

RESEARCH ARTICLE

# The insurance premium in the interest rates of interlinked loans in a small-scale fishery

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(Submitted 22 December 2016; revised 20 October 2017; accepted 29 May 2018; first published online 30 August 2018)

## Abstract

Interest payments based on income flows are a common feature of informal loans. Such so-called 'interlinked loans' can be seen as insurance against very low disposable incomes, as interest payments are lowest when income turns out to be low. This paper examines whether interlinked loans indeed contain an insurance premium and how those premia are determined. A simple theoretical model predicts that interest rates of interlinked loans increase with income volatility when insurance premia exist. Based on data from a small-scale fishery in India, calculations show that, on average, lenders receive 25 per cent of the income, which corresponds to an average interest rate of 49 per cent p.a. A panel data analysis confirms theoretical predictions that interlinked loans contain an insurance component paid by the borrowers.

**Keywords:** India, informal credit markets, informal insurance, interlinked contracts, interlinked loan, insurance premium, interest rate, risk-sharing, small-scale fishery

**JEL Classification:** O16; O17; Q22; H23; Q54; O31

## 1. Introduction

In the rural areas of developing countries, many households have low and risky incomes. Formal insurance and credit are rarely available. Informal credit may be available, but high interest rates of 40–80 per cent p.a. are common (Duflo and Banerjee, 2010). High interest rates render credit-financed investments to increase future income or to lower its riskiness impossible. When income turns out to be low, interest payments lower the disposable part of this income even further.

The described situation may explain the prevalence of a special kind of loan that asks for interest payments in the form of income shares.<sup>1</sup> This type of loan is usually offered by whole-sale traders and often termed 'interlinked' loan, as it links conditions in the

<sup>1</sup> See Crow and Murshid (1992, 1994) as well as Bell and Srinivasan (1989); Bell *et al.* (1997); Minten *et al.* (2012) for the agricultural sector in Bangladesh and India, respectively, and this paper for fisheries in India, and Platteau and Abraham (1987) for fisheries in general.

wholesale market to the loan's interest rate.<sup>2</sup> For interlinked loans, interest payments are high when income turns out to be high, but low when income turns out to be low. Thus, disposable income in low-income situations may turn out to be higher with an interlinked loan than with a standard loan. Interlinked loans can be interpreted as insurance against very low disposable incomes. This interpretation is related to the idea of Stiglitz (1974), who discusses sharecropping as a risk-sharing device: interlinked contracts in which workers provide a share of the harvest to the landlord instead of paying rent for the land.

The interpretation of interlinked loans as insurance raises the question of whether borrowers pay for this additional service in the form of higher interest rates. Empirical evidence is rare, probably because the observation of these interest rates is difficult. Households may even report zero interest rates for interlinked loans, and may mention a price reduction when selling their output to the trader only if explicitly asked. The few existing calculations report relatively higher average interest rates from interlinked credit-output contracts in agriculture (Bell *et al.* (1997) and Crow and Murshid (1992, 1994)) and similar or relatively lower interest rates in the fisheries (Platteau and Abraham, 1987). Empirical investigations of interest rates that also consider variation within interest rates only exist for loans from money-lenders (e.g., Iqbal (1988); Mallick (2012)) and micro-finance institutions (e.g., Baquero *et al.* (2012)) – at least to our knowledge.<sup>3</sup> Although interlinked loans play an important role in many developing countries with respect to their prevalence in informal credit markets<sup>4</sup> and possibly also with respect to their functionality as insurance, there is only limited understanding of how their interest rates compare to other interest rates and how interest rates of interlinked loans are determined.

This paper contributes to the discussion by empirically examining which factors determine interest rates of interlinked loans and whether the interest rates from these loans contain an insurance premium. The analysis is based on data from a household survey in the small-scale fishery of Chilika Lagoon, India, in 2011. The data allow us to construct an unbalanced panel comprising 319 loan contracts held by 234 households. In the empirical analysis of the interest rates, household unobservables can be controlled for and possible endogenous matching can be dealt with – brought up with respect to interlinked contracts by Akerberg and Botticini (2002) – by applying fixed effects at the household level. A theoretical model is used to derive a testable hypothesis as to whether interest rates from interlinked loans contain an insurance premium.

The results are as follows. The calculation of the interest rates from interlinked loans around Chilika Lagoon shows that these interest rates are – on average – higher than other interest rates, namely 49 per cent p.a. compared to 37 per cent p.a. for other loans. If only interest rates from other informal loans are considered – which are 45 per cent p.a. on average, the average interest rate from interlinked loans is not significantly different. The theoretical model predicts that the interest rates of interlinked loans increase with the borrower's average income and decrease with the amount borrowed. If risk-aversion is taken into account, the model predicts that interest rates from interlinked

<sup>2</sup>Contracts are called 'interlinked contracts' when they jointly determine the transaction conditions in at least two markets (Bell, 1988).

<sup>3</sup>Further, Ghatak (1983) analyzes rural interest rates at the state level. Hatlebakk (2009) only uses one loan per household and explicitly excludes interlinked contracts.

<sup>4</sup>Wholesale traders provide the lion's share of informal credit (Hoff and Stiglitz, 1997). Also, interlinked loans often exist next to standard loans (see e.g., Minten *et al.* (2012)).

loans contain an insurance premium that is increasing with the income volatility of the borrower working in a fishery. The results from the econometric analysis of the panel data confirm the theoretical predictions. An increase of one standard deviation of the coefficient of variation of fishing income leads to an increase of 17 percentage points in the interlinked interest rate, e.g., from 40 per cent to 57 per cent p.a. This provides evidence for an insurance premium in the interest rates of interlinked loans.

The key message of the analysis is that interest rates from interlinked loans contain an insurance premium. These results are in line with results from Guirkinger (2008), who provides evidence that borrowers are willing to pay a higher interest rate if this lowers the transaction costs or the risks. The close connection between informal loans and insurance has also been documented before – e.g., in Northern Nigeria, informal loan repayment is conditioned on the realization of random production shocks of the lender and the borrower (Udry, 1990).

The policy implications of the results relate to the insurance function of interlinked loans. First, the expansion of formal credit<sup>5</sup> is unlikely to reduce the prevalence of interlinked loans because of its insurance role, at least as long as few other insurance opportunities exist. Second, recent experimental studies focus on insurance take-up in combination with loans. Interestingly, insurance take-up seems to be higher when the characteristics of the insurance come close to the informal insurance provided by interlinked loans, e.g., when no upfront payment is needed and payments are guaranteed in case of need.<sup>6</sup> Quantitative information on the terms of interlinked loans may also help to design other insurance types. Last, interlinked loans as a way to provide insurance may reduce concerns that these type of contracts – which have the potential of being highly exploitive (see e.g., Basu (1983) and discussion in the literature section) – are used for exploitation around Chilika Lagoon.

The paper proceeds as follows. The next section reviews further related literature and discusses differences between interlinked loans and sharecropping as well as other explanations for higher interest rates from interlinked loans. Section 3 describes the fishery around Chilika Lagoon. Section 4 presents the theoretical framework that guides the econometric model. Section 5 presents the empirical strategy, while section 6 gives the main results. Section 7 presents the sensitivity analysis. Section 8 discusses the findings and concludes.

## 2. Literature

Interlinked contracts were initially discussed in relation to sharecropping,<sup>7</sup> meaning that instead of paying rent for the land, workers give the landlord a share of the output. A

<sup>5</sup>Demircug-Kunt *et al.* (2015) discuss the expansion of formal loans in rural areas. The expansion of financial services impacts interest rates of micro finance institutions (Guha and Chowdhury, 2013) and of money lenders (Mallick, 2012).

<sup>6</sup>Gin and Yang (2009) observe a lower loan take-up when the loan is coupled with weather insurance that implies an upfront payment. Banerjee *et al.* (2014) find similar results for the purchase of mandatory health insurance with loan renewal. Liu *et al.* (2013) find a higher insurance take-up when the insurance fee is paid at the end of the period insured. Karlan *et al.* (2014) initially provide free rainfall index insurance and find that the demand for insurance is higher in subsequent years, once farmers have seen that payouts occur in case of need. Casaburi and Willis (forthcoming) test insurance in which the buyer of the crop deducts the premium from farmer revenues at harvest time – similar to the informal arrangements reported here, and they find a very high take-up rate.

<sup>7</sup>See Bardhan (1980) and Bell (1988) for a general overview on interlinked contracts.

large literature attempted to explain why sharecropping exists although it seems to be inefficient: workers equate their marginal disutility from work to their share in output, times the marginal productivity of labor, instead of equating it to the entire marginal productivity of labor (see e.g., Stiglitz (1974)). As mentioned, Stiglitz (1974) advanced the idea that interlinked contracts are a risk-sharing device in the setting of sharecropping. Thus, a higher output variance of a risk-averse worker in sharecropping should increase the landowner's share (Steiner (2011) and Stiglitz (1974)).<sup>8</sup>

Limited liability of the worker is another explanation (see e.g., Basu (1992)). Limited liability relates to the understanding that a worker will not pay land rent in case of a crop failure. Accordingly, the worker's preferences are not aligned with land owner's. The worker maximizes expected income, while the land owner prefers the minimization of the possibility of a crop failure. Giving a share of the harvest to the land owner instead of a fixed land rent aligns preferences.

Empirical evidence yields mixed results on whether the contract choice in sharecropping is due to limited liability or to risk-sharing.<sup>9</sup> When examining contract choices empirically, Akerberg and Botticini (2002) stress the problem of possible endogenous matching in some of the earlier research on sharecropping, while Prendergast (2002) addresses the issue of responsibility delegation.<sup>10</sup>

Risk-sharing and limited liability may also explain interlinked loans. One major difference between sharecropping and interlinked loans is that with the latter, the loan will be repaid at some point, transforming the initial borrower into the owner of the investment and allowing her to keep the total income. This reduces the possible inefficiency of share contracts,<sup>11</sup> as the reduction in income is only temporary. It also gives an additional incentive to repay the loan. Then, referring to the literature on corporate finance, one can interpret the interlinked loan as 'common stock' and compare it to 'straight debt' (e.g., Ellingsen and Kristiansen (2011)).<sup>12</sup> Platteau and Nugent (1992) discuss the role of share contracts in the fishery and carve out differences between agriculture and fishing. Among others, fishing is risky compared to agriculture (Platteau and Nugent, 1992).

A major concern with interlinked contracts relates to their potentially exploitive structure and their use to extract additional rents. Braverman and Stiglitz (1982) show that interlinked contracts shift the utility frontier outward, but that this may make the tenant worse off. Basu (1983) shows that the 'potential risk' of default leads to isolation, interlinkages and high interest rates. Lenders only lend to borrowers they interact with in a different market, e.g., the labor market. Accordingly, borrowers can only turn to their employer to ask for credit. This allows the lender to charge high interest rates and extract additional rents. Basu (1987) shows that monopolists who

<sup>8</sup>Steiner (2011) argues in terms of grower and winery. The theoretical result was empirically tested by Allen and Lueck (1999) with data on contracts in North American agriculture.

<sup>9</sup>See Laffont and Matoussi (1995), Allen and Lueck (1999), Akerberg and Botticini (2002), Arimoto (2005), Fukunaga and Huffman (2009), for instance.

<sup>10</sup>Other work on interlinkages focuses on financial services, e.g., interlinkages of wholesale transactions and saving (Casaburi and Macchiavello, 2015; Macchiavello and Morjaria, 2015).

<sup>11</sup>Incentives to change behaviour due to having an interlinked loan – and thus to change the earnings distribution – are reduced. In terms of setting the conditions, one would expect that the lender takes potential deviations into account. Braverman and Stiglitz (1982) explicitly state that terms of interlinked contracts are chosen in order to incentivize a certain behaviour.

<sup>12</sup>In rural economies, 'firms' are usually family businesses that operate on the subsistence level, face various market imperfections and informal arrangements, and for whom personal preferences may play a more important role, such that the household level may be the more appropriate level for analysis than a firm.

use non-linear pricing – by means of an interlinked contract – can extract additional rents compared to standard monopolists. Furthermore, in the case of limited liability, a poverty trap may evolve (Mookherjee and Ray, 2002).<sup>13</sup> In terms of direct empirical evidence, Shami (2012) shows that a reduction in isolation – i.e., a connection to markets outside of the village – greatly reduces the exploitative potential of interlinked contracts.

The present paper is also related to the literature on informal credit markets. In this literature, the general explanation for high informal interest rates started with monopoly power or perfect competition with high rates due to a high default probability to end with the imperfect information view (Hoff and Stiglitz, 1990), stressing fixed costs and transaction costs. For interlinked loans, transactions costs are comparably lower, as lenders who also do business in other markets already know the borrower. In addition, these lenders are in the unique position of taking specialized production assets or future income flows as collateral as discussed e.g., in Riekhof (2014), Noack (2013) and Hoff and Stiglitz (1997), respectively. Limited liability is also discussed there (see e.g., Stiglitz and Weiss (1981)). Bell *et al.* (1997) show that lenders are willing to advance larger loans in connection with interlinked contracts. The authors relate this to the debt seniority of the loans. In terms of interest rates, transaction costs saving suggests lower interest rates from interlinked loans.

The present study is closely connected to Platteau and Abraham (1987) and to Minten *et al.* (2012). Platteau and Abraham (1987) give a very comprehensive qualitative description of interlinked loan-output contracts, which corresponds to the situation of Chilika Lagoon in many ways. One major difference is that they report that fishermen have to pay a sales commission to the trader, which we did not find around Chilika Lagoon. The sales commission may be one reason why they find that interlinked interest rates tend to be lower than or equal to other interest rates. In a similar direction as the one developed in this paper, Minten *et al.* (2012) use a regression analysis to compare prices in interlinked loan-output contracts with non-interlinked contracts in agriculture. They do not calculate interest rates, but compare prices in the output markets. They include a dummy for loan use in the past five years in a regression model with output prices as the dependent variable. As the coefficient of the dummy is insignificant, they conclude that interlinkages do not lead to lower output prices. However, this result could also stem from the fact that borrowers already repaid their loans.

### 3. Data and descriptive analysis

#### 3.1 Data collection

The dataset used in this analysis is based on a household survey. A survey was conducted by Frederik Noack and Marie-Catherine Riekhof, together with an interviewer team, in 17 fishing villages around Chilika Lagoon, Odisha, India, from 21 February to 12 April 2011. Chilika Lagoon is located in the Bay of Bengal. It is the largest coastal wetland ecosystem on the Indian sub-continent (Mohapatra *et al.*, 2007). Our survey was part of the ‘Integrated Coastal Zone Management’ Program, funded by the World Bank.

To collect the information, we stratified the entire fishing community according to ecological regions and village size. Within villages, we interviewed a total of 508 randomly-chosen heads of households. In addition to the interviews, we conducted

<sup>13</sup>Exploitative contracting is also discussed by Koszegi (2014).

**Table 1.** Remuneration system of fishing units,  $n = 234$ 

	Same family	Equal shares	Additional share boat owner	Additional share boat owner & net	Pay wage	Other/ no answer
Share of households with a certain system in their fishing unit	42.7 (in %)	8.5 (in %)	20.1 (in %)	9.0 (in %)	3.9 (in %)	15.8 (in %)

group discussions and spoke to local stakeholders like money-lenders, micro-finance organizations and teachers.

### 3.2 Description of the sample

This study focuses on interest rates. From the 508 interviewed households, 436 households were indebted. In total, 555 loans were reported, but information on the interest rate was only available for 430 loans. As the data set only provides information on current debt and not on loans already repaid, information was only used from loans that were taken out in 2009, 2010 and the first months of 2011. This gives 319 loans held by a total of 234 households.<sup>14</sup> Including loans from earlier years could lead to a selection bias, as information on loans taken out during that period, but already repaid, is missing. Solely considering these relatively recent loans reduces the probability of missing loans.

### 3.3 Chilika Lagoon fisheries

Chilika Lagoon is around 65 km long and 18 km wide (Sahu *et al.*, 2014). It is a brackish water body with saltwater inflows from the sea and freshwater inflows from rivers. This generates different ecological conditions within the lagoon. They are reflected in the four sectors of the lagoon, namely the Northern, the Central, the Southern and the Outer Channel Sector. The Outer Channel Sector encompasses the lagoon's main connection to the sea. Villages in this sector are more difficult to reach. The Chilika Development Authority reports 32,530 active fishermen in the lagoon in 2010/11. Total annual catches in 2010/11 of fish, crab, shrimp and prawn were 13 thousand metric tons (Directorate of Fisheries, Government of Odisha, India, 2013).

Predominantly, the male household members go fishing. They fish in groups and share the catch. On average, these so-called 'fishing units' have three members. If not all members belong to the same household, the groups use different remuneration systems. In most cases, the catch is divided into equal shares. The number of shares depends on the remuneration of capital: each member receives one share, but often the boat owner receives an additional share. Sometimes, the net owner also receives an additional share. This implies that the catch is divided into  $n$ ,  $n + 1$  or  $n + 2$  equal shares, with  $n$  denoting the number of fishing unit members. Paying wages to collaborators is not very common. Table 1 gives an overview of the frequency of the different remuneration systems. If the members of a fishing unit do not belong to the same family, the most important sharing mechanism includes that an additional share is given to the boat owner. Accordingly, the income share of capital is 25 per cent for an average fishing unit with three members.

<sup>14</sup>Also, three observations were lost due to missing information on catches, reducing the sample from 323 recently taken out loans to 319 loans used in the sample.

**Table 2.** Average monthly fishing income per fishing unit for the three seasons,  $n = 234$

Season	Summer	Monsoon	Winter
Average monthly catch per fishing unit in Rs	5829.01	6485.35	3844.17
( $\approx$ \$)	(116.8)	(130.0)	(77.0)

Rs = Indian Rupees.

Fishermen use different methods to target different species. Fishing methods used to be related to the subcastes of the fishermen, but that system is disappearing. Over 80 per cent of the households go fishing by boat. Fishing trips last two days on average. The fish caught is usually brought to so-called ‘landing centres’, where fish traders buy the fish and transport it to national or international markets or re-sell it on local markets.

Fishing incomes are low and vary across the three fishing seasons – summer, monsoon and winter – as shown in table 2. There is no lean season as e.g., in agriculture, but interannual income variability, as in many fisheries (Kasperski and Holland, 2013). Data points are based on the fishermen’s ability to recall fishing income for a typical day in each season for 2010/2011, leaving us with one observation per fisherman per season. While more data points would clearly be preferable, the available data still give an idea of the order of magnitude of volatility the fishermen have to deal with over the seasons.

The average of the coefficients of variation of all households’ fishing incomes in the different seasons is 0.51, with a standard deviation of 0.33 across households. Some households face a rather stable fishing income over the seasons – e.g., for a coefficient of variation of  $0.51 - 0.33 = 0.18$  – while others face quite a lot of variation – e.g., for a coefficient of variation close to one ( $0.51 + 0.33 = 0.84$ ).

Few households have an additional income source besides fishing. If they do, fishermen usually work as unskilled laborers to supplement fishing income.

### 3.4 Interlinked loans

Fish traders provide loans without asking for fixed interest payments, but with special agreements about buying the fish at a lower price from the borrower. Price differences are fixed at the beginning of the contract. The indebted fisherman has to offer his entire catch to the fish trader. If the fisherman catches a lot in terms of weight, the income lost because of the interest payments is larger than if he catches little. The principal is repaid separately. One could say that interest is paid in fish and the principal is paid in money. The principal is usually repaid at once.

As the interlinked loans normally do not have a fixed maturity, the repayment of the principal terminates the contract. This set-up is also reported by Platteau and Abraham (1987). The fishermen have an incentive to quickly repay the loan to keep the additional income. Still, due to their low income, it takes some time.<sup>15</sup> Traders do not necessarily favor quick repayment, as they have preferential access to the fish catch as long as the fisherman is indebted. As the data does not report a lot more old interlinked loans compared to standard loans, interlinked loans do not seem to create life-long indebtedness. Also, it is usually possible to take out another loan to repay an existing one.

<sup>15</sup>We have no information on the average duration of an interlinked loan.

The set-up of interlinked loans implies that each household can only have one interlinked loan, because it involves offering the entire catch to the fish trader the household is indebted to. An additional standard loan is possible.

To distinguish a trader that lends money from a trader that does not, we will call the former a 'trader-lender'. Some people around Chilika Lagoon reported that trader-lenders often deduct some baseline amount from the price they give to an unknown fisherman, as they first have to ensure that this fisherman is not indebted to another trader-lender.

The interest rates from interlinked loans are calculated based on the borrower's income loss from selling the fish at a lower price to the trader-lender. These calculations of the interlinked interest rates are either based on income forgone per day due to selling to the trader-lender instead of another trader, or on the fisherman's lost number of Indian Rupees per kg per day due to selling to the trader-lender instead of another trader. In the first case, we multiply the income forgone per day by the fishing days per month, differentiated for the three seasons, and then sum over all months to attain the yearly interest payments. In the second case, we multiply the amount lost by the catch in kilograms. The catch in kilograms means the catch of the total fishing unit times the share the household receives according to the sharing mechanism (see table 1). Then again, we multiply the amount lost per day by the fishing days per month, differentiated for the three seasons, and then sum over all months to attain the yearly interest payments.<sup>16</sup>

Relating the resulting *total yearly interest payments* to the *yearly fishing income of the household* yields the share the trader-lender receives from the fisherman's income as interest payment. On average, the trader-lender receives 26.1 per cent. This is very close to the average income share of capital in fishing income for an average fishing unit with three members, based on the sharing mechanism used most widely if the members of the fishing unit do not belong to the same family (see table 1).

Relating the yearly interest payments to the loan amount yields the yearly interest rate. The average interest rate for a loan from a trader-lender is 49 per cent p.a. In the next section, we connect the information on interlinked loan contracts with other credit contracts.

### 3.5 Informal credit markets around Chilika Lagoon

The description of the credit market is based on the collected data as well as on information from group discussions in the surveyed villages. It seems to be rather representative for the *fishing*-related part of the local population, but may not carry over to households mainly active in agriculture.

Several lender types are available in the credit markets around Chilika Lagoon. This is typical for rural credit markets in less developed economies (see e.g., Menkhoff *et al.* (2012)). Besides trader-lenders, who provide 16 per cent of all loans, other informal sources – i.e., money-lenders, family, friends, neighbors – provide 34 per cent. Formal sources – i.e., banks, micro-finance institutions, cooperatives – provide 50 per cent. From the formal sources, 83 per cent of the loans are loans from micro-finance institutions.

<sup>16</sup>This is an approximation. For loans taken out less than a year before the survey, it may over-estimate the interest rate, as the loan may have been repaid the day after the survey. Still this is not very likely to be the case. Usually, it takes some time to accumulate the money to repay the loan. Otherwise, a loan would not be needed in the first place.



**Table 3.** Data on credit markets,  $n = 319$ 

Loan type	Share in total number of loans	Min. amount	Max. amount	Average amount	Mean interest rate p.a.
Interlinked	16.0%	3000 Rs	2,00,000 Rs	39,894 Rs	49%
Other informal	34.2%	1000 Rs	3,00,000 Rs	33,759 Rs	45%
Formal	49.5%	3000 Rs	1,00,000 Rs	17,130 Rs	31%

Rs = Indian Rupees, in 2011, 50 Rs  $\approx$  1 US\$. The 'share in total number of loans' does not add up to 100% due to rounding errors.

Interlinked loans become more important if one considers the amount lent instead of the number of loans (see table 3).

Interest rates are high and loan amounts comparably small, which is also typical for many rural credit markets in less developed economies. Table 3 depicts the average yearly interest rates as well as the average loan amounts. Interest rates are nominal and calculated as of 2011. The inflation rate is around 10 per cent p.a., based on the consumer price index for agricultural laborers in Orissa (Government of Orissa, India, 2011). On average, interest rates from formal sources are lower than from informal sources, and interest rates from interlinked loans are highest. The difference between interest rates from interlinked loans compared to interest rates from all other loans – 37 per cent p.a. – is significant at the 5 per cent level.<sup>17</sup> The result is similar to the findings from Crow and Murshid (1992, 1994) and Bell *et al.* (1997). When comparing interest rates from interlinked loans to interest rates from other informal loans, the null hypothesis of equality cannot be rejected.<sup>18</sup> This result is in line with the results from Minten *et al.* (2012) and Platteau and Abraham (1987).

The average loan amount is lowest from formal sources and highest in interlinked loans (which corresponds to the results in Bell *et al.* (1997)). The maximum loan amount, in turn, is from a standard informal loan.

The loans are usually not secured by formal collateral. Furthermore, only some loans – mainly loans from formal sources – have a fixed maturity.

Fishermen are self-employed so households need credit for productive as well as consumptive purposes. In the case of productive needs, one sometimes differentiates between fixed capital and working capital (Ray, 1998). The need to finance fixed capital, such as boats and nets, is relatively more important around Chilika Lagoon because fishermen normally sell the fish on the day they catch it. The need to finance working capital is only relevant if they go on longer fishing trips. Demand for consumptive credit arises if the income falls, for example, due to seasonality in fish catches, a decrease in prices or fish stocks, or if consumption needs increase, for example due to weddings, illness or death. The main purposes for taking out a loan for the fishery households around Chilika Lagoon are fishing activities as well as consumption needs (see table 4).

#### 4. Theoretical background

A special focus of this paper is on whether interest rates from interlinked loans contain an insurance premium. Households only demand insurance if they are risk-averse. In the

<sup>17</sup>The  $p$ -value based on a Welch Two Sample  $t$ -test is 0.039.

<sup>18</sup>The  $p$ -value based on a Welch Two Sample  $t$ -test is 0.5802.

**Table 4.** Importance of loan purposes,  $n = 319$ 

Loan purpose	Share of loans with certain purpose
Fishing activities	55%
Consumption needs	19%
Ceremonies	10%
Repayment of other debts	4%
Education of children	2%
Emergencies	4%

One single loan can have several purposes.

following, we examine how risk-aversion of the borrower impacts the interest rate from interlinked loans. In share-cropping, theoretical results predict that risk-aversion of the borrower translates into a higher income share given to the land owner. In this section, a simple model is developed to derive a testable hypothesis that relates risk-aversion to the interest rate of interlinked loans.

The model should incorporate two important empirical observations. First, interlinked and standard loans usually co-exist. Second, interest rates of interlinked loans lie above interest rates of standard loans.<sup>19</sup> Many variables will be taken as exogenous. These variables are then being controlled for in the empirical analysis.<sup>20</sup>

#### 4.1 Credit supply

Consider a small open economy in which two credit-contract types may be offered. The loan types differ only with respect to their interest payment rule. One contract is the standard credit contract that implies constant interest payments  $\alpha$ , the  $\alpha$ -contract. It encompasses all different kinds of ‘business models’ and does not distinguish e.g., between a money lender and a micro-finance organization. The other contract is the  $\beta$ -contract, an interlinked contract. Here, interest payments occur in the form of the income share  $1-\beta$ , with  $\beta > 0$  such that the borrower keeps a positive income.

Assume that the  $\alpha$ -contract is always offered and that its interest rate is fixed in the sense that it is fully determined by household and credit characteristics. For the  $\alpha$ -contracts, one can think of contestable monopolies with free entry and zero expected profits as market structure, as in Bell *et al.* (1997).<sup>21</sup>

For the  $\beta$ -contract, two aspects have to be taken into account. First, with lenders acting risk-neutral, e.g., because they can diversify between different borrowers, they will only offer the  $\beta$ -contract if interest payments are at least  $\alpha$ . Otherwise, they will also offer an  $\alpha$ -contract. Second, the  $\beta$ -contract calls for a monitoring of the borrower’s income, as the borrower has an incentive to hide parts of his income to reduce interest payments.

<sup>19</sup>The set-up is tailored to the case study of the Indian small-scale fishery in the sense that we take the occurrence of a standard loan and an interlinked loan as given. In the end, this set-up seems to be the norm rather than the exception, as the studies on interlinked loans always state a reference interest rate.

<sup>20</sup>For a more encompassing treatment, see Stiglitz (1974) and Steiner (2011).

<sup>21</sup>There could also be perfect competition in that market. The decisive feature is that  $\alpha$ -contracts are offered, that there is free entry in the sense that those lenders offering the  $\beta$ -contract could also offer  $\alpha$ -contracts, and that expected payments below  $\alpha$  would lead to an expected loss of the lender.

Not all lenders are in the position to do so. Only traders can easily observe the borrower’s income,<sup>22</sup> but even they have to cooperate with each other to ensure that an indebted fisherman is not selling part of his catch before reporting to the trader he is indebted to. Together, the fish traders have a monopoly on  $\beta$ -contracts. As the  $\alpha$ -contracts represent the exit option for the borrower, the traders will choose a limit-price policy. They will set  $\beta$  in such a way that the household just prefers the  $\beta$ - to the  $\alpha$ -contract.

### 4.2 Credit demand

Consider a household that demands loan amount  $A$  to increase its income. Income  $g(A)$  is stochastic, with expected income  $E(g(A)) = \mu$  and variance  $\sigma^2 = E(g(A)^2) - \mu^2$ . The loan amount  $A$  is taken as exogenous. Thus, the household only chooses between the two credit-contracts, the  $\alpha$ -contract and the  $\beta$ -contract.

Let

$$r_\beta := (1 - \beta)\mu/A \tag{1}$$

denote the interest rate in the  $\beta$ -contract and

$$r_\alpha := \alpha/A$$

the interest rate in the  $\alpha$ -contract.

Consider a household with mean-variance preferences.<sup>23</sup> Mean-variance preferences are compatible with expected utility maximization if the utility function is a quadratic function or if all distributions of the choice set of the household belong to the same linear class<sup>24</sup> (Sinn, 1990). Let the quadratic utility function  $u(g) = g - \lambda g^2$  represent preferences over disposable income. Its form is problematic because the marginal utility turns negative as incomes become large. We presume that marginal utility turns negative only beyond the range in which  $g$  varies: we assume that  $u'(\tilde{g}) > 0$  with  $\tilde{g} = \beta\mu(1 + \sigma^2/\mu^2)$ , i.e.,

$$\Delta := 1 - 2\lambda\beta\mu(1 + \sigma^2/\mu^2) > 0.$$

Then,  $u'(g) > 0$  for all  $g < \tilde{g}$ .

If interest payments were the same for both contracts, i.e.,  $\alpha = (1 - \beta)\mu$ , choosing the interlinked contract would lead to a higher expected utility, as  $-\lambda\sigma^2 < -\lambda\beta^2\sigma^2$  based on comparing

$$E[u(g - \alpha)] = \mu - \alpha - \lambda(\sigma^2 + (\mu - \alpha)^2) \quad \text{and} \quad E[u(\beta g)] = \beta\mu - \lambda\beta^2(\sigma^2 + \mu^2).$$

Thus, a risk-averse borrower who has mean-variance preferences will strictly prefer the  $\beta$ -contract. The trader can increase total payments in the  $\beta$ -contract such that they are higher than in the  $\alpha$ -contract. This gives the result that the borrower is willing to pay an insurance premium in addition to the pure credit costs  $\alpha$ ,  $r_\beta > r_\alpha$ .

<sup>22</sup>The study of Jacoby and Mansuri (2007) on share-tenants in Pakistan supports this set-up. They find that monitored sharecroppers achieve a higher output than unmonitored sharecroppers. Thus, the standard credit-contract would be the better alternative for lenders who cannot monitor the fishermen easily.

<sup>23</sup>As some empirical evidence suggests that downside risk-aversion may also matter (see e.g., Chiu (2010)), we examine the robustness of the results with respect to the inclusion of skewness and do not find a significant influence (see Riekhof (2016)).

<sup>24</sup> $G$  and  $F$  belong to the same linear class if  $F(x) = G(\delta x + \lambda)$  with  $\delta > 0$ .

In case of  $\text{var}(g) = 0$ , the trader has to set  $\beta$  such that interest payments are equal to  $\alpha$ . This implies  $\partial(1 - \beta)/\partial\sigma > 0|_{\text{var}(g)=0}$ . The insurance premium is increasing in the variance for variance levels close to zero.

The household is indifferent between the two contracts if

$$E[u(\beta g)] = E[u(g - \alpha)] \Leftrightarrow \mu - \alpha - \lambda(\sigma^2 + (\mu - \alpha)^2) = \beta\mu - \lambda\beta^2(\sigma^2 + \mu^2). \tag{2}$$

For the comparison among several households, the income variance relative to the income level is a more appropriate measure. It can be depicted by the coefficient of variation  $V := \sigma/\mu$ . Another advantage is that the coefficient of variation is dimensionless.

Rearranging (2) and rewriting in terms of  $r_\alpha$ ,  $r_\beta$  and  $V^2$  gives

$$r_\beta - r_\alpha - \lambda((V^2 + 1)r_\beta(2\mu - r_\beta A) - r_\alpha(2\mu - r_\alpha A)) = 0. \tag{3}$$

Based on equation (3), one can derive the following testable hypotheses for a risk-averse household:

**H-V** The interest rates from interlinked loans are increasing in the coefficient of variation:

$$\frac{\partial r_\beta}{\partial V} = - \frac{-\lambda r_\beta(2\mu - r_\beta A)}{\underbrace{1 - \lambda(V^2 + 1)2(\mu - r_\beta A)}_{=\Delta > 0}} > 0.$$

The nominator in H-V is  $< 0$  as  $2\mu - ((1 - \beta)\mu/A)A = 2\mu - \mu + \beta\mu > 0$ .

**H- $\mu$**  The interest rates from interlinked loans are increasing in the mean income:

$$\frac{\partial r_\beta}{\partial \mu} = - \frac{-\lambda((V^2 + 1)r_\beta^2 - r_\alpha^2)}{\Delta} > 0.$$

**H-A** The interest rates from interlinked loans are decreasing in the loan amount:

$$\frac{\partial r_\beta}{\partial A} = - \frac{\lambda((V^2 + 1)r_\beta^2 - r_\alpha^2)}{\Delta} < 0.$$

The impacts from mean income and loan amount on the interest rate from interlinked loans are driven by two counter-acting effects. The first effect is related to the definition of the interest rate for interlinked loans for a constant  $\beta$ . A higher mean income increases the interest rate from interlinked loans. A larger loan amount, in turn, decreases the interest rate, as interest payments are distributed over a larger amount. The second effect relates to the constraint of equal expected utilities from an interlinked and a standard loan contract. The increase in interest rates from interlinked loans due to a higher mean income, for example, is bounded by the interest rate for standard loans such that the share given to the fish trader may need to be reduced when mean income increases. For H-A and H- $\mu$ , the first effect dominates. For H-V, there is no counteracting effect through the constraint of equal expected utilities from both contracts, because volatility only matters in interlinked loans.

Two remarks are in order. First, the results also hold with free entry into the  $\beta$ -segment as long as lending traders are risk-averse and ask for a compensation of their

risk-taking.<sup>25</sup> If the traders act risk-neutrally, free entry would drive the mark-up down to zero. Second, the model illustrates the importance of the  $\alpha$ -segment in limiting the interest rates in the  $\beta$ -segment. Related to this, if the fishing income is permanently reduced, e.g., because of a long-run decrease in the resource stock, a lending trader will adapt  $\beta$  in new contracts to earn again at least the same expected interest payments as with an  $\alpha$ -contract.

## 5. Empirical strategy

To investigate the influences of income volatility, mean income and loan amount on the interest rates of interlinked loans – hypotheses  $H-V$ ,  $H-\mu$  and  $H-A$  derived in section 4, we run regressions. Two remarks are in order when specifying the empirical model based on the theoretical model. First, in the theoretical model, agents form expectations, while in the empirical model, we work with data on outcomes. As the fishermen are usually known quite well by the traders, e.g., in terms of fishing skills, methods used and past fishing record, it is sensible to assume that the expectations formed are quite accurate. Second, in the theoretical model, each interest rate of an interlinked loan has a corresponding standard interest rate (see equation (3)). The standard interest rate captures impacts from further household and loan characteristics on the general interest rate level. For example, if the household has a good credit history, it can borrow at lower rates compared to a household with a bad credit history. The household with the good credit history faces a lower standard interest rate and also a lower interest rate from an interlinked loan compared to a household with a worse credit history, all else equal. The standard interest rate that ‘matches’ the interlinked interest rate is a theoretical concept that cannot be observed in the data. To still capture this theoretical concept in the empirical analysis, we use interest rates both from standard loans and from interlinked loans as dependent variables. The coefficients of the independent variables measure the impacts on the interest rates in general, i.e., on the hypothetical interest rate. To capture the direct influences on the interest rates from interlinked loans, we interact those independent variables with a direct influence on the interlinked interest rate – i.e., on the insurance premium – with a dummy that is one if the interest rate belongs to an interlinked contract.

An important empirical problem within the context of this paper is that not all relevant household characteristics – especially with respect to risk preferences – can be observed. Non-observable household characteristics may influence the choice of an interlinked loan and thus its interest rate. To deal with this problem, we estimate a household fixed effect (FE) model. This approach can also deal with the possibility that unobservable household characteristics lead to endogenous matching (see e.g., Akerberg and Botticini (2002)). The loss of information from households with only one loan is a drawback of the FE specification. To compare outcomes, I also apply an ordinary least square (OLS) estimation without household fixed effects. In both specifications, I control for variables taken as exogenous in the theoretical model.

### Estimation with household fixed effects

From the 319 loans in the sample, 168 loans are held by households with only one loan in total, while 151 loans are held by households with more than one loan in total (see

<sup>25</sup>They still have to be in a position to ensure that borrowers cannot secretly sell to a different fish trader.

**Table 5.** Descriptive statistics loans,  $n = 319$

Number of loans of a household	Interlinked loan	Standard loan	Total
One	25	143	168
More than one	27	124	151
Total	52	267	319

Interpretation: 124 standard loans are held by households that – in total – have more than one loan.

table 5). The 151 loans are held by 67 households. When using households FEs, we lose the information from the households that only took out one loan. To be transparent on this, we exclude those loans from the sample used for the FE-estimations. Including those loans will not change the results, as their impacts are captured by the household FEs.

The baseline specification with household FEs takes the form

$$\begin{aligned}
 \text{interest rate}_{l,h} = & \xi_1 \text{interlinked dummy}_l + \xi_2 (\text{interlinked dummy}_l \times V_h) \\
 & + \xi_3 (\text{interlinked dummy}_l \times \log(\mu_h)) \\
 & + \xi_4 (\text{interlinked dummy}_l \times \log(A_l)) + \xi_5 \log(A_l) \\
 & + \Gamma L_l^T + \Lambda_h + c + \Theta D_y^T + \epsilon_{l,h}.
 \end{aligned} \tag{4}$$

The interest rate relates to the loan  $l$  from household  $h$ . The interlinked dummy is one if the interest rate belongs to an interlinked loan and zero otherwise. The coefficient  $\xi_2$  is the effect of income volatility  $V$  on interest rates from interlinked contracts and relates to hypothesis H-V. Mean income  $\mu$  denotes the household’s average fishing income per year. Mean income and loan amount  $A$  are included in logs. Both are interacted with the interlinked dummy to test H- $\mu$  and H-A. The ‘log loan amount’ is also included on its own to control for its general influence on interest rates. The general impact of mean income and income volatility is controlled for through the FEs. Further loan characteristics are summarized in the vector  $L_l$ . In line with the literature on credit markets, the vector  $L_l$  includes a dummy that is one if the loan is from a formal source, as well as a dummy that is one if a repayment date is fixed. This maturity dummy is always zero for interlinked loans, but especially for formal loans, repayment dates are specified. Table A1 in the online appendix gives more information on the credit market variables. The superscript  $T$  in equation (4) indicates that the row vector is transposed to a column vector. The vector  $\Lambda_h$  represents the household FEs. The constant  $c$  captures the conditions in 2011 such that the yearly dummies in the vector  $D_y$  capture the difference of a specific year compared to 2011. The error term is  $\epsilon_{l,h}$ .

### Ordinary least square estimation

The specification is similar to (4). Instead of the household FEs, several controls on the household level are included. Table 6 gives an overview of the variables and their definitions. It also gives some descriptive statistics. We briefly introduce the variables below.

The vector of household variables includes the log-income as well as the coefficient of variation. It also includes dummies that indicate whether the household owns a boat, a motor for the boat, or a cellphone, respectively, and dummies that indicate whether

**Table 6.** Definition and summary statistics of key variables on the household level,  $n = 234$

Variable	Definition	Mean	St. Dev.	Min	Max
$\mu$	Yearly fishing income (RS)	64,634.100	72,947.900	2,000.000	800,000.000
V	Coefficient of variation, seasonal fishing income	0.506	0.334	0.006	1.732
Boat	Dummy, equal to one if household owns a boat	0.808	0.395	0	1
Motor	Dummy, equal to one if household owns a motor	0.440	0.497	0	1
Literacy	Dummy, equal to one if household head is literate	0.641	0.481	0	1
Activity	Dummy, equal to one if household head has additional income generating activity besides fishing	0.179	0.385	0	1
Cell phone	Dummy, equal to one if household owns at least one cell phone	0.513	0.501	0	1
Males 12–60	Number of male household members aged 12–60	2.359	1.243	0	6
Training	Dummy, equal to one if household head ever attended vocational training	0.171	0.377	0	1
Attitude I	Dummy, equal to one if open to newcomers*	0.077	0.267	0	1
Attitude II	Dummy, equal to one if in favor of supporting people with self-inflicted problems*	0.115	0.320	0	1
Central Sector	Dummy, equal to one if household lives in Central Sector	0.299	0.459	0	1
Northern Sector	Dummy, equal to one if household lives in Northern Sector	0.235	0.425	0	1
Southern Sector	Dummy, equal to one if household lives in Southern Sector	0.359	0.481	0	1

(continued.)

Table 6. Continued

Variable	Definition	Mean	St. Dev.	Min	Max
Outer Channel	Dummy, equal to one if household lives in Outer Channel Sector	0.107	0.310	0	1
Khatia	Dummy, equal to one if household belongs to the subcaste Khatia	0.073	0.260	0	1
Asset Index	For description see Table A3	0.014	1.218	-1.402	9.351

\*The household head's attitude is measured by the answers to the following questions:

'Imagine: Two farmers keep goats on community land. Now, the land should be privatized and divided among the two farmers. After the division and privatization, each farmer can sell the land to get some money or he can keep it and use it for whatever he likes. The two farmers are of the same age, are healthy and have similar families. Both farmers have exactly the same amount of goats.

(a) The first farmer has always grazed his goats on the land. The second farmer has started to graze his goats on this land only one year ago.

(b) The first farmer, however, has sold most of his goats to buy luxury consumption goods. Now he is poor and only few of his goats remain. The second farmer has led a modest life. Now he is rich and has increased the size of his goat herd.

Which division of land would you think is fair? (A) The first farmer gets more land. (B) The second farmer gets more land. (C) Both get the same amount.'

We create one dummy called 'attitude I' that equals one if the answer in the first case was (B), i.e., the newly-arrived should receive more land, and a second dummy, 'attitude II' that equals one if the answer to the second question was (A).



the household head has an additional income generating activity, whether he is literate and whether he ever attended vocational training. Another variable gives the number of working-age (age 12–60) male household members in the household. The vector also includes dummies that control for the geographical sector the household lives in and a dummy that indicates whether the household belongs to the subcaste Khartia.<sup>26</sup> Two additional dummies measure the attitude of the household head. One attitude-dummy measures whether the household head is open to newcomers while the other measures his attitude towards supporting people with self-inflicted problems (see table 6 for details). In the OLS specification, the constant  $c$  captures the situation in 2011 in the Outer Channel sector.

## 6. Results

Table 7, column (1) gives results for the specification with household FEs. It shows that income volatility has a positive and significant impact on interest rates from interlinked loans. This confirms H-V. If the coefficient of variation is increased by one, the interest rate from interlinked loans is increased by 51.8 percentage points. If it is increased by one standard deviation – 0.33 for all households – the interest rate is increased by 17 percentage points, i.e., from, say, 50 to 67 per cent p.a.. The effect is quantitatively relevant. Moreover, the results provide evidence for an insurance premium in interlinked loans.

The average income has a positive impact while the loan amount has a negative impact on the interest rate level when the loan is part of an interlinked contract. This confirms H- $\mu$  and H-A.

Interest rate levels are lower when the loan is from a formal lender. The other variables have no significant influence.

Table 7, column (2) presents results for the OLS-specification. The impact of income volatility on the levels from interest rates of interlinked loans is still positive and significant, but smaller than in the specification with household FEs. Re-estimation based on the same sample used for the FE-specification gives a coefficient of around 0.4 (see table 7 column (3)). To examine whether the different sample sizes drive the differences in estimates, we test whether estimated coefficients differ significantly. The null hypothesis of equal coefficients between the two OLS-estimations cannot be rejected.<sup>27</sup> The result suggests that the difference in estimated coefficients is not driven by the different samples. The higher estimated coefficient in the FE-specification points towards an omitted variable bias in the OLS-specification.

The influences of mean income and the loan amount on interlinked interest rates remain significant and of similar size as in the FE specification.

## 7. Robustness

The results from table 7 show that the interest rates from interlinked loans increase with the coefficient of variation. Various checks are performed to assess the robustness of

<sup>26</sup>Khartia is the third most frequently observed subcaste around Chilika Lagoon and the only subcaste with a significant influence on the interest rate.

<sup>27</sup>To test cross-model hypotheses, we apply a Seemingly Unrelated Estimation. Then we test whether the coefficients of 'V  $\times$  Interlinked' in the estimations based on the larger and the smaller sample, respectively, are identical. The  $\chi^2$  statistic is 0.62 with the corresponding  $p$ -value of 0.4300. Thus the null hypothesis of equal coefficients cannot be rejected.

**Table 7.** FE and OLS regression results for interest rates

Dependent variable: Interest rate	(1)		(2)		(3)	
	FE, households with several loans		OLS, whole sample		OLS, households with several loans	
	Coeff	(p-value)	Coeff	(p-value)	Coeff	(p-value)
Interlinked Dummy	0.0462	(0.970)	0.569	(0.371)	0.316	(0.806)
V × Interlinked	0.518**	(0.012)	0.286**	(0.023)	0.412**	(0.013)
Log( $\mu$ ) × Interlinked	0.336**	(0.014)	0.209***	(0.009)	0.198*	(0.060)
Log(A)	0.0371	(0.416)	−0.00970	(0.528)	−0.00445	(0.884)
Log(A) × Interlinked	−0.384***	(0.002)	−0.288***	(0.000)	−0.260**	(0.015)
Maturity	0.0195	(0.743)	−0.00778	(0.700)	−0.0174	(0.736)
Formal loan	−0.176**	(0.016)	−0.161***	(0.000)	−0.109	(0.123)
Y2009	0.0215	(0.812)	−0.0479	(0.260)	0.0134	(0.858)
Y2010	−0.00261	(0.962)	−0.0261	(0.472)	0.0176	(0.761)
V			−0.0576	(0.105)	−0.159**	(0.019)
Log( $\mu$ )			0.0104	(0.451)	0.0130	(0.580)
Boat			−0.0488	(0.298)	−0.211	(0.131)
Motor			−0.0284	(0.304)	−0.105**	(0.021)
Literacy			0.0101	(0.722)	−0.0210	(0.668)
Activity			0.0550	(0.128)	0.103	(0.168)
Khartia			−0.0960**	(0.037)	0.0733	(0.515)

(continued.)

**Table 7.** Continued

Dependent variable: Interest rate	(1)		(2)		(3)	
	FE, households with several loans		OLS, whole sample		OLS, households with several loans	
	Coeff	( <i>p</i> -value)	Coeff	( <i>p</i> -value)	Coeff	( <i>p</i> -value)
Cell phone			−0.0427	(0.193)	−0.0390	(0.512)
Males 12–60			0.00719	(0.520)	0.0116	(0.468)
Training			0.0685	(0.101)	0.0679	(0.234)
Attitude II			0.0107	(0.811)	0.170*	(0.062)
Attitude I			0.0396	(0.217)	−0.0221	(0.728)
Central Sector			−0.145***	(0.009)	−0.455***	0.002)
Northern Sector			−0.101**	(0.042)	−0.430***	(0.004)
Southern Sector			−0.0495	(0.329)	−0.374**	(0.010)
Constant	0.104	(0.827)	0.676***	(0.001)	1.098***	(0.005)
Observations	151		319		151	
Adjusted <i>R</i> <sup>2</sup>	0.369		0.265		0.324	

*p*-values in parentheses; \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01; error terms clustered at the household level.

this finding. The robustness checks for the specification with FEs are reported below, and a table of regression results is available in online appendix A.2. Results for the OLS specification can be found in online appendix A.3.

First, informal loans in general – and not only interlinked loans – may play an insurance role. To assess this, we construct a dummy that equals one if the loan is a standard loan from an informal source, namely from money lenders, friends, neighbours or relatives. The dummy is then interacted with ‘V’, ‘log( $\mu$ )’ and ‘log(A)’, as was done with the interlinked dummy. Column (1) of table A2 gives the results for the FE specification. The effect of income volatility on the interest rate from other informal loans is not significant.

Second, one could argue that the interest rate is jointly determined with other conditions of the credit contract. To properly deal with this, a simultaneous equation approach with well-identified instruments would be needed. As it is difficult to find these instruments, we follow Menkhoff *et al.* (2012) and check the robustness of the results by comparing results when taking the respective variables out. The respective variables are ‘log(A)’ and ‘log(A) × Interlinked’, ‘maturity’ as well as ‘formal loan’. The impact on income volatility on interest rates of interlinked loans does not change much when taking out ‘maturity’ and ‘formal loan’ (see table A2, columns (2)-(4)). When taking out ‘log(loan amount)’ and ‘log(loan amount) × interlinked’, the coefficient of the ‘Interlinked Dummy’ becomes significant. Interlinked loans may be closely connected to the loan size. This is also suggested by Bell *et al.* (1997) and the descriptive statistics in table 3: the average loan amount is highest for interlinked loans. Also, the coefficient of ‘V × Interlinked’ increases a little, but it is not significantly different from the value in the baseline specification.<sup>28</sup> This suggests that the insurance premium is not connected to the loan amount.

Another important empirical problem is that households may select only certain loans in an interlinked contract. We directly model the household’s choice of loan contract type based on a treatment-regression model. The reason is a potential selection bias. The interlinked loans may differ from the standard loans for reasons other than the loan type – i.e., the treatment status – per se. We propose that the *purpose of the loan* is an exogenous instrument in this context. First, for the households, more risky loans are those that change their income stream – like fishery investments – while other loans may just cover needs. The purpose of the loan influences their choice of loan type, i.e., whether insurance is warranted. Second, it can reasonably be argued that the lender cannot observe the true reason for a loan such that the interest rate will be independent of the true purpose. Hence, we construct two dummies, ‘fishing loan’ and ‘consumption loan’, that equal one if the loan purpose is either fishing or consumption, respectively, and that equal zero otherwise. Then we estimate equation (4) with

$$I_l = \begin{cases} 1, & \text{if } \lambda_1 \text{ fishing loan} + \lambda_2 \text{ consumption loan} + \nu_{l,h} > 0 \\ 0, & \text{otherwise} \end{cases}$$

to model treatment assignment. The error term is  $\nu_{l,h}$ . For the estimation, we use ‘treatreg’ in STATA, which is based on Heckman (1978), as well as ‘itreatreg’ discussed

<sup>28</sup>To test the difference in coefficients, we demean the variables and estimate both specifications – with and without ‘log(loan amount)’ and ‘log(loan amount) × interlinked’ – as a Seemingly Unrelated Estimation. Then, we test whether the coefficients of ‘V × Interlinked’ in both specifications are significantly different from each other (HO: both are equal). The *p*-value is 0.2786.

**Table 8.** Treatment-regression model regression results for interest rates

Dependent variable: Interest rate		
Interlinked Dummy	0.599	(0.329)
V × Interlinked	0.283**	(0.019)
Log( $\mu$ ) × Interlinked	0.209***	(0.006)
Log(A)	-0.0102	(0.486)
Log(A) × Interlinked	-0.287***	(0.000)
Maturity	-0.00781	(0.688)
Formal loan	-0.162***	(0.000)
Y2009	-0.0506	(0.218)
Y2010	-0.0280	(0.424)
V	-0.0565*	(0.098)
Log( $\mu$ )	0.0103	(0.438)
Boat	-0.0499	(0.266)
Motor	-0.0292	(0.271)
Literacy	0.0106	(0.699)
Activity	0.0553	(0.111)
Khartia	-0.0944**	(0.033)
Cell phone	-0.0435	(0.170)
Males 12–60	0.00766	(0.478)
Training	0.0678*	(0.088)
Attitude II	0.0124	(0.776)
Attitude I	0.0391	(0.204)
Central Sector	-0.143***	(0.007)
Northern Sector	-0.0997**	(0.037)
Southern Sector	-0.0486	(0.318)
Constant	0.677***	(0.000)
Observations	319	

*p*-values in parentheses; \**p* < 0.10, \*\**p* < 0.05, \*\*\**p* < 0.01; error terms clustered at household level.

in Brown and Mergoupis (2011). Table 8 reports results. The impact of income volatility of interest rates from interlinked loan-output contracts is as before.

The first stage is given in table 9. The table does not report marginal effects, so only the sign of the coefficient can be easily interpreted. A fishing-related loan increases the likelihood of taking out an interlinked loan. The estimated correlation between the treatment-assignment errors and the outcome errors is  $-.274$ . Based on a likelihood-ratio test, the null hypothesis of no correlation between the treatment errors and the outcome cannot be rejected (*p*-value = 0.541). It suggests that there is no impact

**Table 9.** Probit regression results for interlinked contracts

Dependent variable: <i>Interlinked contract</i>		
Fishing loan	1.4707***	(0.307)
Consumption loan	0.0220	(0.3398)
Constant	-2.0492***	(0.294)
Observations	319	
Pseudo $R^2$	0.168	

$p$ -values in parentheses; \*\*\* $p < 0.01$ ;  
error terms clustered at the household level.

through the selection of certain loans into an interlinked contract on the interest rate of interlinked loans.

Limited liability may be important in explaining the existence of interlinked loans around Chilika Lagoon. With the understanding that the borrower defaults if the disposable income turns out to be too low, the preferences of the lender and the borrower become dis-aligned. In this setting, all agents are assumed to be risk-neutral. Usually, a collateral requirement aligns preferences. If a collateral is not available, interlinked loans can also align preferences. To examine whether indebted households with and without interlinked loans differ in their limited liability, we compare the group means of mean yearly fishing income, average asset index<sup>29</sup> and the value of fishing assets. In addition, we also compare the average coefficient of variation between the two groups. No significant differences between these two groups are found (see table A3 in the online appendix). Accordingly, limited liability at the household level does not seem to be a good explanation for why some households have an interlinked loan and others do not.

Another fact that makes limited liability as an explanation for high interest rates of interlinked loans less likely is the following. The reason for taking out most loans is related to fishing activities. This usually means buying a boat, a motor or new nets. These items, in turn, can be seen as collateral. Similarly, most households own a fishing boat in the first place. Markets for used fishing boats exist, such that fishing boats can serve as collateral. Around Chilika Lagoon, limited liability may explain why certain borrowers choose informal over formal loans, but it is unlikely to explain interest payments in the form of an income share.

Last, a selection bias may distort results. Contracts taken out after 2008, but already repaid, are missing. As the maturity of most contracts is at least one year, the sample is reduced to those contracts taken out in 2010 and 2011 and the baseline specification is re-estimated. Results do not change tremendously (see table A2, column (5)).

## 8. Discussion and conclusion

This study examines the interest rates of interlinked loans in the small-scale fishery of Chilika Lagoon, India. The interest rates of interlinked loans are, on average, higher than interest rates of standard loans, but not significantly different from interest rates of other informal loans. Still, the analysis provides evidence that interest rates from interlinked

<sup>29</sup>The asset index is based on Filmer and Pritchett (2001) and explained in more detail in the online appendix.

loans contain an insurance premium. The insurance premium increases with the income volatility of the borrower. Risk-averse fishermen are willing to pay for the insurance-like service of interlinked loans. In the risky small-scale fishery sector without any formal insurance opportunities, the interlinked loan seems to provide an important additional service.

One may ask why interest rates from interlinked loans are not significantly higher than interest rates from other informal loans although the former contain an insurance premium. The theoretical model focuses on the insurance premium and discusses the role of standard loans to limit the insurance premium, leaving other issues aside. Especially, it does not explicitly consider transaction cost savings. The relatively low interest rate in interlinked loans compared to other informal loans may, in turn, be related to transaction costs saving specific to the interlinked nature of the loan, and to a certain degree to competition between fish traders. An interlinked loan includes the condition that fishermen offer their whole catch to the trader. Thereby, the trader ensures himself or herself access to high-quality fish. While this is a transaction cost saving for the trader, only a certain degree of competition will transfer part of these savings to the fishermen. This interpretation is in line with Braverman and Stiglitz (1982) who find that interlinked contracts extend the overall utility frontier, but that this may or may not benefit the agent. It is similar to the interpretation of Minten *et al.* (2012) that interlinkages may be an extra service to the farmers (in their case) to ensure future supply.

As the income share the fish trader receives as interest payments is of a size similar to the average share allocated towards the remuneration of capital within fishing units, one could argue that the insurance premium is within a reasonable range. Also, in terms of duration, we find no more 'old' interlinked loans relative to standard loans in the data.

In spite of the insurance mechanism in interlinked loans, the set-up of the contracts can be a source of worry, because it can facilitate exploitation. Once a fisherman has entered the contract, his income partly depends on the lender, and if price reductions are too high, the fisherman is not likely to be able to repay the loan. Theoretical models to explain interlinkages rely to a large extent on some sort of 'isolation' or fragmentation that leads to monopoly power, at least in some markets. Thus, breaking isolation should help to reduce the exploitative potential of interlinked contracts.

Based on the present analysis, potential misuse of the contracts can be reduced by the following factors. First, the analysis shows the importance of standard loans, as they limit the interest rate the fish trader can ask for. Second, it has to be ascertained that a certain level of competition between the lending fish traders still prevails, even though – up to a certain point – limited entry is needed for the system to work. Some competition between lenders gives the borrowers the possibility to repay the old loan with a new loan.

The present analysis further suggests that only improving credit markets will not be sufficient to reduce the prevalence of interlinked loans. The importance of interlinked loans can be reduced when other insurance means are introduced. The analysis also gives insights into successful set-ups of insurance connected to loans, a question currently intensively studied in development economics: interlinked loans contain no upfront payment for that insurance and automated 'payouts' in low income states, and they do contain an insurance premium, i.e., fishermen are willing to pay for an insurance-like service.

Whether or not the share the fishermen need to give to the fish trader is reasonable is partly an empirical question. Around Chilika Lagoon, the income share the fish trader receives as interest payments is of a size similar to the average share allocated towards the remuneration of capital within fishing units. Thus, one could argue that – on

average – shares in interlinked contracts are within a reasonable range. As discussed above, this is related to a sufficiently high level of competition in the credit market as well as between fish traders.

The focus of this paper is on the interest rates of interlinked loans in fisheries. Although this includes a discussion of the reasons for interlinked loans, the analysis is on the level of the loans. Household characteristics are mainly controlled for by household FEs. The examination of which kinds of households take out interlinked loans, either exclusively or in combination with standard loans, is left for future research. Such an analysis may also deepen the understanding of the connection between resource use, risk and interest rates when markets are missing.

**Supplementary material.** The supplementary material for this article can be found at <https://doi.org/10.1017/S1355770X18000311>.

**Acknowledgements.** The author thanks Clive Bell, Johannes Bröcker, Margrit Buser, Hans Gersbach, Holger Görg, Katrin Kamin, Frederik Noack and Martin F. Quaas, as well as participants at the AEL Conference 2014, the UCSB seminar and the SSDEV Summer School for their comments on the paper. Furthermore, thanks are given to Jyotirmayee Acharya, D.P. Dash, Manoranjan Dash, S.K. Mohanty, Ajit Kumar Pattnaik, Tapas Paul, Jack Ruitenbeek and our interviewees for their kind support during the field work. The usual disclaimer applies. Finally, financial support is acknowledged from the World Bank and the German Ministry of Education and Research (BMBF) via Grant 01LA1104C while the author was at Kiel University.

## References

- Akerberg DA and Botticini M** (2002) Endogenous matching and the empirical determinants of contract form. *Journal of Political Economy* **110**(3), 564–591.
- Allen D and Lueck D** (1999) The role of risk in contract choice. *Journal of Law, Economics, and Organization* **15**(3), 704–736.
- Arimoto Y** (2005) State-contingent rent reduction and tenancy contract choice. *Journal of Development Economics* **76**(2), 355–375.
- Banerjee A, Duflo E and Hornbeck R** (2014) (Measured) profit is not welfare: evidence from an experiment on bundling microcredit and insurance. Working Paper 20477, National Bureau of Economic Research.
- Baquero G, Hamadi M and Heinen A** (2012) Competition, loan rates and information dispersion in microcredit markets. ESMT Research Working Paper ESMT-12-02.
- Bardhan PK** (1980) Interlocking factor markets and agrarian development: a review of issues. *Oxford Economic Papers* **32**(1), 82–98.
- Basu K** (1983) The emergence of isolation and interlinkage in rural markets. *Oxford Economic Papers* **35**(2), 262–80.
- Basu K** (1987) Disneyland monopoly, interlinkage and usurious interest rates. *Journal of Public Economics* **34**(1), 1–17.
- Basu K** (1992) Limited liability and the existence of share tenancy. *Journal of Development Economics* **38**(1), 203–220.
- Bell C and Srinivasan TN** (1989) Interlinked transactions in rural markets: an empirical study of Andhra Pradesh, Bihar and Punjab. *Oxford Bulletin of Economics and Statistics* **51**(1), 73–83.
- Bell C, Srinivasan TN and Udry C** (1997) Rationing, spillover, and interlinking in credit markets: the case of Rural Punjab. *Oxford Economic Papers* **49**(4), 557–85.
- Bell CLG** (1988) Credit markets and interlinked transactions. In Chenery H and Srinivasan T (eds), *Handbook of Development Economics*, vol. I, Amsterdam: Elsevier, pp. 763–830.
- Braverman A and Stiglitz JE** (1982) Sharecropping and the interlinking of agrarian markets. *American Economic Review* **72**(4), 695–715.
- Brown GK and Mergoupis T** (2011) Treatment interactions with nonexperimental data in Stata. *Stata Journal* **11**(4), 545–555.



- Casaburi L and Macchiavello R** (2015) Loyalty, exit, and enforcement: evidence from a Kenya dairy cooperative. *American Economic Review* **105**(5), 286–90.
- Casaburi L and Willis J** (forthcoming) Time vs. State in insurance: experimental evidence from contract farming in Kenya. *American Economic Review*. Available at <https://www.aeaweb.org/articles?id=10.1257/aer.20171526&&from=f>
- Chiu WH** (2010) Skewness preference, risk taking and expected utility maximisation. *Geneva Risk and Insurance Review* **35**(2), 108–129.
- Crow B and Murshid K** (1992) The finance of trade and agriculture in a backward area of Bangladesh. *European Journal of Development Research* **4**(2), 36–60.
- Crow B and Murshid K** (1994) Economic returns to social power: merchants' finance and interlinkage in the grain markets of Bangladesh. *World Development* **22**(7), 1011–1030.
- Demirguc-Kunt A, Klapper L, Singer D and van Oudheusden P** (2015) The Global Findex Database 2014: measuring financial inclusion around the world. Washington, DC: World Bank Group. Policy Research working paper, no. WPS 7255.
- Directorate of Fisheries, Government of Odisha, India** (2013) Fisheries Statistics. Available at [http://www.orissafisheries.com/File/statistics\\_2013\\_june.pdf](http://www.orissafisheries.com/File/statistics_2013_june.pdf) (Accessed 03 September 2013).
- Duflo E and Banerjee AV** (2010) Giving credit where it is due. *Journal of Economic Perspectives* **24**(3), 61–80.
- Ellingsen T and Kristiansen EG** (2011) Financial contracting under imperfect enforcement. *Quarterly Journal of Economics* **126**(1), 323–371.
- Filmer D and Pritchett LH** (2001) Estimating wealth effects without expenditure data or tears: an application to educational enrollments in states of India. *Demography* **38**(1), 115–132.
- Fukunaga K and Huffman WE** (2009) The role of risk and transaction costs in contract design: evidence from farmland lease contracts in U.S. agriculture. *American Journal of Agricultural Economics* **91**(1), 237–249.
- Ghatak S** (1983) On interregional variations in rural interest rates in India. *Journal of Developing Areas* **18**(1), 21–34.
- Gin X and Yang D** (2009) Insurance, credit, and technology adoption: field experimental evidence from Malawi. *Journal of Development Economics* **89**(1), 1–11.
- Government of Orissa, India** (2011) Economic Survey 2010–2011, Orissa. Technical report, Planning and Coordination Department, Directorate of Economics and Statistics, Government of Orissa, India.
- Guha B and Chowdhury PR** (2013) Micro-finance competition: motivated micro-lenders, double-dipping and default. *Journal of Development Economics* **105**, 86–102.
- Guirking C** (2008) Understanding the coexistence of formal and informal credit markets in Piura, Peru. *World Development* **36**(8), 1436–1452.
- Hatlebakk M** (2009) Capacity-constrained collusive price discrimination in the informal rural credit markets of Nepal. *Review of Development Economics* **13**(1), 70–86.
- Heckman J** (1978) Dummy endogenous variables in a simultaneous equation system. *Econometrica* **46**(4), 931–959.
- Hoff K and Stiglitz J** (1990) Introduction: imperfect information and rural credit markets: puzzles and policy perspectives. *World Bank Economic Review* **4**(3), 235–250.
- Hoff K and Stiglitz JE** (1997) Moneylenders and bankers. *Journal of Development Economics* **52**(2), 429–462.
- Iqbal F** (1988) The determinants of moneylender interest rates: evidence from rural India. *Journal of Development Studies* **24**(3), 364–378.
- Jacoby HG and Mansuri G** (2007) Incentives, supervision, and sharecropper productivity. Washington, DC: World Bank, Policy Research Working Paper WPS 4125.
- Karlan D, Osei R, Osei-Akoto I and Udry C** (2014) Agricultural decisions after relaxing credit and risk constraints. *Quarterly Journal of Economics* **129**, 597–652.
- Kasperski S and Holland DS** (2013) Income diversification and risk for fishermen. *Proceedings of the National Academy of Sciences* **110**(6), 2076–2081.
- Koszegi B** (2014) Behavioral contract theory. *Journal of Economic Literature* **52**(4), 1075–1118.
- Laffont J-J and Matoussi MS** (1995) Moral hazard, financial constraints and sharecropping in El Oulja. *Review of Economic Studies* **62**(3), 381–399.

- Liu Y, Chen KZ, Hill RV and Xiao C** (2013) Borrowing from the insurer: an empirical analysis of demand and impact of insurance in China. IFPRI Discussion Paper 1306, International Food Policy Research Institute (IFPRI).
- Macchiavello R and Morjaria A** (2015) Competition and relational contracts: evidence from Rwanda's coffee mills. 2015 Meeting Papers 431, Society for Economic Dynamics.
- Mallik D** (2012) Microfinance and moneylender interest rate: evidence from Bangladesh. *World Development* **40**(6), 1181–1189.
- Menkhoff L, Neuberger D and Rungruxsivorn O** (2012) Collateral and its substitutes in emerging markets' lending. *Journal of Banking & Finance* **36**(3), 817–834.
- Minten B, Vandeplas A and Swinnen JFM** (2012) Regulations, brokers, and interlinkages: the institutional organization of wholesale markets in India. *Journal of Development Studies* **48**(7), 864–886.
- Mohapatra A, Mohanty R, Mohanty S, Bhatta K and Das N** (2007) Fisheries enhancement and biodiversity assessment of fish, prawn and mud crab in Chilika Lagoon through hydrological intervention. *Journal of Coastal Research* **15**(3), 229–251.
- Mookherjee D and Ray D** (2002) Contractual structure and wealth accumulation. *American Economic Review* **92**(4), 818–849.
- Noack F** (2013) *Structural Change in Resource-Abundant Economies* (PhD thesis), Christian-Albrechts-Universität zu Kiel.
- Platteau J-P and Abraham A** (1987) An inquiry into quasi-credit contracts: the role of reciprocal credit and interlinked deals in small-scale fishing communities. *Journal of Development Studies* **23**(4), 461–490.
- Platteau J-P and Nugent J** (1992) Share contracts and their rationale: lessons from marine fishing. *Journal of Development Studies* **28**(3), 386–422.
- Prendergast C** (2002) The tenuous trade-off between risk and incentives. *Journal of Political Economy* **110**(5), 1071–1102.
- Ray D** (1998) *Development Economics*. Princeton, NJ: Princeton University Press.
- Riekhof M-C** (2014) *Essays in Resource and Development Economics* (PhD thesis). Christian-Albrechts-Universität zu Kiel.
- Riekhof M-C** (2016) The insurance premium in the interest rates of interlinked loans in a small-scale fishery. CER ETH Working Paper 16/264.
- Sahu BK, Pati P and Panigrahy R** (2014) Environmental conditions of Chilika Lake during pre and post hydrological intervention: an overview. *Journal of Coastal Conservation* **18**(3), 285–297.
- Shami M** (2012) The impact of connectivity on market interlinkages: evidence from rural Punjab. *World Development* **40**(5), 999–1012.
- Sinn H-W** (1990) Expected utility, mu-sigma preferences, and linear distribution classes: a further result. *Journal of Risk and Uncertainty* **3**(3), 277–81.
- Steiner B** (2011) Contracting in the wine supply chain with bilateral moral hazard, residual claimancy and multi-tasking. *European Review of Agricultural Economics* **39**(3), 369–395.
- Stiglitz J and Weiss A** (1981) Credit rationing in markets with imperfect information. *American Economic Review* **71**(3), 393–410.
- Stiglitz JE** (1974) Incentives and risk sharing in sharecropping. *Review of Economic Studies* **41**(2), 219–55.
- Udry C** (1990) Credit markets in northern Nigeria: credit as insurance in a rural economy. *World Bank Economic Review* **4**(3), 251–269.

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**Cite this article:** Riekhof M-C (2019). The insurance premium in the interest rates of interlinked loans in a small-scale fishery. *Environment and Development Economics* **24**, 87–112. <https://doi.org/10.1017/S1355770X18000311>