of the landlord in figure 1. This extension to the stage game is sufficient to support the extortionary wage as a subgame perfect outcome. Applying this solution to the multiple agent model implies that all landlords and merchants are involved in the coordination game. The punishment of a deviating merchant or landlord now implies that the other players must trigger the pareto-inferior outcome of the coordination game. In a coordination game this will be a Nash-equilibrium of the subgame defined by the node where the merchant deviates. Anticipating the punishment, the merchant and the laborer will not deviate, and the outcome where the laborer accepts the extortionary wage will be subgame perfect.

Note that all other players must change their behavior to trigger the inferior equilibrium of the coordination game. In the single landlord-single merchant case this is relatively trivial. In the multiple agent case, the players may have to coordinate on the punishment. For some payoff structures it will be the best response for all players to coordinate on the inferior equilibrium if only one player insists on the punishment. As a consequence the punishment is easily triggered. Basu's (2000) example of coordination on the management of a common resource is of this kind.

However, for other payoff structures it will not necessarily be the best response for the other players to coordinate on the inferior equilibrium, if only a subset play the corresponding actions. In that case players have to coordinate on the punishment by simultaneously choosing the actions that correspond to the inferior equilibrium. We may imagine a situation where the superior equilibrium is one where all landlords and merchants interact socially, while the inferior equilibrium is one where they do not interact. Some players may decide not to interact, with the purpose to trigger the inferior equilibrium, but it may still be the best response for the others to interact among themselves. Although this set of actions does not constitute a Nash equilibrium, it illustrates that the inferior equilibrium might be difficult to trigger. Thus a coordination game may support a subgame perfect equilibrium, but it requires that the players believe that the inferior equilibrium will actually be triggered in the case of a deviation.

3. Alternative models and empirical implications

First note that the triadic model is an extension of a standard Stackelberg model, where the laborer has to accept a labor contract that leaves him with his reservation utility. A Stackelberg model is a reasonable description of a local labor market with a single employer, who has sufficient information to discriminate among the laborers, and thus is able to offer each laborer a contract that gives him the reservation utility. The basic idea of the triadic model is that the laborer may accept an even lower wage than in the standard Stackelberg model. However, in line with the Stackelberg model we will not discuss the possibility that the number of laborers may affect the equilibrium outcome. For a discussion of this topic within our principal-agent framework, see Bell (1989). The simple, and relevant, extension of our model to the multiple laborer case is to imagine that the landlord plays the same triadic game simultaneously with multiple laborers, and the outcome for each laborer is the same as in a single laborer model.

Although this is the case, we will argue that the laborers might receive heterogeneous wage offers. The laborers might differ with respect to the extortionary wage w_0 they accept, as it is defined by the condition $U(r, n) = U(w_0, t)$. Heterogeneity between villages might be explained by the transportation costs discussed above. Heterogeneity within villages might be explained by household characteristics, including preferences, and alternative employment options. We shall expect land holdings to be one such factor. A laborer with some land, where he can produce food, will be less dependent on the landlord and the merchant, which in turn means that *U(r, n)* will be higher. As a result the landlord will offer a higher wage w_0 to the wealthier laborers.

Note that this extension does not change the basic structure of the model. The landlord offers the lowest wage to the laborer who accepts the lowest wage, and offers successively higher wages to laborers with higher reservation utilities. A potential objection to this outcome is that a laborer who is offered a low wage might undercut a better paid laborer. However, the Stackelberg-type model that we apply assumes that the landlord knows the reservation wage for each laborer, and thus knows that the less wealthy laborer will actually accept the lower wage.

The models in section 2, as well as alternative models of the rural labor market, imply that the number of landlords and merchants within a village is likely to affect the rural wages. When it comes to external markets, we expect the wage to be higher the lower is the transaction cost. In the empirical analysis, travel time to the external market is supposed to capture this factor. Geographically proximity to market areas may also have demand effects, which in turn might contribute to higher rural wages. The reduced form model, which we estimate, is supposed to capture both the supply and the demand effects of the distance variable on the equilibrium rural wages. Finally, we expect to find variation in wages according to gender and caste, which may reflect statistical or other kinds of discrimination.

4. Data and econometric methodology

We apply the Nepal Living Standard Survey (NLSS) conducted by the Central Bureau of Statistics (1996), Nepal (CBS), during the period June 25, 1995 to June 15, 1996. CBS interviewed 2657 rural households in 215 wards[5]. In most wards 12 households were interviewed[6]. The wards were sorted into three strata or ecological belts, the mountains, hills and terai. Within each stratum, wards were selected with probabilities proportional to the number of households in the ward. Then the households were

[5]In Nepal every village is divided into nine administrative zones, called wards.
[6]In the remote Far-Western region 16 households were interviewed in each village, to increase the number of respondents. Including the urban sector it was planned to interview 3388 households in 275 wards. A ward in the remote Dolpa district in the mountains was not visited. In addition, three households are missing in another mountain ward.

randomly selected within each ward[7]. We apply weighted regressions (and descriptive statistics) which take into account that the sample households had different probability of being selected[8]. We report robust standard errors, which also take into account that observations within wards (cluster) might be correlated. We intend to estimate a reduced form wage-equation, where we include the exogenous variables that we believe affect rural wages.

Out of the 2657 rural households, 970 households report that at least one household member had income as an agricultural worker (hired on a daily basis, which is the most common contract) during the last 12 months. The total number of agricultural workers for all these households is 1897. Information is missing on some variables for some households, and in the regression, the number of observations will be 1826. Note that the probability of a household to be selected does not depend on the number of household members. Thus the number of household members in a randomly selected household will be random. Consequently a random sample of household members will be self-weighted, in the same manner as a sample of households. We may alternatively use households as the unit of observation, and select one household member to represent the household. This would make some sense, since gender, age, and (in some cases) caste are the only variables that differ among household members. However, this alternative approach (where we selected the male with the longest period of work, when possible) turned out to give approximately the same results, and we rather report the results for the full sample, where we also capture the variation in wages for different types of labor.

The theoretical model in section 2, as well as the alternative models mentioned in section 3, predicts that equilibrium wages depend on a set of exogenous variables. We thus estimate a reduced form model, where we (except for some quadratic parts) assume linear relationships between the exogenous variables and the rural wages. We allow the workers' preferences for leisure to vary between castes, and equilibrium wages to vary between types of labor, according to gender and age of the workers. We allow the workers' reservation wages to vary with their land-value and the distance to the market area. We also allow the resulting equilibrium wages to vary with the distance to the local shop, which affects the probability that a merchant is involved in the wage-setting game, and with the number of landlords

[7]Approximately 12% of the initial sample were replaced by another random household, because the household was not found or not at home.

[8] The final household rooster in the selected villages differed from the census that was applied in the selection of villages, some remote villages had 16 respondents, and the probabilities were not balanced between strata.

within the village, where we apply a proxy variable that is based on the available information on the distribution of land-value within the village.

Although these variables are exogenous to the theoretical models discussed, it might be the case that a more realistic model would have to include, in particular, land-distribution and distance to the local shop as endogenous variables. One may imagine that as the rural wages increases, the workers will be able to buy land from the landlords, and one may also imagine that as rural wages increases within a village, it becomes more profitable to establish a local shop. In addition to the OLS-estimations we have thus estimated a set of instrumental-variables (IV) regressions.

We will report three IV-regressions for each OLS-regression[9]. One regression (column *b*) where land-value and the distance to local shops are instrumented by the distance to the market area and caste-dummies. One regression (column *c*) where only the distance to the local shop is instrumented by these instruments, and another (column *d*) where only distance to the market area is applied as an instrument for the distance to the local shop. For the two latter, where land-value is considered as exogenous, we add the explanatory variables that are derived from land-value. The regressions for the full sample, the hill sample and the terai sample are reported in respectively tables 2-4. Note that we have not been able to find instruments that are external to the OLS-specification.

We first note that the results differ drastically between the sub-samples, which indicates that the full sample results summarize the results from the sub-samples. We thus prefer to discuss the results separately for the two main sub-samples, that is, the hill and the terai samples. We still report the full sample results in table 2 for comparison.

Independently of the specification, individual land-value turns out to have no significant effect on rural wages for the two sub-samples. We thus conclude that land-value appears to be exogenous, which allows us to add (in column *c* and *d*) the explanatory variables that are derived from land-value[10]. Also note that the first-stage model seems to be better estimated for column *c* and *d*. For the hill sample the

[9] The R-squared in the IV-regressions is calculated on the basis of the actual values of the endogenous variables, rather than the predicted values, which imply that R-squared might be negative, and thus omitted from our tables. Significant parameters are still significant, see www.stata.com/support/faqs/stat/2sls.html, for details on this issue.
[10] If land-value is endogenous, then the dummy for landless households, and the village level proxies, which we derive, may still be exogenous. We avoid these difficulties, since land-value appears to be exogenous to the rural wages.

last specification (column *d*), where the caste-dummies are not applied as instruments, is very poorly estimated. Furthermore, whether we apply column *b* or *c*, the coefficients are not significantly different from the OLS-regression, when we use a Hausman test. We may thus apply the more efficient OLS-estimates. We conclude that for the hill sample column *c* seems to be the best IV-model, and the results indicate that there are no serious problems with endogeneity. This is what we would expect given the exogenous character of our explanatory variables. We also note that the distance to local shops has no significant effect on the wages.

In the terai sample, on the other hand, the distance to the local shops appear to affect the rural wages, and, possibly as a result of the direct effect, also appears to be endogenous. Again we believe column *c* to be the most robust model, since we have included the caste-dummies as instruments, and these are important determinants in the first-stage regression, which is reported in the lower part of the table. But all three IV-regressions give similar results.

The IV-parameter for the distance to local shops is larger than the OLS-parameter, which is as expected. The triadic model predicts that the rural wages will be higher the further away (and thus supposedly the less powerful) are the merchants. But with higher wages it will also be more profitable to establish shops, which will counteract the direct effect. For the terai sample we have support for the hypothesis that the existence of local merchants has a negative effect on the equilibrium wages, that is, wages are higher the longer is the distance to the local shops. This effect is counteracted by the positive effect of higher wages on the profitability of the local shops. The combined effect shows in the OLS-regression, as well as in the descriptive statistics. However, for the hill sample only the latter correlation seems to be present, that is, the distance to local shops is smaller the higher are the rural wages.

A related econometric issue is that our sample of workers consists of household members that are self-selected in the sense that they have decided to be agricultural workers. In addition, there is migration of agricultural workers from the hills to the terai, which in turn means that the regional separation of the sample might be affected by self-selection[11]. We test for these two kinds of selection bias, by estimating

[11] One may also imagine selection bias due to migration out of the rural sector. That is, if rural wages were higher, less people would migrate, and the rural sample would be larger, possibly leading to a wage-equation that differs from the one we estimate. But since we do not include human-capital based explanatory variables, but intend to estimate a reduced form model that is based on broad market characteristics, we will not expect the effect of migration out of the sector to differ

Heckman selection models. In doing so we apply landvalue and the caste dummies as identifying variables. As in the IV-regressions we had to use variables that would otherwise be included as explanatory variables in the OLS-regression. We have selected identifying variables that tend not to affect the rural wages, while they do affect a person's probability of being an agricultural worker. The maximum-likelihood Heckman-selection models are reported in column *e*, *f* and *g* of tables 2-4.

In each table, column *e* shows the effect of selection from the total sample of household members in the region into the sample of workers in that region. Column *f* shows the effect of selection from the full sample of rural households into that particular regional sample of workers, that is, the combined effect of the migration decision and the decision to be a worker. Column *g* shows the effect of selection into a region, subject to being a worker, that is, the pure migration effect. The results indicate that selection is only an issue when it comes to migration of workers to terai (column *4g*). This effect also shows in the combined selection model for terai (column *4f*). In the other Heckman-regressions the Mills-ratio is not significantly different from zero, and we rather apply the OLS-results. For all regressions, including those where selection appears to be a problem, the parameters are basically the same as in the OLS-regression.

5. Results

Table 1 presents the explanatory variables, as well as the average value for the dependent variable, the daily wage, for different sub-samples. The wage includes the self-reported value of in-kind payments. Some workers have reported more than one contract, and in those cases we have calculated the average wage, using the number of days as weights. Tables 2 to 4 present the estimations, where table 2 presents the full sample with regional dummies included as explanatory variables, while table 3 presents the hill-area subsample, and table 4 presents the terai (lowlands) subsample.

If we compare two villages that are otherwise similar, then we shall, according to the triadic model, expect wages to be lower in villages where merchants are present. To test this hypothesis we apply the reported distance to the local shops measured in hours[12]. As discussed in the previous section, the OLS-

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significantly from the effect of migration to another rural region. We do not have information that may determine the rural-urban migration, and will thus not test for selection out of the rural sample.

[12] Some obvious data errors affected the initial results when it comes to the distance variable, and we have made the following corrections: When a household reported a distance of two days more than the median distance within a ward, then we replaced the distance by the median. This affected four (of the initial 3161) households. For comparison, the median

regression gives a conservative, and biased, estimate that takes into account the counteracting effect of reduced wages on the profitability of the local shops (and thus probably the distance to the local shops). If we apply the conservative results, which are consistent with the descriptive statistics, then we find that in the terai the wage shifts down by close to 2 rupees per 15 minutes of travel, or 8 rupees for approximately 1 hour of travel. According to the IV-regressions the direct effect, which is implied by the triadic model, appears to be three to four times larger than the conservative (OLS) estimate. The variation in wages must be compared to the median, which is approximately 40 rupees.

For the terai villages we can thus reject the zero-hypothesis of no effect, and conclude that we have support for the triadic model. In the hills, on the other hand, we find no support for the triadic model. The difference between the terai and the hill villages might be due to the fact that merchants have a relatively less important economic position in the hills, where farmers seem to rely more on their own production.

In contrast to other models of market power, the triadic model predicts that the number of landlords will not matter for the equilibrium wages. Thus whenever the merchant-variable is significant, we shall not expect the number of landlords to matter, and vice-versa. To test these predictions we apply the number of households that have landvalue above a certain cutoff. The cutoff is based upon the maximum landvalue within each ward, and we pick the median of these maximal values between villages[13]. As predicted the variable appears to have a significant effect in the hills, where the merchant variable is not significant, while the number of landlords variable is not significant in the terai, where the merchant variable is significant[14]. This pattern is also supported by the descriptive data in table 1.

One may believe that the effect of the number of landlords rather reflects labor demand. We thus control for a demand indicator. We define a cutoff for landvalue, which is at the 95% percentile for landvalue among the workers, and assume that households with a larger landvalue will have a demand for labor

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distance in the full sample is 10 minutes. To be consistent, we also replaced the distance to the market area by the ward median, if a household reported a distance four days more then the median. This affected eight (of the initial 3269) households. For comparison, the median distance in the full sample is 1.5 hours. While the errors influenced the effect of the distance to local shops, they did not influence the effect of the distance to the market area.

[13] With larger samples from each ward the cutoff would be higher, while the number of households having landvalue above the cutoff will be either higher or lower, depending on the distribution of landvalue within the village. Our indicator for the number of landlords is thus only an indicator. The number of landlords that is mentioned in table 1 must thus not be interpreted literary.

input that is a linear function of the excess landvalue. We apply the average, within village, of this demand indicator as an explanatory variable. The variable is first of all a control variable, which turns out to have the expected positive effect on rural wages.

The triadic model, as any reservation wage model, predicts that wages will decrease with the distance to the external labor market. We apply the distance, measured in hours, to the nearest market area, to test this hypothesis. The variable turns out not to have a significant effect on wages, when we control for other variables. This may reflect the fact that the laborers' outside options are not employment in the nearest market area, but rather migration to the cities.

With reservation wage pricing, we shall expect wages to vary with individual characteristics, in particular with the landvalue of the household, which will have a direct effect on the reservation wage. We find that landless workers have significantly lower wages, but only in the hill sample. This difference between regions may be due to a selection process. The most able landless households may migrate to the terai region. The selection part of the Heckman model for the terai sample shows that the landless tend to migrate, which is consistent with this explanation.

We find no separate effect of ethnicity[15]. This contrasts with previous work by us, where we found ethnicity to be a determinant of rural informal interest rates in Nepal. The result must imply that reservation wages do not vary between castes, apparently in contrast to the demand for informal credit (which might explain price discrimination in the credit market). There are, however, wage differences between types of labor. Women earn significantly less than men, and children earn significantly less than adults. We have included a second-degree polynomial for age, which has its maximum at approximately 40 years. A similar result appears if we replaced the polynomial by a child-dummy.

We also notice that there are no differences in rural wages between the hills and the terai, when we control for other factors. The explanation is most likely the heavy migration from the hills to the terai of Nepal. However, there is an east-west difference in wages, with wages being higher in the two remote

[14] As table 1 indicates the difference is not due to a systematic difference in number of landlords between the two regions.
[15] The exception is the dummy for ethnic groups belonging to the terai region for the full sample. We believe that this is due to a de facto effect, which only shows up in the larger sample, where the variation in wages are larger.

western regions. This indicates that the remote western regions constitute a separate labor market, which possibly is integrated with labor markets in India[16].

6. Conclusions

We find empirical support for the triadic model presented by Basu (1986), for the case of the rural terai of Nepal. That is, rural wages are significantly lower the shorter is the distance to the local shops. Thus, the existence of a village merchant appears to improve the landlords' power towards the laborers. Furthermore, in line with our generalization of the model, a proxy for the number of landlords within the village is only significant for the hill sample, where the merchant appears not to matter. Both results support the theoretical model that we present, where we show that the triadic model is robust to a set of generalizations.

Labor migration may explain why wages do not depend on the distance to the nearest market, and may also explain why there is no difference in rural wages between the hills and the lowlands, when we control for other variables. However, the low wages among the landless workers that remain in the hills indicate a certain selection effect when it comes to migration.

We find no wage-discrimination according to caste, which in turn indicates that all workers receive the same reservation wage. This has two possible implications, one is that preferences do not differ between castes. The other is that we have no support for models where the labor market is separated according to caste (such as third-degree price-discrimination, or statistical discrimination). But, as expected, wages differ among types of labor, women and children earn less then adult men.

We may summarize. The rural labor supply seems to be competitive in the sense that workers tend to migrate to the terai, where there is an upward trend in the demand for labor. In equilibrium they all seem to accept their reservation wage. However, there is a cost of migration, which in turn may explain why wages still differ between villages, according to the local market structures. That is, wages appear to be higher in the hill villages where landlords compete for labor, and wages are lower in the terai villages where local merchants are present. These results support the triadic model.

[16] Professor Pitamber Chettri at Tribhuvan University suggested this interpretation.

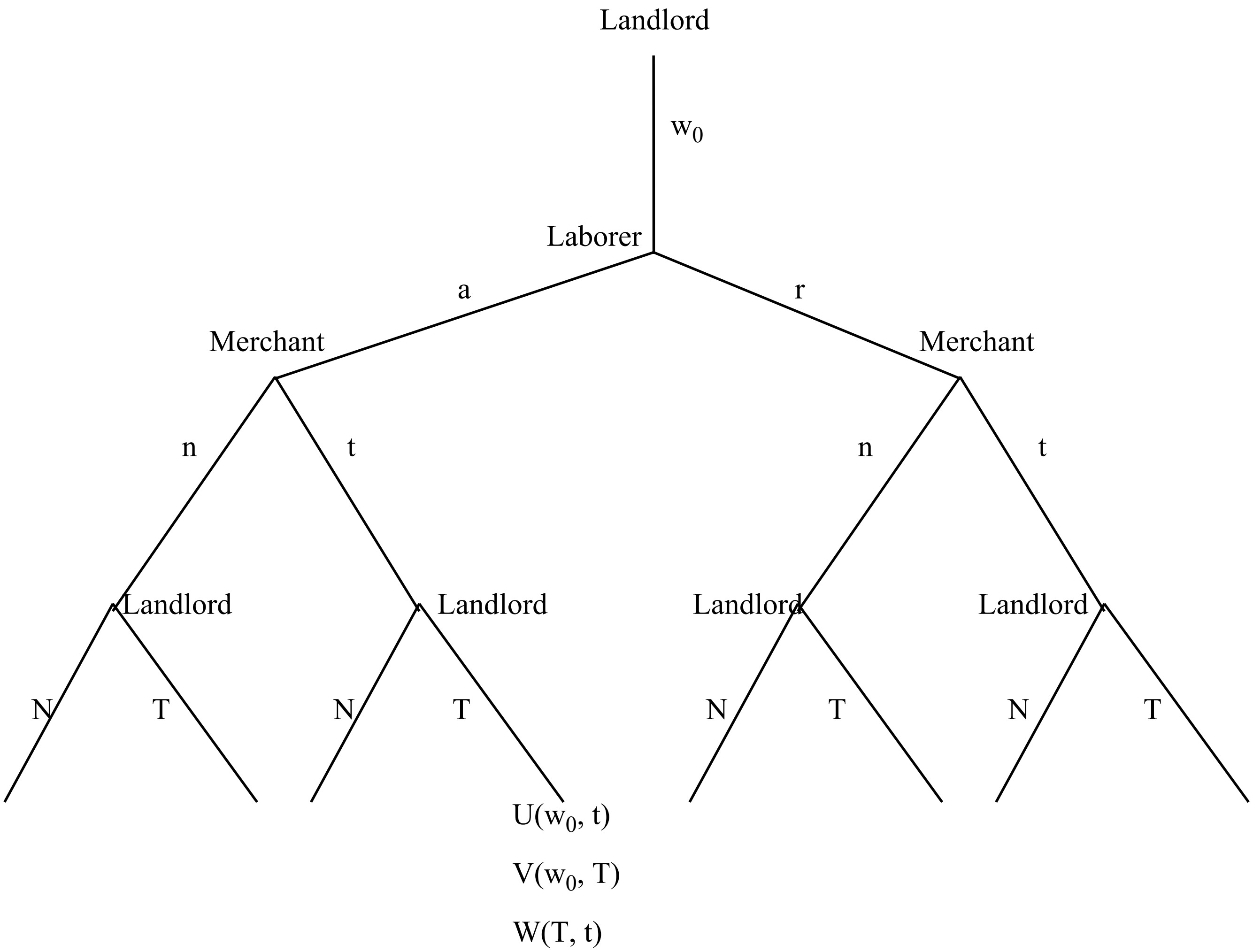

Figure 1. The stage game

Table 1. Descriptive statistics.

Categories	N	Mean wage (rupees per day)
All households	1897	38.7
Gender:		
Male	1021	42.6
Female	876	34.1
Age:		
≤ 18 years	254	35.4
>18	1643	39.2
Land value:		
Value = 0	439	34.8
0< Value < 33 700	509	39.7
Value ≥ 33 700 (median)	949	40.2
Castes:		
Shudra (occ.caste)	184	44.7
Terai, ethic groups	992	34.8
Hill, ethnic groups	402	41.0
Missing	31	45.6
Chettri	155	44.6
Brahmin (base)	133	47.2
Climatic belt:		
Terai (lowlands)	1152	37.0
Hills	515	42.7
Mountains (base)	230	39.4
East-west regions		
Mid and far west	214	48.9
West, central, east	1683	37.5
Distance to market center:		
Dist ≤ 1.5 hours (median)	935	39.5
1.5 < dist < 5 hours	692	37.8
Dist ≥ 5 hours	232	38.0
Distance to local shops:		
≤ 1 hour in terai	1014	35.9
> 1 hour in terai	106	47.2
≤ 1 hour in hills	350	45.2
> 1 hour in hills	154	37.4
No of landlords in ward*:		
N = 0, terai	528	36.0
N = 1, 2, 3, terai	576	36.9
N = 4, 5, 6, 7, terai	48	52.1
N = 0, hills	304	37.9
N = 1, 2, 3, hills	189	47.4
N = 4, 5, 6, 7, hills	22	67.0
Demand indicator **:		
≥ median	952	40.6
< median	945	36.6

* Landlord: Landvalue > median over wards for the max. landvalue within ward
This indicator must not be interpreted literary.
** Mean within ward: landvalue above the overall 95% percentile among laborers

Table 2. The full sample

Depend: Wage (rupees/day)	OLS (a)	IV (b)	IV (c)	IV (d)	Heckman (e)
Woman	-9.353***	-7.884***	-9.103***	-9.249***	-9.537***
	(0.994)	*(1.631)*	*(1.001)*	*(1.012)*	*(0.998)*
Age	0.452***	0.414*	0.489***	0.461***	0.649***
(years)	*(0.137)*	*(0.245)*	*(0.132)*	*(0.158)*	*(0.189)*
Age^2	-0.006***	-0.006*	-0.006***	-0.006***	-0.008***
	(0.002)	*(0.003)*	*(0.002)*	*(0.002)*	*(0.002)*
Hours to	0.240	**2.287**	**3.572**	**-5.789**	0.008
shop	*(1.102)*	***(5.169)***	***(5.644)***	***(12.78)***	*(0.952)*
Mid or far	10.084***	7.250	11.560***	10.371***	11.903***
Western	*(2.658)*	*(4.844)*	*(2.829)*	*(2.851)*	*(2.860)*
Land-value	-0.107	**14.52****	0.116	-0.229	
('00 000)	*(0.524)*	***(7.1)***	*(0.563)*	*(0.652)*	
Landless	-2.973*		-2.989	-3.451*	
	(1.655)		*(1.842)*	*(2.027)*	
Mean-demand	1.61***		1.71***	1.53**	1.51***
('00 000)	*(0.575)*		*(0.613)*	*(0.666)*	*(0.578)*
No. of land-	2.241**		2.635**	1.681	2.144**
lords proxy	*(0.965)*		*(1.090)*	*(1.565)*	*(0.932)*
Hours to	-0.160				-0.381
market	*(0.333)*				*(0.290)*
Chettri	-2.430			-3.788	
	(4.583)			*(5.302)*	
Terai-ethnic	-9.744**			-10.66**	
	(4.401)			*(2.022)*	
Hill-ethnic	-2.285			-1.084	
	(4.016)			*(4.585)*	
Shudra	0.339			-0.602	
	(4.701)			*(5.145)*	
Missing	-3.277			0.490	
	(4.764)			*(9.020)*	
Hills	1.485	-0.872	2.397	0.027	1.846
	(3.149)	*(4.247)*	*(3.760)*	*(4.144)*	*(2.979)*
Terai	1.662	-2.054	-0.870	-2.459	-4.623
	(3.454)	*(5.630)*	*(6.055)*	*(10.24)*	*(3.084)*
Constant	37.086***	25.209***	28.709***	44.021***	28.614***
	(5.368)	*(7.246)*	*(8.242)*	*(17.102)*	*(6.921)*
R^2	0.2091	Negative	0.1636	0.1341	
N	1826	1826	1826	1826	1826

Robust standard errors in parentheses. Endogenous variables in bold.
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table 2, continued for the full sample: The first stage regression for "hours to shop" in the IV-regression, and the selection model for the Heckman regression.

	OLS (a)	IV (b)	IV (c)	IV (d)	Heckman (e)
	1. stage. Dep. Var:	Hours to shop			Selection:
Woman		0.013	0.017	0.017	-0.088**
		(0.041)	*(0.041)*	*(0.041)*	*(0.037)*
Age (years)		-0.001	0.002	0.002	
		(0.007)	*(0.007)*	*(0.007)*	
Age^2		0.000	-0.000	-0.000	
		(0.000)	*(0.000)*	*(0.000)*	
Child					-1.104***
					(0.044)
Mid or far Western		0.049	0.048	0.048	
		(0.078)	*(0.078)*	*(0.078)*	
Land-value ('00 000)			-0.020	-0.020	***-0.168****
			(0.015)	*(0.015)*	***(0.038)***
Landless			-0.079*	-0.079*	***0.284****
			(0.044)	*(0.044)*	***(0.080)***
Mean-demand ('00 000)			-0.016*	-0.016*	
			(0.008)	*(0.008)*	
No. of land-lords proxy			-0.093***	-0.093***	
			(0.014)	*(0.014)*	
Hours to market		**0.034*** **	**0.027*** **	**0.027*** **	
		(0.010)	***(0.010)***	***(0.010)***	
Chettri		**-0.220***	**-0.225***	-0.225*	***-0.089***
		(0.120)	***(0.120)***	*(0.120)*	***(0.146)***
Terai-ethnic		**-0.097**	**-0.152***	-0.152*	***0.672****
		(0.088)	***(0.089)***	*(0.089)*	***(0.113)***
Hill-ethnic		**0.257****	**0.199***	0.199*	***0.434****
		(0.119)	***(0.119)***	*(0.119)*	***(0.124)***
Shudra		**-0.103**	**-0.156**	-0.156	***0.397****
		(0.117)	***(0.117)***	*(0.117)*	***(0.145)***
Missing		**0.614***	**0.625****	0.625**	***0.341****
		(0.316)	***(0.311)***	*(0.311)*	***(0.187)***
Hills		-0.278**	-0.242**	-0.242**	
		(0.111)	*(0.112)*	*(0.112)*	
Terai		-0.748***	-0.684***	-0.684***	
		(0.105)	*(0.105)*	*(0.105)*	
Constant		1.046***	1.150***	1.150***	-1.010***
		(0.191)	*(0.191)*	*(0.191)*	*(0.117)*
Mills ratio					1.988
					(1.946)
R^2		0.1790	0.1987	0.1987	
N		1826	1826	1826	16116

Instruments and identifying variables in bold

Table 3. The hill sample

Depend: Wage (rupees/day)	OLS (a)	IV **** (b)	IV **** (c)	IV (d)	Heckman (e)	Heckman (f)	Heckman (g)
Woman	-12.01***	-10.52***	-10.71***	-7.219	-11.69***	-11.73***	-11.72***
	(2.203)	*(2.346)*	*(2.279)*	*(34.70)*	*(2.237)*	*(2.172)*	*(2.172)*
Age	0.544**	0.937**	0.722*	1.235	0.813	0.722*	0.611**
(years)	*(0.274)*	*(0.413)*	*(0.427)*	*(5.107)*	*(0.612)*	*(0.370)*	*(0.289)*
Age^2	-0.006	-0.012*	-0.009	-0.015	-0.010	-0.008*	-0.007*
	(0.004)	*(0.006)*	*(0.006)*	*(0.069)*	*(0.007)*	*(0.005)*	*(0.004)*
Hours to	-0.158	**-9.419**	**-9.597**	**-41.26**	-0.545	-0.548	-0.577
shop	*(1.138)*	***(6.659)***	***(6.665)***	***(296.5)***	*(1.275)*	*(1.267)*	*(1.246)*
Mid or far	5.495	4.973	5.750	8.822	7.361	7.182	7.234
Western	*(4.658)*	*(5.366)*	*(5.519)*	*(29.36)*	*(4.812)*	*(4.855)*	*(4.946)*
Land-value	-0.028	**0.723**	-0.250	-0.385			
('00 000)	*(1.09)*	***(4.2)***	*(1.26)*	*(3.29)*			
Landless	-12.14**		-5.428	13.33			
	(4.740)		*(6.930)*	*(184.2)*			
Mean-demand	1.2***		1.07**	0.675	0.899*	0.883*	0.873*
('00 000)	*(0.441)*		*(0.529)*	*(3.98)*	*(0.472)*	*(0.457)*	*(0.458)*
No. of land-	4.349**		1.822	-6.957	3.629**	3.706**	3.842**
lords proxy	*(1.765)*		*(2.221)*	*(81.72)*	*(1.707)*	*(1.601)*	*(1.518)*
Hours to	-0.160				-0.354	-0.347	-0.348
market	*(0.276)*				*(0.303)*	*(0.310)*	*(0.311)*
Chettri	-1.083			-12.23			
	(6.373)			*(81.29)*			
Terai-ethnic	3.058			-28.15			
	(7.981)			*(227.9)*			
Hill-ethnic	-5.075			4.625			
	(5.372)			*(69.06)*			
Shudra	4.656			-10.74			
	(6.452)			*(113.9)*			
Missing	-6.409			28.70			
	(5.958)			*(252.6)*			
Constant	37.422***	40.102***	42.481***	70.432	26.390	29.422*	34.306***
	(6.899)	*(7.316)*	*(6.537)*	*(243.6)*	*(27.169)*	*(17.168)*	*(6.259)*
R^2	0.2828	Negative	Negative	Negative			
N	493	493	493	493	493	493	493

Robust standard errors in parentheses. Endogenous variables in bold.
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
****Coefficients not different from the corresponding OLS-model, using a Hausman test.

Table 3, continued for the hill sample: The first stage regression for "hours to shop" in the IV-regression, and the selection model for the Heckman regression

	OLS (a)	IV (b)	IV (c)	IV (d)	Heckman (e)	Heckman (f)	Heckman (g)
	1. stage. Dep. Var:	Hours to shop			Selection:		
Woman		0.127	0.116	0.116	0.035	0.043	0.141*
		(0.128)	*(0.125)*	*(0.125)*	*(0.054)*	*(0.046)*	*(0.079)*
Age		0.004	0.017	0.017			
(years)		*(0.027)*	*(0.026)*	*(0.026)*			
Age^2		-0.000	-0.000	-0.000			
		(0.000)	*(0.000)*	*(0.000)*			
Child					-0.914***	-0.793***	0.030
					(0.065)	*(0.056)*	*(0.114)*
Mid or far		0.157	0.081	0.081			
Western		*(0.234)*	*(0.246)*	*(0.246)*			
Land-value			-0.009	-0.009	***-0.116****	***-0.103****	***0.016***
('00 000)			*(0.033)*	*(0.033)*	***(0.041)***	***(0.037)***	***(0.048)***
Landless			0.620*	0.620*	***0.194***	***-0.113***	***-0.429****
			(0.354)	*(0.354)*	***(0.199)***	***(0.153)***	***(0.220)***
Mean-demand			-0.013	-0.013			
('00 000)			*(0.013)*	*(0.013)*			
No. of land-			-0.275***	-0.275***			
lords proxy			*(0.049)*	*(0.049)*			
Hours to		**0.025***	**0.004**	**0.004**			
market		***(0.014)***	***(0.012)***	***(0.012)***			
Chettri		**-0.400****	**-0.271**	-0.271	***-0.076***	***-0.099***	***0.029***
		(0.173)	***(0.177)***	*(0.177)*	***(0.179)***	***(0.164)***	***(0.348)***
Terai-ethnic		**-0.620*****	**-0.759*****	-0.759***	***0.011***	***-0.861*****	***-2.047*****
		(0.154)	***(0.177)***	*(0.177)*	***(0.237)***	***(0.189)***	***(0.293)***
Hill-ethnic		**0.255**	**0.236**	0.236	***0.324****	***0.371****	***0.053***
		(0.191)	***(0.191)***	*(0.191)*	***(0.164)***	***(0.150)***	***(0.311)***
Shudra		**-0.185**	**-0.375***	-0.375*	***0.219***	***0.224***	***-0.239***
		(0.203)	***(0.192)***	*(0.192)*	***(0.176)***	***(0.168)***	***(0.310)***
Missing		**0.763***	**0.854****	0.854**	***0.426****	***0.455*****	***0.605***
		(0.423)	***(0.417)***	*(0.417)*	***(0.242)***	***(0.224)***	***(0.425)***
Constant		0.648	0.803*	0.803*	-1.136***	-1.465***	0.046
		(0.502)	*(0.487)*	*(0.487)*	*(0.165)*	*(0.153)*	*(0.252)*
Mills ratio					3.112	1.976	1.214
					(8.799)	*(5.069)*	*(4.040)*
R^2		0.0597	0.1271	0.1271			
N		493	493	493	6547	16165	1875

Instruments and identifying variables in bold

Table 4. The Terai sample

Depend: Wage (rupees/day)	OLS (a)	IV (b)	IV (c)	IV (d)	Heckman (e)	Heckman (f)****	Heckman (g)****
Woman	-7.737***	-6.359***	-7.664***	-7.871***	-7.688***	-8.093***	-7.980***
	(1.112)	*(2.282)*	*(1.227)*	*(1.203)*	*(1.133)*	*(1.136)*	*(1.091)*
Age (years)	0.376**	0.435	0.590**	0.472**	0.502**	0.709***	0.442***
	(0.148)	*(0.378)*	*(0.239)*	*(0.237)*	*(0.206)*	*(0.196)*	*(0.145)*
Age^2	-0.005**	-0.006	-0.007**	-0.006**	-0.006**	-0.009***	-0.006***
	(0.002)	*(0.005)*	*(0.003)*	*(0.002)*	*(0.003)*	*(0.002)*	*(0.002)*
Hours to shop	7.543***	**25.074****	**30.966*****	**19.852**	7.057***	6.590***	6.550***
	(1.797)	***(12.374)***	***(10.274)***	***(21.43)***	*(2.203)*	*(2.158)*	*(2.067)*
Mid or far Western	10.708***	3.204	11.093**	9.591**	12.292***	10.998***	10.518***
	(3.708)	*(6.449)*	*(4.971)*	*(4.332)*	*(3.928)*	*(3.915)*	*(3.660)*
Land-value ('00 000)	-0.676	**13.42**	-0.737	-0.837			
	(0.536)	***(10.95)***	*(0.563)*	*(0.564)*			
Landless	-2.076		-0.072	-1.059			
	(1.558)		*(2.467)*	*(2.579)*			
Mean-demand ('00 000)	3.57*		2.98*	2.73	3.35**	3.11**	2.92*
	(1.81)		*(1.74)*	*(2.11)*	*(1.63)*	*(1.56)*	*(1.54)*
No. of land-lords proxy	1.043		2.267	1.903	1.188	1.109	1.260
	(1.289)		*(1.484)*	*(1.937)*	*(1.169)*	*(1.200)*	*(1.198)*
Hours to market	0.327				0.001	-0.031	-0.025
	(0.456)				*(0.734)*	*(0.699)*	*(0.665)*
Chettri	-9.380			-10.72			
	(8.043)			*(9.24)*			
Terai-ethnic	-9.858			-8.620			
	(6.592)			*(6.806)*			
Hill-ethnic	1.398			-0.779			
	(6.789)			*(8.498)*			
Shudra	-2.180			0.718			
	(7.698)			*(8.755)*			
Missing	1.547			1.767			
	(7.700)			*(8.235)*			
Constant	36.768***	17.145**	16.301*	30.200**	25.052***	17.228***	25.822***
	(7.086)	*(7.734)*	*(8.263)*	*(14.107)*	*(5.536)*	*(5.810)*	*(3.203)*
R^2	0.2373	Negative	Negative	0.1545			
N	1108	1108	1108	1108	1108	1108	1108

Robust standard errors in parentheses. Endogenous variables in bold.
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level
****Mills-ratio significantly different from zero

Table 4, continued for the terai sample: The first stage regression for "hours to shop" in the IV-regression, and the selection model for the Heckman regression

	OLS (a)	IV (b)	IV (c)	IV (d)	Heckman (e)	Heckman (f)	Heckman (g)
	1. stage. Dep. Var:	Hours to shop			Selection:		
Woman		0.002	0.011	0.011	-0.177***	-0.163	-0.104
		(0.027)	*(0.027)*	*(0.027)*	*(0.059)*	*(0.269)*	*(0.083)*
Age (years)		-0.008	-0.008	-0.008			
		(0.005)	*(0.005)*	*(0.005)*			
Age^2		0.000	0.000	0.000			
		(0.000)	*(0.000)*	*(0.000)*			
Child					-1.310***	-1.190***	-1.154
					(0.060)	*(0.063)*	*(0.136)*
Mid or far Western		0.113**	0.091*	0.091*			
		(0.049)	*(0.050)*	*(0.050)*			
Land-value ('00 000)			0.013	0.013	***-0.202****	***-0.152****	***0.064****
			(0.011)	*(0.011)*	***(0.060)***	***(0.055)***	***(0.026)***
Landless			-0.083***	-0.083***	***0.242****	***0.447****	***0.658****
			(0.028)	*(0.028)*	***(0.101)***	***(0.096)***	***(0.213)***
Mean-demand ('00 000)			0.069**	0.069**			
			(0.030)	*(0.030)*			
No. of land-lords proxy			-0.070***	-0.070***			
			(0.018)	*(0.018)*			
Hours to market		**0.025*** **	**0.027*** **	**0.027*** **			
		(0.009)	***(0.008)***	***(0.008)***			
Chettri		**0.147**	**0.109**	0.109	***-0.349***	***-0.608****	***-0.853****
		(0.141)	***(0.144)***	*(0.144)*	***(0.220)***	***(0.221)***	***(0.350)***
Terai-ethnic		**-0.083***	**-0.101****	-0.101**	***0.672****	***1.192****	***2.084****
		(0.044)	***(0.043)***	*(0.043)*	***(0.171)***	***(0.174)***	***(0.306)***
Hill-ethnic		**0.235****	**0.177**	0.177	***0.205***	***-0.159***	***-0.733****
		(0.116)	***(0.111)***	*(0.111)*	***(0.210)***	***(0.212)***	***(0.316)***
Shudra		**-0.166****	**-0.235*** **	-0.235***	***0.889****	***0.403****	***0.085***
		(0.067)	***(0.069)***	*(0.069)*	***(0.248)***	***(0.237)***	***(0.343)***
Missing		**-0.062**	**-0.018**	-0.018	***0.119***	***0.119***	***-0.275***
		(0.146)	***(0.144)***	*(0.144)*	***(0.290)***	***(0.269)***	***(0.420)***
Constant		0.466***	0.534***	0.534***	-0.831***	-1.561***	-0.497*
		(0.107)	*(0.111)*	*(0.111)*	*(0.189)*	*(0.181)*	*(0.271)*
Mills ratio					0.654	4.012	6.928
					(1.666)	*(1.857)*	*(1.814)*
R^2		0.0591	0.0833	0.0833			
N		1108	1108	1109	7189	16143	1853

Instruments and identifying variables in bold

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