Labor contracts and risk sharing

Federico H. Gutierrez
Vanderbilt University
Labor Contracts and Risk Sharing

Federico H. Gutierrez∗

Vanderbilt University

May, 2013

Background paper for the World Development Report 2014

Abstract

This paper studies the role of labor contracts as a mechanism to allocate risks between the employer and the employee. The first part of the paper discusses the rationale for using labor contracts as risk-sharing agreements as well as the limits set by problems of asymmetric information and costly enforcement. The second part of the paper reviews the empirical evidence with special emphasis on Mexico.

1 Introduction

The classical view of labor markets where wages are fully flexible and adjust to accommodate movements in labor demand and labor supply is certainly questionable. The labor and development economics literature suggests that even in low-income countries where most of the labor force is in agriculture, government interventions are usually non existent and unionization is low, labor markets do not function like the Marshallian model found in textbooks.

∗Department of Economics, 421 Calhoun Hall, Vanderbilt University, Nashville, TN 37240
e-mail: federico.h.gutierrez@Vanderbilt.Edu
An alternative to a Marshallian labor market is a contract labor market. A labor contract is an agreement between an employer and an employee in relation to the tasks and responsibilities of the worker and the compensation he will receive for his labor services. Labor contracts emerge naturally when there is no instantaneous exchange of labor for money.

The presence of labor contracts per se does not necessarily imply that the predictions of the Marshallian labor market are incorrect. With labor contracts, wages may still adjust to accommodate contemporaneous changes in labor demand and labor supply. A contract labor market behaves differently from a Marshallian labor market when labor contracts have other functions rather than the mere specifications of workers’ tasks. One of these functions is the allocation of risks in a way different from a spot labor market. This is precisely the focus of this paper. It studies how labor contracts can be used to efficiently distribute risks between the employer and the employee by specifying the appropriate wage scheme. It studies labor contracts as risk-sharing agreements between employers and employees.

Any wage scheme in a contract implicitly contains a risk-sharing rule. One polar situation is a fixed-wage contract. Here, the risk of productivity fluctuations is entirely allocated to the employer. The contract fully insures the worker against any productivity shock by guaranteeing an invariant salary. The employer is the sole residual claimant. The other polar situation is a piece-rate contract. In this type of contracts, the remuneration of a worker linearly depends on the units of production he generates. Then, any productivity shock directly impacts on the worker’s salary. This type of contracts does not contain any insurance against productivity fluctuations. Between these two polar contracts, it is possible to find others that share risks between an employer and an employee in different proportions.

The rationale for using labor contracts as a risk-sharing mechanism is as follows. Workers are usually risk-averse and often cannot perfectly smooth consumption when they suffer a negative income shock. This is so because their access to financial markets is limited and generally not as good as the access that firms have. Consequently, workers have preferences for jobs that not only are well-paid but also have a relatively stable salary. By contrast, firms are expected
to be risk-neutral or to behave as such given the better access they have to financial markets. Equilibrium in the market is achieved when firms compete for workers offering contracts. Labor contracts contain explicitly or implicitly two aspects of the remuneration that are relevant for workers: the level and the volatility (or risk). However, because firms are risk-neutral, they only care about the level of workers’ remuneration. Thus, to attract workers, firms have the incentive to offer labor contracts that minimize the risk of wage fluctuations insuring in this way the worker against productivity shocks.

There are limits to the use of labor contracts as a risk-sharing instrument. These limits are: the cost of enforcing contracts and problems of asymmetric information.

The implicit insurance component of labor contracts implies that workers are paid above their marginal productivity during bad shocks and below their productivity in good shocks. Then, there are incentives for the firm to renege during bad shocks. The use of labor contracts as mechanisms to allocate risk likely depends on how good the enforcement of contracts is. Nonetheless, even when no enforcement is possible, labor contracts can still be used as a risk-sharing mechanism. Theoretical papers show the conditions for this. (e.g., Thomas and Worrall [1988]). However, the assumptions these papers make are yet to be empirically verified.

With respect to problems of asymmetric information, moral hazard can severely restrict the role of labor contracts as a risk-sharing mechanism. In some jobs, tasks are difficult to monitor. If this is the case, a labor contract that fully insures the worker reduces his incentives to put effort at work. Then, a wage scheme is used to create the appropriate incentives to employees to work hard. When tasks are not observable or difficult to monitor, there is a trade-off between insurance and incentives in labor contracts.

Another problem of asymmetric information is adverse selection. Workers who are more likely to receive a productivity shock self-select into jobs that provide implicit insurance in labor contracts. Because firms do not observe the individual likelihood of productivity shocks, they offer the same contracts to observationally similar workers. This implies that workers with a low likelihood of bad shocks may decide not to work in the firm.
This paper analyzes the rationale and limits of using labor contracts as a risk-sharing mechanism and reviews the empirical evidence. Section 2 discusses the types of contracts and their characteristics. Section 3 derives the optimal labor contract when firms are risk-neutral and workers are risk-averse. It also contrasts the predictions of a contract labor market and a spot labor market. Section 4 discusses the limits of labor contracts as a mechanisms to allocate risks. This section is divided in three subsections: enforcement problems, moral hazard, and adverse selection. Section 5 focuses on rural labor markets. Labor and land contracts are substitutes and both have implication in relation to risk allocation. Section 6 discusses government interventions. Section 7 reviews the empirical evidence when productivity fluctuations occur at the aggregate level while in section 8 reviews the empirical evidence when productivity shocks are worker-specific.

2 Labor Contracts

This paper defines a labor contract as *any* agreement between an employer and an employee. However, it is important to classify contracts according to their characteristics to understand the different economic implications they have.

First, labor contracts can be formally written or simple verbal (oral) agreements. A verbal agreement can be as legally binding as a written one if the employment relation can be directly or indirectly verified in court. As Malcomson [1999] points out, statements of policy in company handbooks and decisions by one party have been used as evidence of labor contracts. Naturally, the advantage of a written contract is that it is explicit in many dimensions and consequently easily verifiable. This is precisely the reason for a written contract.

Second, it is important to understand the difference between complete and incomplete contracts. An incomplete contract does not explicitly foresee all possible circumstances that could arise. One reason for a contract to be incomplete is that there may be too many potential circumstances to contemplate or some of them may rarely occur (e.g., a natural disaster); so,
the costs of explicitly contemplating all scenarios may exceed the benefits. Another reason why contracts are incomplete is because some circumstances cannot be observed or verified, so, there is no point in including them in the contracts. For example, in some occupations, a contract cannot specify the level of effort of the worker because it is not observable by the employer. This is the case when tasks are complex or difficult to monitor.

The part of the contract that is implicit and/or unverifiable should be self-enforcing to be meaningful. That is, none of the parties should have incentives to unilaterally deviate from what was agreed. For obvious reasons, unverifiable clauses cannot be enforced by third parties. In summary, a contract may have a part that is self-enforcing and a part that is not, which requires that a third party should be able to verify and impose sanctions in case of a violation of the contract.

2.1 Insurance in contracts: “fringe” benefits vs. income smoothing

There are two types of insurance associated with labor contracts. The first one is the set of insurance services that cover certain risks explicitly such health shocks, accidents and unemployment. The worker may or may not receive these insurance services depending on the job he has. Many, but not all, of these insurance services are considered fringe benefits.

The other type of insurance associated with labor contracts is usually implicit. It is the insurance against productivity shocks or productivity fluctuations. There are risks in the production process such as weather shocks, price changes and strikes, which if realized, affect the value of the marginal productivity of workers. If a worker’s remuneration is determined exclusively by the value of his marginal productivity, it will fluctuate considerably as a consequence of shocks. Labor contracts can provide insurance to workers against these shocks specifying the appropriate wage scheme. For example, if a contract specifies that a worker will receive a fixed monthly remuneration, then it implicitly indicates that the worker is fully insured against productivity fluctuations. Nonetheless, a fixed remuneration may or may not be an equilibrium.
The main focus of this paper is the second type of insurance, the implicit insurance against productivity shocks. The paper will discuss the rationale for using labor contracts as a mechanism to efficiently allocate risk between the employer and the employee. It will also analyze the limits and the empirical evidence.

3 Implicit insurance in labor contracts

This section presents how labor contracts are used as a risk-sharing mechanism between the employer and the employee. In case of uncertainties in the production process, labor contracts are expected to implicitly contain a form of insurance to protect workers against excessive earnings fluctuations.

First, section 3.1 analyzes a “spot” labor market. This is a market that functions as if labor services were exchanged for money on a daily basis. In this market, there is no insurance in labor contracts. The market clears in every period and the wage of a worker is equal to his marginal productivity. I present a labor market with no insurance to understand the differences with a more sophisticated labor market (section 3.2) where labor contracts are used to efficiently allocate risk between the employer and the employee.

3.1 A spot labor market

Before analyzing the functioning of a contract labor market, it is important to review the implications of a spot labor market in the presence of uncertainties. A labor market functions as a spot market if wages are flexible and constantly adjust to accommodate fluctuations in labor demand and labor supply. For example, in some countries harvest workers are hired at a daily basis and paid in relation to their productivity. Each day, the wage rate adjusts to clear the market.

In this market, profit maximization of firms implies that a worker should receive as a compensation the value of his marginal product, as equation (1) indicates.
\[ pf'(h, s) = w \]  

where \( p \) is the price the firm sells its product and \( f'(\cdot) \) is the physical marginal productivity of the worker. This productivity depends on the number of hours he works \( h \) and on a compound \( s \) that contains all other elements that affect the productivity of the worker. The variable \( s \) contains the use of other inputs such as capital and labor services of other workers in the firm, technology used by the firm, and random elements that affect the production process in general (e.g., weather shocks) or the productivity of the worker in particular (e.g., health shocks).

Equation (1) is useful to understand the situations that may affect the wage of a worker. Changes in any of the elements on the left-hand side of (1) may impact on the worker’s compensation (the right-hand side). If we include the possibility that moving from one firm to another is costly for workers, then the magnitude of the wage fluctuation will depend on the interaction of the type of shock with the presence of mobility costs in the labor market. Mobility costs are usually related to frictions in the market that make the search process costly in terms of time, money, and effort. If jobs are geographically distant, mobility costs may also include migration costs.

To better understand how the interaction of shocks and mobility costs are expected to affect wages in the spot market, I classify the shocks in four different categories: i) worker-specific shocks, ii) firm-specific shocks, iii) industry-specific shocks, and iv) economy-wide shocks.
Table 1: Remuneration of workers and productivity shocks

<table>
<thead>
<tr>
<th></th>
<th>without mobility costs</th>
<th>with mobility costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>worker-specific shock</td>
<td>wages fluctuate</td>
<td>wages fluctuate</td>
</tr>
<tr>
<td></td>
<td>in the same magnitude</td>
<td>in the same magnitude</td>
</tr>
<tr>
<td></td>
<td>as that of the productivity shock</td>
<td>as that of the productivity shock</td>
</tr>
<tr>
<td>firm-specific shock</td>
<td>no change in wages</td>
<td>wages fluctuate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in the same magnitude</td>
</tr>
<tr>
<td></td>
<td></td>
<td>as that of the productivity shock</td>
</tr>
<tr>
<td>industry-specific shock</td>
<td>no change in wages</td>
<td>change in wages</td>
</tr>
<tr>
<td></td>
<td>(if returns to skills are similar</td>
<td>smaller in relation to</td>
</tr>
<tr>
<td></td>
<td>across industries)</td>
<td>firm-specific shocks</td>
</tr>
<tr>
<td>economy-wide shock</td>
<td>wages fluctuate</td>
<td>wages fluctuate</td>
</tr>
<tr>
<td></td>
<td>in the same magnitude</td>
<td>in the same magnitude</td>
</tr>
<tr>
<td></td>
<td>as that of the productivity shock</td>
<td>as that of the productivity shock</td>
</tr>
</tbody>
</table>

Table 1 summarizes how different types of shocks impact on wages. The explanation of table 1 is as follows.

**Worker-specific shocks:** If the productivity shock is specific to the person, such as an accident or illness that creates a temporary disability, then the compensation of the worker will be temporarily reduced irrespective of the presence of mobility costs in the labor market because these shocks are attached to the worker and not the workplace. Hence, moving to a different firm does not improve the productivity of the worker.

**Firm-specific shocks:** When the productivity shock is firm-specific, mobility costs play an important role on wage fluctuations. In an extreme situation where a worker can freely move from one firm to another at no cost, the firm-specific shock should not affect the worker’s
remuneration. The worker can quit the job in the firm that suffered the shock and find a similar job in a different firm.

In the absence of mobility costs, workers will migrate from firms that receive the adverse productivity shock to other firms in the economy. In equilibrium, the mobility of workers will stop when all the firms, those that received the shock and those that didn’t, have the same marginal productivity of labor.

With costly mobility, workers will not change jobs unless the wage decline exceeds the cost of searching for a new job. If the mobility cost is too high, workers will keep jobs in the firm that experience the productivity shocks. Their wages will decline.

**Industry-specific shocks:** The adjustment of wages to industry-specific shocks is similar to the adjustment of firm-specific shocks. If there are no mobility costs, the shock forces some workers to migrate from firms in industries that are affected by the productivity shock to firms in other industries in the economy where productivity levels have not been compromised. The compensation of workers will not change if they are able to find similar jobs in other industries. However, if moving from one job to another is costly to workers, the magnitude of the wage reduction is expected to be lower in the case of industry-specific shock than in the case of firm-specific shocks. The reason is that the decline in productivity is partially offset by an increment in the price of the good the industry produces as a consequence of a supply contraction, precisely due to the shock\(^1\). In equation (1), the industry-specific shock makes the two elements on the left-hand side move in opposite direction. The marginal productivity \(f'(h, s)\) decreases and the price \(p\) increases. The magnitude of the price change as a consequence of the shock will depend on the demand elasticity of the industry. In the extreme case where the demand of the good produced by the industry is completely inelastic, the productivity shock can be entirely passed on to the consumers with no impact on the wages of workers.

**Economy-wide shocks:** Finally, if the productivity shock is at the aggregate level, the

\(^{1}\)International trade may prevent the price to change. In this case, industry-specific shocks and firm-specific shocks are likely to have similar effects on workers’ compensation.
classical theory predicts that, with or without mobility costs, the aggregate productivity should affect the worker's compensation. All firms and industries are affected by aggregate shocks. So, moving from one job to another does not improve the productivity of the worker.

### 3.2 Contract Market

The previous section illustrated how different types of shocks in the production process are expected to impact on the worker's remuneration when the labor market functions as a spot market. Nonetheless, a spot market is probably not the best representation of labor markets even for low-income countries. An alternative to a spot market is a contract labor market that insures workers against some of the aforementioned shocks by reducing the volatility of labor incomes.

This section shows that a contract market can dominate a spot labor market. Labor contracts are expected to have two functions. First, they are designed to indicate the tasks and responsibilities of the worker as well as the compensation he will receive for his labor services. Second, the compensation scheme may contain an insurance component against productivity shocks. In this case, there is an implicit risk-sharing agreement between the employer and the employee. This section illustrates the rationale for this second function of labor contracts using a simple model.

Workers tend to be risk-averse. So, not only do they care about the level of income they can get in a job, but they also care about the stability of earnings. On the other side of the market are firms. Firms are usually in a better position to deal with risk. For simplicity, let's take this idea to the extreme and assume that firms are risk-neutral. In this setting, a spot labor market like the one described in the previous section is not efficient because uncertainties in the production process creates volatility in the compensation of risk-averse workers. A better equilibrium can be achieved if labor contracts specify a compensation scheme such that the risks in the production process are reallocated from workers to firms. This type of labor contracts
may emerge naturally when firms compete for workers.

To simplify the analysis, let’s assume that a labor contract only specifies, the number of hours the employee has to work \( h(s) \) and the compensation he will receive \( \varepsilon(s) \) in each state of the world \( s \) (i.e., the contract is \( [h(s), \varepsilon(s)] \)). The variable \( s \) as in the previous sections captures the randomness in the production process.

Competing for workers, firms offer the best possible contract, conditional on obtaining a desirable level of expected profits. Then, the optimal contract will solve,

\[
\max_{h(s), \varepsilon(s)} E(U(h(s), \varepsilon(s), s))
\]

\[\text{s.t. } E(F(h(s), s) - \varepsilon(s)) \geq c\]

Equation (2) is the expected utility of the worker. The function \( U(.) \) is assumed to be concave in all its arguments. This is sufficient for the worker to be risk-averse. Equation (3) indicates that any contract that the firm offers should yield an expected level of profits at least equal to a constant \( c \). This constant is given by the level of competition in the product market. Free entry of firms will set \( c = 0 \). For simplicity, in (3) the production function \( F(.) \) only depends on the hours worked by the employee and on the productivity shock \( s \). The only cost for the firm is the amount paid to the employee \( \varepsilon(s) \).

The first order conditions of the problem are:

\[
U'_{\varepsilon(s)} = \lambda \quad \forall \varepsilon(s)
\]

\[
U'_{h(s)} = -\lambda F'_{h} \quad \forall h(s)
\]

In equations (4) and (5), \( \lambda \) is the Lagrange multiplier, which does not depend on \( s \). So, if the marginal utility of earnings does not change with the state of the world or the number of hours worked (i.e., utility function is separable in earnings and hours worked), equation (4) indicates that the optimal contract will assure the worker a compensation that does not change
with productivity shocks. This is precisely the insurance component of the contract. On the contrary, in a spot market like the one described in the previous section, earnings tend to move with productivity shocks.

To summarize, if firms are risk-neutral they will offer contracts that fully insure workers against productivity shocks. This means that, under certain conditions of the utility function, earnings will be constant. This is the optimal risk-sharing agreement between a risk-averse worker and a risk-neutral firm.

### 3.3 Role of firm’s risk aversion

The assumption that all firms are risk-neutral is certainly questionable. Some firms, particularly in developing countries, are small, owned and operated by members of the same family. In this case, not only the level of profits matter, but also the volatility. The optimal risk-sharing agreement between the firm and the employee is not to fully insure the worker. A simple way of incorporating risk aversion of firm owners is replacing equation (3) with $E\left[V(\Pi(s))\right] \geq c$, where $\Pi(s) = F(h(s), s) - \varepsilon(s)$ as before. The function $V(.)$ is assumed to be strictly concave and can be interpreted as the utility of the firm owner. Then, the first order condition with respect to the worker’s compensation is as follows:

$$U_{\varepsilon(s)}' = V_{\Pi(s)}' \lambda \quad \forall \varepsilon(s)$$  \(\text{(6)}\)

Equation (6) indicates that fully insuring the worker is not the optimal contract for the firm when owners are risk-averse. The marginal utility of the worker and his income fluctuate with the state of the world. Nonetheless, the degree of insurance to the employee is given by:

- a well-diversified portfolio: Even when firm owners are risk-averse, they may behave as if they were risk-neutral (equation (4)), if they have access to a rich set of financial instruments that allows them to minimize or eliminate the impact of profit fluctuations on their wealth.
• low risk aversion of entrepreneurs: there are reasons to believe that entrepreneurs are on average less risk-averse than workers. Entrepreneurs self-selected into occupations that are usually associated with volatile income. The attitude towards risk is likely to be a determinant in the occupational choice.

• size of the firm: larger firms are expected to better manage worker-specific productivity shocks. In a large firm, if a worker suffers an accident, there are other workers who can temporarily perform his duties. Also, profits of firms with many employees fluctuates less (proportionally) when one employee suffers a productivity shock than firms with only few employees.

• product diversification: volatility in the demand of a product creates volatility in profits. To minimize this, firms can offer a variety of products in markets that are not highly (positively) correlated.

For the reasons just explained, even when firms are not risk-neutral they may behave as such if they have good access to financial markets. However, it seems that this is not true in some developing countries. Banerjee and Duflo [2012] study whether firms are credit constrained in India. They exploit a policy change in 1998 that changed the eligibility of firms to a priority access to bank lending.

Indian banks are required to lend no less than 40% of their credit to what is called the priority sector. This sector includes small scale industry and agriculture. Before 1998, a firm’s total investment in plant and machinery could not exceed Rs 6.5 million to belong to the priority sector. In January 1998, this limit increased to Rs. 30 million, but then decreased to Rs. 10 million in January 2000.

The idea of Banerjee and Duflo is that firms should respond differently to this policy change depending on whether they are credit constrained or not. If firms that became part of the priority sector as a consequence of the 1998 reform are not credit constrained, then
the subsidized credit should mostly substitute market credit. But, if these firms are credit constrained, the policy reform should induce more borrowing and expansion of output.

Banerjee and Duflo find evidence of credit constraints in Indian firms. Firms that entered the priority sector as a consequence of the policy change increased sales between 16% and 19%. The estimated increase in profits is also large, about 50%. These results do not directly indicate that firms do not act as risk-neutral agents. However, the idea that firms have good access to credit markets and that they insure workers against productivity risks is questionable when there is direct evidence of credit constrains.

In an agricultural setting, Rosenzweig and Biswanger [1993] show that farmers in India do not act as risk-neutral agents. They present evidence that farmers allocate productive assets not only to maximize expected profits, but also to reduce its volatility. Although their study does not explicitly address the implications of farmers’ risk-aversion on labor contracts, the fact that farmers do not behave as risk-neutral employers is expected to affect how they share risk with workers.

4 Limits to insurance in labor markets

This section presents the limits of labor contracts as a mechanism to share risks. The section is divided in three subsections: enforcement problems, moral hazard, and adverse selection.

4.1 Enforcement of contracts

Using labor contracts as a risk-sharing mechanism implies that workers are paid below their marginal productivity in “normal” times with the promise of getting compensation above its marginal product during bad productivity shocks. Depending on how costly it is to replace a worker, the firm has incentives to renege by firing the worker or reducing his payment during bad shocks. One way of minimizing this problem is improving the enforcement of contracts. But this requires that a third party should be able to verify the conditions of the contract.
If a contract is formally written, we naturally expect a better enforcement. A judge can compare what it is written in the contract and evaluate what part has been violated. Nonetheless, even formally written contracts are sometimes difficult to enforce. This happens when verifying the actions and omissions of the parties is too costly or simply not possible.

On the other hand, verbal (oral) agreements are not necessarily unenforceable. But naturally, there are elements in this type of contracts that are more difficult to verify.

More remarkably, even in situations where enforcement is not possible, the existence of labor contracts that insure workers against productivity shocks is possible. Thomas and Worrall [1988] theoretically show the conditions for this. Their paper describes an economy with risk-neutral firms and risk-averse workers that can hire or work either in a spot labor market or in the long-term contract market. In the spot labor market, labor services are instantaneously exchanged for money. This market is similar to the one described in section 3.1 where wages fluctuate each period. The interesting feature about Thomas and Worrall’s paper is that long-term contracts cannot be legally enforced. Thus, these contracts should be self-enforcing. That is, neither the firm nor the worker should have incentives to renege.

A key ingredient in the Thomas and Worrall’s paper is reputation costs. If a firm reneges, it quickly obtains a bad reputation and no worker will be willing to write a long-term contract with this firm. Bad reputation is also a problem for workers. When workers change jobs, they usually have to provide references from previous employers. If a worker reneges a long-term contract, the rest of the firms will know it and will not offer him another long-term contract. In this environment, when a productivity shock affects wages in the spot market, the firm and the worker in the long-term employment compare the costs and benefits of reneging. For the firm, reneging has the benefit of hiring a similar worker at a lower wage. The cost of reneging is obtaining a bad reputation and not being able to write a long-term contract again. Long-term contracts pays in equilibrium a lower wage than the average spot market wage.

The result of the study is that the optimal contract when legal enforcement is not possible is one with a fixed wage that occasionally adjusts to accommodate relatively large shocks
that significantly change the spot market wage. Thomas and Worrall’s result is very important because it indicates that a contract that provides insurance to workers by offering a stable wage is possible even when legal enforcement is not possible. Nonetheless, it is not clear whether the conditions the paper imposes are present in the economy.

4.2 Moral hazard

Moral hazard could be a serious problem in labor contracts that are implicitly used to share risk. This section continues with the simple model presented before to illustrate the problems of moral hazard. The main message is that if the effort of workers cannot be perfectly observed, and monitoring costs are high, a labor contract that fully insures the worker against productivity shocks is not optimal (i.e., the optimal risk sharing in the absence of monitoring costs is that a risk-neutral firm fully insures the worker as explained in section 3.2). The reason is that the wage scheme is also used to create the appropriate incentives to work hard.

To illustrate this, assume that $h$ in equations (2) and (3) is the effort of the worker instead of the hours worked. Since effort is not observable, it cannot be specified in the contract. The worker will freely choose the effort level that maximizes his utility. If the labor contract fully insures the worker against productivity shocks by paying a fixed salary, then the worker will have no incentive to put any effort. To create the incentives for the worker to exert the desired level of effort, the remuneration should depend on observable outcomes that are associated with effort. To see this, let’s derive the optimal contract when effort $h$ is not observable in equations (2) and (3).

Incorporating moral hazard in the maximization problem in equations (2) and (3) requires additional changes. First, I use the duality theorem. This theorem implies that the solution to the maximization problem in equations (2) and (3) is identical to the solution of a problem that maximizes profits subject to the utility of worker$^2$. Second, since $h$ is not part of the contract

\footnotesize{This the duality theorem. The maximization of (2) subject to (3) yields the same solution of maximizing $E(F(h(s), s) - \varepsilon(s))$ s.t. $E(U(h(s), \varepsilon(s), s)) \geq d$, where $d$ is the maximum utility level after solving (2) and (3).}
because it is unobservable, maximizing profits is identical to minimizing the worker’s payment subject to the utility of the worker. Third, $s$ should be a shock that occurs after the worker chooses the level of effort and cannot be directly observed by the employer. Fourth, to simplify the analysis the effort can only take two values $h \in \{h^*, h^0\}$. With these three modifications, if the employer wants to induce effort level $h^*$ the optimal contract is the solution to the following problem:

\[
\begin{align*}
\min_{\varepsilon(Y)} & \quad E(\varepsilon(Y)) \\
\text{s.t.} & \quad E(U(h^*, \varepsilon(Y))) \geq c \\
& \quad h^* = \arg\max_h E(U(h, \varepsilon(Y)))
\end{align*}
\]

Equation (7) is the objective function of the firm. It is the expected value of the worker’s remuneration. In contrast to the problem in section 3.2, the remuneration is not a function of $s$ because it is not observable. But, the remuneration may depend on the outcome $Y = F(h, s)$. Equation (8) is simply the utility of the worker. Equation (9) is the incentive compatibility constraint. It says that the effort level $h^*$ can be induced only if it is the best option for the worker given the wage scheme specified in the contract.

The first order condition of the problem is as follows.

\[
\frac{1}{U'_{\varepsilon(Y)}} = \lambda + \mu \left(1 - \frac{P(Y|h_0)}{P(Y|h^*)}\right)
\]

$\lambda$ and $\mu$ are the Lagrange multipliers of (8) and (9). It can be shown that they are both strictly positive. $P(Y|h^*)$ is the probability that outcome $Y$ occurs conditional on worker’s effort $h^*$, and $P(Y|h_0)$ is the probability of the same outcome when effort level is $h_0$. Equation (10) indicates that the more likely an outcome $Y$ occurs with effort level $h^*$, the higher the wage in this state. Note that when $\frac{P(Y|h^*)}{P(Y|h_0)}$ increases, the marginal utility $U'_{\varepsilon(Y)}$ decreases, which implies that the worker’s remuneration $\varepsilon(Y)$ increases.
The most common example of moral hazard is when a firm owner hires a manager. If we assume that outcome can only take two values, \( Y^{high} \) and \( Y^{low} \), then the wage of the manager will co-move with the outcome \( Y \) as long as more effort increases the probability of \( Y^{high} \). How much will the wage fluctuate with outcome will depend on the risk aversion of the manager (i.e., derivative of \( U'(Y) \)). If the manager is highly risk averse, the wage fluctuation will be low. But, the wage cannot be fixed because it would destroy the incentives to put in effort \( h^* \).

From the model, we conclude that when worker’s effort is not observable, the moral hazard problem creates a trade-off between insurance and incentives in labor contract. Comparing this result with the results found in section 3.2, unobserved effort limits, but does not eliminate, the implicit insurance in labor contracts.

Direct evidence of moral hazard in labor markets is scarce. The reason is that worker’s effort is observable neither by the employer nor by the econometrician. Thus, it is usually not possible to measure shirking. Foster and Rosenzweig [1994] paper is one of the few studies on moral hazard and contractual arrangements. This paper studies rural labor markets in the Philippines. The basic idea is that changes in the body mass index (BMI) are determined by calorie intake and energy expenditure. Since agricultural work is predominantly physical work, the depletion of body mass, for a given calorie intake indicates the level of work effort.

The empirical strategy in Foster and Rosenzweig [1994] study consists of regressing the BMI of workers on lagged BMI, calorie intake, the type of labor contract, and other controls. A two-stage least squares method is used to deal with the endogeneity of the regressors. The paper finds that the type of contract significantly affects work effort. Workers under a piece-rate contract deplete 10% more body mass than workers under time-wage contracts.

### 4.3 Adverse selection

Adverse selection occurs when workers are heterogeneous with respect to the likelihood of experiencing a bad productivity shock. Returning to the characterization of shocks made in
section 3.1, adverse selection could only be problematic in the case of worker-specific shocks (e.g., illness or accidents) because, in the rest of the cases, the entire workforce within the firm suffers a productivity drop. Moreover, only worker-specific shocks depend exclusively on the worker type.

The worker usually has better information about his likelihood of suffering a productivity shock than the employer. For example, the worker knows how healthy he is and consequently how likely it is for him to become sick and miss days at work. However, the employer knows little about how healthy a worker is. Then, the employer will have no option but to offer a contract assuming that the worker’s health is similar to other workers with the same characteristics (e.g., age and gender). To see this, let’s go back to the model in section 3.2. With a risk-averse worker and a risk-neutral firm, the optimal contract pays a salary that is constant across states. Using equation (3), this implies that the remuneration of the worker is the following.

\[
\varepsilon = E(F(h(s), s) - c)
\]  

Let \( s = 1 \) if the worker is sick and \( s = 0 \) if the worker is not sick, and let \( P_{s=1} \) be the probabilities of \( s = 1 \). Then, (11) becomes

\[
\varepsilon = P_{s=1}F(h(1), 1) + (1 - P_{s=1})F(h(0), 0) - c
\]  

From (12) it is clear that the remuneration of the worker depends on the probability that he gets sick. Since the worker is expected to be less productive when sick \( (F(h(1), 1) < F(h(0), 0)) \), the higher the probability of getting sick, the lower the offered remuneration.

The problem with asymmetric information is that the probability of getting sick is not observable. Thus, the employer estimates this probability based on the observable characteristics of the worker. This implies that workers who are relatively healthy are paid below their expected marginal productivity. Consequently, a healthy worker may decide to reject the offer.
When there is heterogeneity in the probability of productivity shocks and it is not observed by the employer, a firm that offers a contract that insures workers against productivity shock may attract only “bad” workers with respect to the probability of receiving a bad productivity shock.

Evidence of adverse selection in agricultural markets is reported by Foster and Rosenzweig [1993]. Using data from India and the Philippines, the paper is able to estimate the fraction of agricultural workers’ productivity that is observable by the employer and use this information to test for adverse selection. The authors compare the outcome of piece-rate contracts (without problems of adverse selection) and time-wage contracts. The findings of the paper indicate that there is a lot of uncertainty about workers’ productivity. In India, 88% of the variance in productivity is known by the employer; in the Philippines, only 32%. Because workers under a time-rate contract are paid in relation to the observable part of their productivity, higher uncertainty on the side of employer increases the gap between the true productivity and the payment. The paper suggests that, in the Philippines, a 10% increase in the unobservable component of the workers’ productivity generates a 6.6% increase in the fraction of the work time the worker allocates to piece-rate jobs. This is a clear evidence of adverse selection.

5 Agricultural sector: labor and land markets

In the agricultural sector, it is important to discuss land and labor markets together. Some labor contracts can be substituted with land contracts that are also used to share risk. This is the case of sharecropping, a common arrangement in Asia. The message of this section is that not only labor contracts but also land contracts are used in the agricultural sector to allocate risk between parties.

This section discusses three types of agricultural contracts between a landlord and a tenant: i) fixed wage contracts, ii) fixed rental contract, and iii) sharecropping
5.1 Fixed wage contract

In a fixed wage contract, the landlord hires the tenant and pays him a constant amount of money for performing certain tasks. Thus, the landlord becomes the sole residual claimant. The tenant is implicitly insured against any shock that occurs after labor services are provided (e.g., an unexpected decline in prices after the harvest).

A piece-rate contract is a type of fixed wage contract that is used when the outcomes of tasks are perfectly observed. This contract pays a constant amount of money for each unit produced. For example, in South America, grape harvest workers are paid by the volume of grapes they gather.

The functioning of a market where workers have piece-rate contracts is similar to the spot labor market described in section 3.1. Consequently, shocks that affect the production process before labor services are provided are likely to affect the worker’s labor income. There is no insurance in labor contracts against these shocks.

A time-rate contract is another form of fixed wage contract. The problem with this contract is that it creates pervasive incentives in the allocation of work effort and other inputs if tasks are difficult to monitor. Moral hazard problems can be severe in this case.

5.2 Fixed rental contract

In a fixed rental contract, the landlord receives a fixed amount of money for renting his land and the tenant is the sole residual claimant. This contract solves the moral hazard problem. The tenant has the correct incentives to efficiently allocate inputs and effort in the production process. The marginal benefits are fully appropriated by the tenant and can be compared with marginal costs. The problem with fixed rental contracts is that risks are fully allocated to tenants. This type of contracts is not an efficient risk-sharing agreement if tenants are more risk-averse or landlords have better access to consumption smoothing mechanisms.
5.3 Sharecropping

A sharecropping contract is an agreement in which the landlord rents his land to a tenant in exchange for a share of the crop produced. In relation to risk allocation, this contract is between the fixed-wage contract and the fixed-rental contract. In a sharecropping contract, part of the risk is allocated to the tenant and part to the landlord. For example, if a pest destroys part of the crop, the tenant’s payment to the landlord decreases in the same proportion the crop was destroyed.

A problem with sharecropping is that it may be inefficient. The sharecropper has incentives to allocate variable inputs below the social optimal level. The reason is that the sharecropper maximizes his profits when the marginal cost of inputs equals the private marginal benefit, which is only a fraction of the marginal productivity of the input. For example, if the sharecropping contract indicates that 50% of the output will be paid to the landlord, the sharecropper will use fertilizer only until the cost of an additional pound of fertilizer equals half the value of the marginal productivity of fertilizers.

The inefficiency of sharecropping arises from actions of the sharecropper that are not observable or are difficult to monitor by the landlord. If the inputs in the production process were observable, they would be included in the contract. Whether the actions of the sharecropper are easy to monitor or not is an empirical question. Using data from India, Shaban [1987] studies the efficiency of sharecropping with respect to input allocation. In the seven villages studied in the paper, 20% of households are involved in sharecropping and 5% in fixed-rent contracts. 80% of tenants also own some land.

Shaban’s idea to test if sharecropping is inefficient consists of comparing the level of inputs and output of plots controlled by the owner and plots controlled by sharecroppers. Owners are expected to choose the optimal level inputs. Since a large fraction of tenants also own some land, it is possible to analyze the decisions made by the same households in their own plots and in the plot where they are sharecroppers.
Shaban’s paper shows that plots controlled by owners produce 33% more than sharecropped plots. The level of inputs is also higher in their own plots in the order of 19% to 55%.

6 Government interventions and labor markets

The previous sections showed that there are limits to how well employers can insure employees against productivity shocks. Policies that directly or indirectly ease those limits can help improve the level of risk sharing and insurance embedded in contracts:

Access to financial markets: If firms have a better access to financial markets, they can diversify their portfolio and reduce the impact of productivity fluctuations on owners’ income (i.e. shareholders). The access to financial markets makes a firm more likely to act as a risk-neutral agent, even when shareholders are risk-averse. This helps firms offer labor contracts that better insure workers against productivity shocks. In other words, when firms have better financial instruments to diversify their portfolio, workers are expected to receive better contracts in terms of wage stability.

Enforcement of contracts: Even though the legal enforcement of contracts is not always necessary for risk-sharing contracts, in some industries and occupations it may certainly help. As previously explained, the insurer (i.e., the employer) has the incentive to renge the contract when the productivity shock occurs because risk-sharing contracts pay the workers below the marginal product in the absence of shocks and above it when shocks occur. Improving the enforcement of contract helps increase the level of risk sharing.

7 Empirical evidence: aggregate shocks

This section discusses previous evidence on the use of labor contract as a mechanism to share risk and discusses a couple of papers that test the existence of a contract equilibrium for aggregate productivity shocks. These papers show evidence in favor of a contract equilibrium
and against a spot market equilibrium.

Beaudry and DiNardo [1991] study the implicit contract hypothesis using U.S. data. The paper focuses on whether the movement of wages is more consistent with a contract market where employers insure workers against productivity shocks, or with a spot labor market. Three hypotheses are tested: i) contract labor market with mobile worker between employers, ii) contract labor market without mobile workers, and iii) spot labor market.

Beaudry and DiNardo’s paper derives testable implications from a dynamic model with risk-neutral entrepreneurs and risk-averse workers. The intuition is as follows. If the labor market functions as a spot market, wages should adjust to current labor market conditions. History should not matter for wage determination. But, in a labor market with risk-sharing contracts, past labor market conditions should be important determinants of wages. With limited mobility of workers between firms, the wage of a worker is negotiated only at the beginning of the contract and depends on the labor market conditions at that time. When worker are mobile, wages are negotiated at the beginning of the contract and each time labor market conditions improve to prevent workers from moving to other firms.

Labor market conditions in each period are approximated with the level of unemployment, which measures the labor market tightness. Beaudry and DiNardo indicate that movements in the unemployment rate follows aggregate productivity fluctuations. Then, the empirical strategy consists of estimating a Mincer-type equation with the unemployment rate among regressors.

\[
\ln w_{i,t} = x_{i,t}' \beta + \gamma U_i + \epsilon_{i,t} \tag{13}
\]

\[
U_i = \begin{cases} 
U_t & \text{spot market} \\
U_0 & \text{contract with costly mobility} \\
\min\{U_j\}_{j=0}^t & \text{contract with costless mobility}
\end{cases} \tag{14}
\]

Equation (13) indicates that the (log) wage of worker \(i\), \(t\) periods after his contract began,
depends on a vector of characteristics $x_{i,t}'$ that includes schooling, experience, marital status, industry, etc. and on the level of unemployment $U_i$ in the economy that applies to that worker according to the type of labor contract. If the labor market functions as a spot market, the wage $t$ periods after the contract began depends on current level of unemployment. But, in a contract labor market with costly mobility, contracts are negotiated when they are signed, so, the wage depends on the unemployment rate when the contract began. Finally, if workers can move between firms at no cost, the wage depends on the minimum level of unemployment since the contract began.

Table 2 presents some of the most important results of the paper. Each row is a separate regression. Only the coefficients of interest are reported. In the first three rows, each specification corresponds to alternative assumptions about the functioning of the labor market. The first row assumes a spot labor market. The second row assumes a contract market with costly mobility and the third row, a contract market with costless mobility. All the coefficients are negative and statistically significant as the theory predicts. But, the coefficient of the minimum unemployment rate since start of job is higher in absolute value. In row 4, the three theories are nested in the specification. The results suggest that a contract market with costless mobility is the most appropriate description of the U.S. labor market.
Table 2: spot market or contract market

<table>
<thead>
<tr>
<th></th>
<th>contemporaneous unemployment rate</th>
<th>unemployment at start of job</th>
<th>Minimum rate since start of job</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSID (levels)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.020</td>
<td></td>
<td>-0.030</td>
<td>-0.045</td>
</tr>
<tr>
<td>(0.002)</td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>0.000</td>
<td>0.013</td>
<td>-0.059</td>
<td></td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td>PSID (fixed effects)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.014</td>
<td></td>
<td>-0.021</td>
<td>-0.029</td>
</tr>
<tr>
<td>(0.002)</td>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>-0.007</td>
<td>-0.006</td>
<td>-0.029</td>
<td></td>
</tr>
<tr>
<td>(0.0025)</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td></td>
</tr>
</tbody>
</table>

source: Beaudry and DiNardo (1991)

More recently, Ham and Reilly [2002] propose another test for the implicit contract hypothesis. The advantage of this test is that it imposes less structure on the preferences of workers. More specifically, consumption and leisure are not required to be separable in the utility func-
tion. Ham and Reilly also use unemployment as a measure of aggregate productivity shocks. They distinguish between industry and occupation unemployment rate.

Ham and Reilly use data from the Panel Data of Income Dynamics (PSID) to test the implicit contract hypothesis in the U.S. Consistent with Beaudry and DiNardo’s conclusions, the results of the test indicate that the implicit contract hypothesis cannot be rejected.

Interestingly, in Ham and Reilly’s paper two other models of labor markets are tested in addition to implicit contracts, intertemporal substitution and hours restriction models. Using the same data, these two models are rejected. This indicates that the implicit contract hypothesis is a more accurate representation of labor markets not just when predictions are contrasted with a spot market.

8 Empirical evidence: idiosyncratic shocks

This section presents evidence on how labor contracts are used as an insurance mechanism against workers’ idiosyncratic productivity shocks. This section is based on Gutierrez [2012].

Using the Mexican Family Life Survey (MxFLS) (Rubalcava and Teruel [2007a], Rubalcava and Teruel [2007b]), Gutierrez presents a new test for an implicit contracts equilibrium against a spot labor market equilibrium. The paper uses acute illness as an indicator of productivity shock to test the predictions of the model. The intuition of the test is as follows. If a labor contract fully insures a worker against idiosyncratic productivity shocks, then illness episodes should not affect his/her remuneration. Illness decreases the worker’s productivity but the wage scheme of the contract implicitly insures the worker. This is the optimal contract derived in section 3.2 when firms are risk-neutral. However, although that the remuneration of the worker should not decrease with illness, it should depend on the ex-ante probability of getting sick. At the moment of offering a contract, the employer predicts the number of days the worker will be unable to work as a consequence of illness. A worker who is expected to be sick more often is offered a fixed-wage contract with a lower remuneration than a contract offered to a
more healthy worker. The test for implicit contracts consists of analyzing whether the worker’s remuneration decreases with illness shocks and whether it depends on the ex-ante probability of getting sick.

Note that if the labor market is closer to a spot market, like the one described in section 3.1, than to a contract market, then the predictions with respect to the impact of illness and the probability of getting sick on the worker’s remuneration is different. In a spot labor market, an illness shock temporarily decreases the productivity of the worker and his wage. But, the probability of getting sick should not affect his/her remuneration. In a spot labor market, the worker’s remuneration reflects the current realized productivity of the worker and is not associated with the future productivity of the worker.

The main estimating equation of the paper is derived from a simple theoretical model and is the following.

\[ \log(w_i) = \log(f'_i) + \beta_1 \text{male}_i + \beta_2 \text{sick}_i + \beta_3 \text{psick}_i + \beta_4 \text{psick}_i \times \text{male}_i + \mu_i \]  

Equation (15) is the wage equation for worker \(i\). \(\log(f'_i)\) is the marginal productivity of the worker when he/she is healthy. As is common in the literature, it is approximated with formal education and potential experience. The variable male is an indicator of the worker’s sex. The coefficient \(\beta_1\) captures standard discrimination and, if any, differences in productivity between male and female workers. The variable sick\(_i\) indicates whether the worker is sick, and psick\(_i\) is the ex-ante probability that the worker gets sick. The interaction of male and psick is included because women are expected to receive lower wages even when they have the same probability of getting sick than male workers. Because, if the average woman misses days at work not just when she gets sick but when other members of the family get sick, then the employer is expected to internalize it in the labor contract and reduce the wage in relation to a male worker of similar productivity. Although not shown here, the paper present clear evidence that women in Mexico act as caretakers of family members.
Nested in equation (15) are predictions of a spot labor market and the predictions of a contract market. If the labor market in Mexico is close to a spot labor market, then $\beta_2 < 0$ and $\beta_3 = \beta_4 = 0$. In other words, in a spot labor market, the wage equals the current productivity of the worker. Since illness is expected to decrease the productivity of the worker, when the worker gets sick her wage should decrease. But, if labor contracts are used allocate risk between the employer and the employee, then $\beta_2 = 0$, $\beta_3 < 0$, $\beta_4 > 0$.

8.1 Wage workers and self-employed workers

Self-employed workers are a natural control group for wage workers in equation (15). Risk-sharing contracts are possible only to wage workers. Self-employed workers are simultaneously the employer and the employee of the firm, so productivity fluctuations necessarily impact on earnings/profits. For this reason, the wages of self-employed workers should behave as if they were employed in the spot labor market.

Table 3 shows the main results of Gutierrez (2012). The first two columns show the results of a standard Mincer equation for wage workers and self-employed. As usual, wages are increasing in education and have an inverse U-shape profile on potential experience. Columns 3 and 4 show the result of estimating equation (15). For wage workers, the coefficient of the probability of getting sick is negative and the interaction of this variable with the gender indicator is positive. The coefficient of own illness is not statistically different from zero. This is consistent with a contract equilibrium where employers fully insure workers against idiosyncratic productivity shocks. The regression for self-employed workers correctly rejects the contract equilibrium. The probability of getting sick and its interaction with the gender dummy is not statistically different from zero. The specification in columns 5 and 6 is similar including locality characteristics among regressors. For self-employed workers the coefficient of own illness is negative and statistically different from zero. This is consistent with the predictions of a spot labor market.
<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>wage worker i</th>
<th>self-employed ii</th>
<th>wage worker iii</th>
<th>self-employed iv</th>
<th>wage worker v</th>
<th>self-employed vi</th>
</tr>
</thead>
<tbody>
<tr>
<td>secondary</td>
<td>0.466***</td>
<td>0.554***</td>
<td>0.464***</td>
<td>0.550***</td>
<td>0.376***</td>
<td>0.405***</td>
</tr>
<tr>
<td></td>
<td>(0.0238)</td>
<td>(0.0666)</td>
<td>(0.0333)</td>
<td>(0.0732)</td>
<td>(0.0292)</td>
<td>(0.0649)</td>
</tr>
<tr>
<td>college</td>
<td>1.172***</td>
<td>1.280***</td>
<td>1.165***</td>
<td>1.277***</td>
<td>1.040***</td>
<td>1.056***</td>
</tr>
<tr>
<td></td>
<td>(0.0342)</td>
<td>(0.0987)</td>
<td>(0.0452)</td>
<td>(0.116)</td>
<td>(0.0409)</td>
<td>(0.105)</td>
</tr>
<tr>
<td>potential experience</td>
<td>0.0412***</td>
<td>0.0292**</td>
<td>0.0411***</td>
<td>0.0302**</td>
<td>0.0405***</td>
<td>0.0287**</td>
</tr>
<tr>
<td></td>
<td>(0.00353)</td>
<td>(0.0120)</td>
<td>(0.00321)</td>
<td>(0.0124)</td>
<td>(0.00322)</td>
<td>(0.0121)</td>
</tr>
<tr>
<td>potential experience sq/100</td>
<td>-0.0695***</td>
<td>-0.0414</td>
<td>-0.0691***</td>
<td>-0.0437*</td>
<td>-0.0702***</td>
<td>-0.0403</td>
</tr>
<tr>
<td></td>
<td>(0.00838)</td>
<td>(0.0253)</td>
<td>(0.00770)</td>
<td>(0.0249)</td>
<td>(0.00752)</td>
<td>(0.0246)</td>
</tr>
<tr>
<td>male</td>
<td>0.0336*</td>
<td>0.203***</td>
<td>-0.0976*</td>
<td>0.268***</td>
<td>-0.0550</td>
<td>0.326***</td>
</tr>
<tr>
<td></td>
<td>(0.0196)</td>
<td>(0.0575)</td>
<td>(0.0565)</td>
<td>(0.0798)</td>
<td>(0.0537)</td>
<td>(0.0794)</td>
</tr>
<tr>
<td>year 2005</td>
<td>0.191***</td>
<td>0.306***</td>
<td>0.192***</td>
<td>0.309***</td>
<td>0.208***</td>
<td>0.282***</td>
</tr>
<tr>
<td></td>
<td>(0.0169)</td>
<td>(0.0547)</td>
<td>(0.0375)</td>
<td>(0.0842)</td>
<td>(0.0320)</td>
<td>(0.0707)</td>
</tr>
<tr>
<td>psick</td>
<td>-1.496*</td>
<td>0.644</td>
<td>-1.678**</td>
<td>0.492</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.763)</td>
<td>(0.666)</td>
<td>(0.689)</td>
<td>(0.685)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male * psick</td>
<td>2.052***</td>
<td>-0.731</td>
<td>1.698**</td>
<td>-0.501</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.783)</td>
<td>(0.642)</td>
<td>(0.726)</td>
<td>(0.657)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>own illness</td>
<td>0.000122</td>
<td>-0.184</td>
<td>0.01000</td>
<td>-0.228**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0426)</td>
<td>(0.117)</td>
<td>(0.0420)</td>
<td>(0.108)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.914***</td>
<td>1.722***</td>
<td>2.024***</td>
<td>1.660***</td>
<td>2.209***</td>
<td>1.988***</td>
</tr>
<tr>
<td></td>
<td>(0.0419)</td>
<td>(0.147)</td>
<td>(0.0777)</td>
<td>(0.166)</td>
<td>(0.0736)</td>
<td>(0.166)</td>
</tr>
</tbody>
</table>

locality characteristics: No, Yes
Observations: 8,602, 1,869, 8,523, 1,846, 8,245, 1,812
R-squared: 0.170, 0.132, 0.170, 0.134, 0.195, 0.175

Clustered standard error in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

locality characteristics include population size and fraction of labor force in agriculture.
8.2 Firm’s size

In section 3.3, the assumption that firms are risk-neutral was questioned. However, it was argued that a firm is more likely to act as a risk-neutral agent if it is large. This section analyzes how the introduction of a firm size variable modifies the results for Mexico.

In large firms, the absence of a worker is expected to have a minor impact on production. Some of the tasks assigned to him can be temporarily performed by other workers within the establishment. But, in small firms, each worker represents an important part of the workforce. His absence may significantly hurt the production process. If small firms do not fully insure workers, the coefficient of own illness in equation (15) should be negative when firm size is included among regressors.

Table 4 results suggest that even small firms fully insure workers against idiosyncratic productivity shocks. The coefficient of own illness remain statistically zero.
Table 4: Impact of firm size
Dep Var: log hourly earnings

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>wage worker</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
<td>ii</td>
<td></td>
</tr>
<tr>
<td>secondary</td>
<td>0.361***</td>
<td>0.448***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0304)</td>
<td>(0.0337)</td>
<td></td>
</tr>
<tr>
<td>college</td>
<td>1.012***</td>
<td>1.131***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0423)</td>
<td>(0.0452)</td>
<td></td>
</tr>
<tr>
<td>potential experience</td>
<td>0.0412***</td>
<td>0.0407***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00333)</td>
<td>(0.00338)</td>
<td></td>
</tr>
<tr>
<td>potential experience sq/100</td>
<td>-0.0720***</td>
<td>-0.0682***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00771)</td>
<td>(0.00792)</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>-0.0667</td>
<td>-0.0988*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0553)</td>
<td>(0.0590)</td>
<td></td>
</tr>
<tr>
<td>year 2005</td>
<td>0.218***</td>
<td>0.201***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0328)</td>
<td>(0.0380)</td>
<td></td>
</tr>
<tr>
<td>psick</td>
<td>-2.421***</td>
<td>-1.957**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.794)</td>
<td>(0.921)</td>
<td></td>
</tr>
<tr>
<td>male * psick</td>
<td>1.668*</td>
<td>1.395</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.875)</td>
<td>(0.969)</td>
<td></td>
</tr>
<tr>
<td>own illness</td>
<td>-0.00624</td>
<td>0.00602</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0785)</td>
<td>(0.0782)</td>
<td></td>
</tr>
<tr>
<td>log firm size</td>
<td>0.0210*</td>
<td>0.0285**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0116)</td>
<td>(0.0131)</td>
<td></td>
</tr>
<tr>
<td>log firm size * psick</td>
<td>0.293*</td>
<td>0.205</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
<td>(0.180)</td>
<td></td>
</tr>
<tr>
<td>log firm size * male * psick</td>
<td>0.0577</td>
<td>0.264</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.210)</td>
<td>(0.226)</td>
<td></td>
</tr>
<tr>
<td>log firm size * own illness</td>
<td>0.0108</td>
<td>0.00639</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0327)</td>
<td>(0.0324)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.168***</td>
<td>1.968***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0785)</td>
<td>(0.0866)</td>
<td></td>
</tr>
</tbody>
</table>

locality characteristics Y N
Observations 7782 7782
R-squared 0.202 0.180

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

locality characteristics include size and fraction of labor force in agriculture.
9 Summary and conclusions

This paper studied the role of labor contracts as a mechanism to allocate risks between employers and employees. It was shown that a contract equilibrium may dominate a spot labor market equilibrium. However, there are limits associated with costly enforcement of contracts and problems of adverse selection.

The evidence suggests that firms offer contracts that provide insurance against productivity shocks. This seems to be case for both aggregate shocks and idiosyncratic productivity shocks.
References


