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ABSTRACT

We study the design of optimal unemployment protection schemes to evaluate its impact on labor markets, welfare and productivity. We consider a life-cycle economies with formal and informal labor markets, unobservable effort to find and keep formal jobs, and unobservable heterogeneities across worker to find better formal jobs.

We analyze the first best allocation to compare with the allocations stemming from the implementation of two alternative schemes: (i) a simple unemployment insurance system with a defined profile of unemployment benefits; (ii) an unemployment insurance saving account scheme parameterized by a replacement rate, an initial contribution to the saving account, a minimum level of savings at which the payment is suspended, and a maximum level of savings at which the contributions are suspended.

Our quantitative analysis makes clear that both schemes can have a significant impact on welfare and productivity. Two additional lessons can be learned. First, no scheme is necessarily better in both economies. Second, a reform that implements an scheme that it is welfare improving does not necessarily boost productivity and viceversa.

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INFORMALIDAD Y PRODUCTIVIDAD: EL ROL DE LOS ESQUEMAS DE SEGURO DE DESEMPLEO

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RESUMEN

Estudiamos el diseño de esquemas óptimos de seguro de desempleo para evaluar el impacto sobre los mercados laborales, el bienestar y la productividad. Consideramos una economía de ciclo de vida con mercados laborales formales e informales, esfuerzo inobservable para encontrar y mantener un empleo formal, y heterogeneidad inobservable entre trabajadores para encontrar un mejor empleo formal.

Analizamos la asignación óptima en comparación con asignaciones derivadas de la implementación de dos esquemas alternativos: (i) un sistema sencillo de seguro de desempleo con un perfil definido de beneficios; (ii) un esquema de cuenta de ahorro parametrizado por una tasa de reemplazo, una contribución inicial a la cuenta de ahorro, un nivel mínimo de ahorro al que se suspende el pago y un nivel máximo de ahorro al que se suspenden las contribuciones. Nuestro análisis cuantitativo deja claro que ambos esquemas pueden tener un impacto significativo en el bienestar y la productividad. Se pueden aprender dos lecciones adicionales. En primer lugar, ningún esquema es necesariamente mejor en ambas economías. En segundo lugar, una reforma que implementa un esquema que mejora el bienestar no necesariamente aumenta la productividad y viceversa.

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Informality and Productivity: The Role of Unemployment Insurance Schemes*

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Abstract

We study the design of optimal unemployment protection schemes to evaluate its impact on labor markets, welfare and productivity. We consider a life-cycle economies with formal and informal labor markets, unobservable effort to find and keep formal jobs, and unobservable heterogeneities across worker to find better formal jobs.

We analyze the first best allocation to compare with the allocations stemming from the implementation of two alternative schemes: (i) a simple unemployment insurance system with a defined profile of unemployment benefits; (ii) an unemployment insurance saving account scheme parameterized by a replacement rate, an initial contribution to the saving account, a minimum level of savings at which the payment is suspended, and a maximum level of savings at which the contributions are suspended.

Our quantitative analysis makes clear that both schemes can have a significant impact on welfare and productivity. Two additional lessons can be learned. First, no scheme is necessarily better in both economies. Second, a reform that implements an scheme that it is welfare improving does not necessarily boost productivity and viceversa.

Keywords: Unemployment Insurance, Moral Hazard, Informality, Hidden Savings, Productivity.
JEL classification: D82, H55, I38, J65.

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1 Introduction

Latin America has not converged to per capita income levels of developed countries, and consequently alternative measures of total factor productivity are well behind (see Alvarez-Parra, F. A. and M. Toledo. (2016)). In most of these countries, a large share of labor market relationships cannot be monitored by governments and this can promote informality. The informal sector in LA countries produces between 25 to 76 percent of gross domestic product (GDP) (Schneider and Enste, 2000).¹ The fact that these low productivity activities are hard to monitor by the government hints that the implications of the design of UI schemes in terms of occupational choices and so productivity are fundamental. Hence, this feature of labor market might have not only a significant negative impact on aggregate productivity but also represents a challenge for the provision of unemployment insurance.

Alternative unemployment insurance schemes are high on the policy agendas of many governments for which labor market informality is a critical matter to understand the link between informality and productivity. Proposals range from the abolition of labor taxes to changes in the form of unemployment protection.

We study the design of optimal protection schemes within a class in economies with high informality to evaluate its impact on labor markets, welfare and productivity. We consider economies that display several key features that are fundamental to analyze the LA case. First, individuals income in formal and informal labor markets change during their life cycle. This feature is key to quantify the role played by savings and alternative features of the credit market. Second, individuals must exert effort to find and keep formal jobs, and that effort cannot be monitored by the government. Third, some individuals are more able to work in the formal sector as their technology to find them is better; i.e. their cost of searching is lower.

There are three distinct components in an optimal policy for the unemployed in this setting: first, insuring workers against uncertainty in the prospect of finding a job; second, providing workers with the liquidity to smooth consumption while unemployed and in early ages; third, insuring workers against being less efficient to find good jobs. The distinction between the first two ingredients were discussed, among others, by Feldstein and Altman (1998), Feldstein (2005) and Shimer and Werning (2008). The third component has more subtle implications for the optimal design of alternative schemes as it can add a new margin of tension to provide incentives and insurance.

We first study the key features of an economy in which there is no informational friction,

¹In particular, about 33% of the labor force in Latin America reports being employed in a business of their own—mostly subsistence self-employment (in contrast, 9% in the United States). Moreover, salaried employees constitute 80% of the work force in the US but only 55% in Latin America.

i.e. both effort and informal jobs opportunities are observable as well as workers' type, and so full-insurance is attainable. This framework is key as a benchmark to identify the sources of potential inefficiencies and quantify the impact of the implementation of alternative schemes, both in terms of utility and productivity. Ex-ante optimality dictates that workers are fully insured against both employment shocks and also type shocks; consumption is constant through time and states of nature and also across workers' types.

We identify three dimensions of inefficiencies in which an equilibrium allocation can be distorted and so the design of an optimal system should alleviate to increase welfare. We concentrate in the following channels: intertemporal smoothing, redistributive issues and insurance for the risk of unemployment. The intertemporal channel relates with the shape of the wage profile and the lack of a more sophisticated credit market. Since salaries are, in average, increasing with age, agents would like to bring future incomes to their early ages in order to smooth consumption. However, as the access to credit market will be limited, they have no way to instrument this intertemporal transfer. So, an optimal scheme might need to subsidize young workers' consumption; i.e. a key role for liquidity provision.

The redistributive channel relates to the lack of insurance market against workers' type; i.e. their unobservable ability to find high productivity formal jobs. Since efficient workers can find a higher formal wage with less effort, in order to maximize the ex-ante welfare, it is optimal to redistribute consumption from efficient to inefficient workers. That is, an optimal scheme must provide cross-subsidies between types.

Finally, an optimal scheme must try to alleviate the income volatility stemming from the possibility of losing a job and becoming unemployed; i.e. insurance for the risk of unemployment. Again, a contingent market could solve this problem, but its existence is not possible due to the unobservability of informality and worker's types.

Then, we analyze the implementation of two alternative unemployment protection schemes in order to study their quantitative implications.

We first introduce a simple unemployment insurance scheme that captures most of the main features of the status quo in the economies under analysis. We assume that an individual who has been working in the formal sector at age $n - 1$, and losses his or her job at age n , receives an insurance payment during J periods. Rejected formal job offers are unobservable by the government. When the worker retires, the government provides d every period as retirement payment.

Secondly, we introduce an unemployment insurance saving account scheme parameterized by a replacement rate, which determines UI payments, an initial contribution to the saving account, a minimum level of savings at which the payment is suspended, and a maximum level of savings at which the contributions are suspended.

We perform quantitative exercises for economies calibrated to Argentina and Mexico under several scenarios. For the case of Argentina, the provision of liquidity is the most beneficial policy as it attains 44% of total potential welfare gains while the most perjudicial is the implementation of UISA with no private credit markets as it decreases utility by 67%. However, the implementation of UISA with unmonitored private credit markets (i.e. hidden savings) increases welfare by 43%. The implementation of UI with no liquidity transfer has modest positive impact, 3%, with the peculiarity that unemployment benefits are increasing with the unemployment spell.

In terms of productivity, the comparison between benchmark and the first best shows that there is some room to efficiently increase TFP; a bit higher than 1%. Remarkable, the implementation of any scheme with positive welfare implications has a negative impact on TFP.

For the case of Mexico, the implementation of an UISA in which savings are observable is the most beneficial policy as it attains 47% of total potential welfare gains while the less beneficial is the implementation of an UI with no liquidity transfers as it increases utility modestly by 6.9%. In this case, unemployment benefits are decreasing with the unemployment spell. The implementation of UISA with unmonitored private credit markets (i.e. hidden savings) increases welfare by 21.1%.

In terms of productivity, the comparison between benchmark and the first best shows that there is significant room to efficiently increase TFP; almost 13%. In contrast with the Argentinean case, the implementation of any scheme with positive welfare implications has a positive impact on TFP, most remarkably the UISA with monitored private savings would imply TFP gains of about 16%.

Related Literature

These is an large literature studying the optimal contracting approach to unemployment insurance starting from Shavell and Weiss (1979). The most prominent example is Hopenhayn and Nicolini (1997). They conclude that unemployment benefits should decline during an unemployment spell and wage taxes should increase after reemployment with the length of the unemployment spell. Most of this literature assumes that individuals are homogenous in their employability and all their savings and employment opportunities are observable. This paper relaxes those assumptions and, instead of theoretically characterizing the constrained efficient allocation, studies the impact of implementing the two alternative unemployment insurance schemes mentioned.

Employability heterogeneity has been highlighted recently by Mustre-del-Rio (2015). In particular, it shows that heterogeneity in the disutility of work, which captures permanent

differences in labor supply, is required to generate empirically valid employment patterns. This ex-ante heterogeneity poses a challenge to the design of optimal unemployment insurance, since the government does not longer knows how an individual's effort affects his chances of finding a job. Fuller (2014) shows that relaxing the assumption that the unemployment insurance agency knows the utility costs of exerting effort substantially modifies the optimal contract and that considering that heterogeneity is quantitatively important in terms of welfare.

The role of hidden savings has been highlighted Rogerson (1985), who shows that preventing the individual from entering the asset market is critical since in the optimal contract with moral hazard, as those proposed by Shavell and Weiss (1979) and Hopenhayn and Nicolini (1997), the unemployed is actually willing to save. The observability of individual savings is an assumption that is questionable even for developed countries, since households have always the option of storage, which is very hard to observe for the government. While perfect observability of savings is widespread in the literature on optimal allocation with private information, two notable exceptions are Cole and Kocherlakota (2001) and Abraham and Pavoni (2008). Cole and Kocherlakota (2001) show that the constrained efficient allocation with hidden savings coincides with an economy in which agents can only self-insurance themselves with precautionary savings, In contrast, Abraham and Pavoni (2008) show that the constrained efficient allocation can do better than that if the individuals' effort affect their future income. In both cases, however, the existence of hidden savings hinders the ability of providing insurance for the unemployed. In a McCall (1970)'s model in which the worker can borrow and lend a risk-free bond, Shimer and Werning (2008) show that, with CARA preferences, constant benefits and optimal unemployment insurance are equivalent. In addition, with CRRA preferences, they show numerically that restricting the unemployment insurance agency to use a constant benefit policy imposes small costs when savings are unobservable.

Lastly, another important assumption in this literature is that employment is an observable state. As informal employment is an unobservable, workers can claim unemployment insurance benefits and, at the same time, work in the informal sector. However, recent research has focused on studying the optimal UI if there is an informal sector that allows unemployed individuals to secretly work in the informal sector and, simultaneously, ask for unemployment benefits. In particular, Alvarez-Parra and Sanchez (2009) argue that the existence of a hidden labor market modifies the optimal UI in a nontrivial way. The optimal contract has two phases: (i) unemployment benefits decrease very slowly to encourage workers to search for a job instead of working in the informal sector, and (ii) after several months of unemployment, benefits decline abruptly to zero. Since the optimal design

involves payments and taxes that depend on the history of workers' labor market decisions and earnings, an unemployment insurance saving account (UISA) seems a reasonable scheme to implement such a contract. In particular, Espino and Sanchez (2013) show that about 40 percent of a new borns welfare gains between the benchmark economy and the full insurance economy can be delivered with a simple UISA scheme. In addition, that UISA scheme would decrease the size of the informal sector. The last result, however, depends heavily on the government ability to control households savings.

Espino and Sanchez (2015) use a simple model to study the optimal design of unemployment insurance and employment protection. Workers are risk averse and face the possibility of unemployment. Firms are risk neutral and face random shocks to productivity. Workers can participate in a shadow economy, or informal sector. Countries should encourage formal employment to address the issue of informal employment by means of relatively high severance payments and negative payroll taxes. Along these same lines, unemployment payments cannot be too large.

Finally, the introduction of UISAs in the US economy is studied by Feldstein and Altman (1998) using Panel Study of Income Dynamics. Their findings indicate that this proposal has a large impact in terms of improving incentives. A similar exercise is performed by Vodopivec and Rejec (2001) using data of the Estonian labor market. Hatchondo and Hopenhayn (2002) complement the work of Vodopivec and Rejec (2001) by providing welfare calculations of alternative UISA designs for the Estonian labor market. In their model, the only friction is moral hazard arising from the facts that the government cannot observe if workers quit jobs and unemployed individuals reject job offers. Related, Setty (2016) studies the implementation in the United States of a hybrid system that combines unemployment insurance and UISAs, and finds significant welfare gains of that program.

2 The Environment

Each period $t = 0, 1, 2, 3, \dots$, a new ex-ante identical generation of N_t individuals is born. The population growth rate is constant at $x \geq 0$; i.e. $N_t = (1 + x)^t$. Each of these households has the following lifetime profile.

During the first N periods agents can participate in labor markets and work (i.e. working periods). When an individual reaches age $N + 1$, he retires from the labor market. Once retired, individuals survive to the next period with probability ρ .

Workers have heterogenous abilities to find high productivity jobs. This is represented by the disutility of search effort, where $\theta \in \{\underline{\theta}, \bar{\theta}\}$. The fraction of workers with θ ability is given by $g(\theta) > 0$, and $\underline{\theta} < \bar{\theta}$ can be interpreted as skill and unskilled workers, respectively.

This margin of heterogeneity is key for the analysis herein, and it is discussed in more detail below.

In each date t and given θ , the worker's date- t utility depends on consumption c_t and the corresponding effort level e_t , according to the utility function $u(c_t) - \theta e_t$. Lifetime expected discounted utility for an individual with preference shock θ is represented by

$$E \left\{ \sum_{t=1}^{\infty} \beta^t [u(c_t) - \theta e_t] \right\}$$

where $\beta \in (0, 1)$ is the discount factor and E is the expectation operator.

2.1 Labor Market Decisions

We define the labor market decisions faced by an individual during his working periods. An individual of working age $n = 1, \dots, N$ can either work in the formal sector, work in the informal sector, or be unemployed. The employment decisions in those three different states are the following.

First, consider a worker who enters his working period n with an offer in the formal sector. The worker's wage offered, denoted ω_n , is his productivity in the formal sector. As the offer is accepted, a worker who exerts effort e keeps this job in the formal sector next period with probability $q_f(e)$.

Second, consider a worker who enters his working period n with an offer in the informal sector. The worker's wage will equal his productivity in the informal sector, $\varpi_n < \omega_n$. If he accepts this offer, he must decide how much effort e to exert to receive an offer in the formal sector next period, with probability $q_i(e)$. Importantly, informal job offers are not only low productivity jobs but also unobservable to third parties.

Finally, consider a worker who enters his working period n as unemployed; i.e., he does not receive either a formal or an informal job offer. The worker decides how much effort e to exert to receive an offer in the formal sector next period, with probability $q_u(e)$. Any rejected offer will make the worker unemployed immediately.

We assume that a worker can receive offers in both sectors at the same time. Therefore an active worker's opportunity status is denoted by $\{f, i, b, u\}$, which denote formal, informal, and both offers and unemployed states, respectively.

The technology to find a job in the formal sector satisfies $q_f(e) > q_u(e) > q_i(e)$ for all e . So effort is most productive to find a formal job if the worker is already in this sector. On the other hand, working in the informal sector makes effort less productive than being unemployed. So workers choose a costly effort level e that translates in receiving a formal sector offer with probabilities increasing in e . This is a key feature when effort is

unobservable because it implies that if individuals receive insurance against not having a formal job they will have incentives to reduce effort; i.e., moral hazard.

The probabilities for a worker of age n to find a job in the informal sector are all exogenous but conditional upon the current employment status. The conditional probability of having an offer in the informal sector next period if the worker has worked informally during the current period is p_i ; that is, $1 - p_i$ is the separation rate in the informal sector. The conditional probability of having an offer in the informal sector next period if the worker has been unemployed in the current period is p_u . Finally, p_f is the conditional probability of having an offer in the informal sector next period if the worker has worked in the formal sector during the current period. We assume that $p_i > p_u > p_f$ for all n ; i.e. informality is persistent as informal offers tomorrow are most likely if working informally today.

So there are two technological differences between the formal and the informal sector. Worker are more productive (and so wages are higher) in the formal sector than in the informal sector.

2.2 Financial Markets

Both agents and the government have access to financial markets. Agents must also undertake consumption-savings decisions. That is, an agent must allocate his resources (which will include financial income, as detailed below) between consumption and savings. There are two assets to save which differ in the account observability. Individuals can save at the gross interest rate R in observable saving accounts.

Alternatively, there is an asset with a lower return $r \leq R$ but the amount saved in that asset is unobservable. The only reason the worker would demand this instrument is to avoid monitoring by the government. Other than that, as both financial instruments are available, he chooses to save by means of the high return asset. These unobservable savings can be thought of as investment opportunities or other forms of asset accumulation that are typically not observable by the government.

Once retired (i.e., age $n \geq N + 1$), this is the only decision they must make. We assume that the retired worker can trade a mortality contingent claim, at the price η , which pays 1 unit of the consumption good as the worker survives and 0 otherwise. Agents are endowed with $m_0 \geq 0$ when they are born.

The role of savings in this setting is key. Once a worker knows his type, the only source of risk is unemployment risk. So workers save for precautionary purposes and, if retirement benefits are low relative to employment income, they also save for retirement.

2.3 The Retired Worker's Problem

Retired workers always face the same problem at age $n \geq N+1$. Suppose that this individual survives and reaches period n with m asset holdings, and receives a transfer $h \geq 0$ from the government as a retirement payment. Denote $H(m)$ as his expected lifetime utility and so, as retired agents survive with probability ρ , H must solve

$$H(m) = \max_{m' \geq 0} [u(m + h - \eta m') + \beta \rho H(m')] \quad (1)$$

where m' denote next period asset holdings; i.e. the amount of mortality contingent securities that pays 1 unit of the consumption good in case of survival.² Notice that retired agents do not exert any effort; i.e. $e_t = 0$ for all $t \geq N + 1$.

3 Full information

We first study the key features of an economy in which there is no informational friction, i.e. both effort and informal jobs opportunities are observable, and so full-insurance is attainable. To characterize the optimal allocation we consider the problem of a planner who allocates consumption and effort while it has access to credit markets at the gross interest rate $R = \beta^{-1} = (1 + x)$.³

3.1 The Ex-Ante Representative Worker's Problem

The problem faced by retired workers has been analyzed in (2.3), and as the problem is time-consistent, H is given by (1) in which we assume that $h = 0$ without loss of generality. Notice that the fact that agents can sign mortality contingent claims makes financial markets dynamically complete for retired workers and so they allocate resources efficiently.

Let $s_n \in \{f, i, b, u\}$ be the worker's job opportunity at age n . Let s^n denote a partial history up to age n with $\pi(s^n)$ as its corresponding (endogenous) probability. The planner insures the representative worker ex-ante (i.e. before his type θ has realized) and therefore the corresponding problem is the following.

$$\begin{aligned} \max_{((\tau_n, e_n)_{n=1}^N, m)} \sum_{\theta} \sum_{n=1}^N \sum_{s^n} \left\{ \beta^{n-1} \pi(s^n) [u(w_{\theta, n}(s^n) + \tau_n(\theta, s^n)) - \theta e_n(\theta, s^n)] \right. \\ \left. + \sum_{s^N} \beta^N \pi(s^N) H(m(\theta, s^N)) \right\} g(\theta), \end{aligned} \quad (2)$$

²In our setting with CRRA, as the budget constraint is homogeneous of degree one if $h = 0$ then H has closed form solution in this case; i.e. $H(w) = A (m)^{1-\sigma}$ for some constant $A > 0$.

³This assumption is not innocuous as it is key to make the alternative schemes comparable and immune to differences in returns.

subject to

$$\sum_{\theta} \left\{ \sum_{n=1}^N \sum_{s^n} (1+x)^{-(n-1)} \pi(s^n) \tau_n(\theta, s^n) + \sum_{s^N} (1+x)^{-N} \pi(s^N) m(\theta, s^N) \right\} g(\theta) \quad (3)$$

$$= m_0 - S^{UI},$$

where S^{UI} is defined below.

That is, in this stationary environment the fictitious planner can manipulate all the cross-sectional resources to maximize the ex-ante utility of the representative worker. The following result follows from first order conditions in problem (2).

Lemma 1 *Under full information, full insurance is attained and so consumption and period $N+1$ asset holdings are constant; i.e. $c_n(\theta, s^n) = c^*$ and $m(\theta, s^N) = m^*$ for all $n = 1, \dots, N$, all s^n and all θ .*

So optimality dictates that workers are fully insured against both employment shocks and also preference shocks.

Let λ^* be the Lagrange multiplier corresponding to the constraint (4). It follows from necessary first order conditions that $\lambda^* = u'(c^*) = H'(m^*)$ while the envelope condition implies that $H'(m^*) = u'(c_R^*)$ where c_R^* stands for the consumption of the retired worker. Hence, $c^* = c_R^*$ and so $m^* = (1 - \rho\beta)c^*$ and $H(m^*) = \frac{u'(c^*)^{1-\sigma}}{1-\rho\beta}$. These facts make the planner's problem (2) simplify as follows.

Lemma 2 *Given λ^* , problem (2) reduces to solve*

$$\max_{(\tau_n, w_n, e_n)_{n=1}^N} \int_{\theta} \sum_{n=1}^N \sum_{s^n} R^{-(n-1)} \pi(s^n) [\lambda w_n(s^n) - \theta e_n(s^n)] g(\theta)$$

$$+ \lambda^* R^{-N} m^* - \lambda^* \frac{1 - R^{-N+1}}{1 - R^{-1}} c^* + \frac{1 - R^{-N+1}}{1 - R^{-1}} u(c^*) + R^{-N} H(m^*).$$

i.e., it reduces to maximize the expected discounted flow of income net of the cost of effort, in utility units.

This problem becomes non-standard as the planner must undertake the discrete choice about whether the worker should make use of alternative job opportunities or not. The difficulty is not only when a low productivity, informal job opportunity arrives. The opportunity of a formal job, either alone or jointly with an informal opportunity, does not make the optimal choice simpler either. To see this, notice that although both the worker's productivity (and so his wage) is high and also the technology to find a high productivity, formal job next period dominates, the higher probability of becoming unemployed can make the option of formal job undesirable. This will critically depend on the low value of being unemployed. All these facts are key to determine the optimal size of the informal sector. To tackle these issues, we solve the problem backwards.

3.2 Characterization

Suppose that the last period N one or two job opportunities are available. As a type- θ worker needs not to do any effort as he will be retired next period, the optimal choice is to make the individual work in the sector with higher productivity.

Period $N - 1$

In the case that there is no job opportunity, the worker remains unemployed and the optimal values and an effort level satisfy

$$\begin{aligned}\phi_{N-1}(\theta, u) &= [-\theta \tilde{e}_{N-1}(\theta, i^r)] \\ &\quad + \beta \lambda^* (q_u(\tilde{e}_{N-1}(\theta, i^r))w_f + (1 - q_u(\tilde{e}_{N-1}(\theta, i^r)))p_u w_i),\end{aligned}$$

where $\tilde{e}_{N-1}(\theta, u)$ is uniquely determined by

$$\theta = \beta \lambda^* q'_u(\tilde{e}_{N-1}(\theta, i^r))(w_f - p_u w_i).$$

.

Suppose first that a formal job opportunity is drawn at period $N - 1$. The optimal choice must satisfy:

$$\phi_{N-1}(\theta, f) = \max\{\phi_{N-1}(\theta, f^a), \phi_{N-1}(\theta, u)\}$$

and $\tilde{e}_{N-1}(\theta, f)$ is corresponding optimal level of effort. If the worker is allocated to work in the formal sector

$$\begin{aligned}\phi_{N-1}(\theta, f^a) &= [\lambda^* w_{N-1, f} - \theta \tilde{e}_{N-1}(\theta, f)] \\ &\quad + \beta \lambda^* (q_f(\tilde{e}_{N-1}(\theta, f^a))w_f + (1 - q_f(\tilde{e}_{N-1}(\theta, f^a)))p_i w_i),\end{aligned}$$

where $\tilde{e}_{N-1}(\theta, f^a)$ is uniquely determined by

$$\theta = \beta \lambda^* q'_f(\tilde{e}_{N-1}(\theta, f^a))(w_f - p_i w_i).$$

Alternatively, if the worker is not making use of that job opportunity, he remains unemployed.

Similarly, if an informal job opportunity is drawn, the optimal choice must satisfy

$$\phi_{N-1}(\theta, i) = \max\{\phi_{N-1}(\theta, i^a), \phi_{N-1}(\theta, u)\}$$

and $\tilde{e}_{N-1}(\theta, i)$ is corresponding level of effort. Here if the worker is allocated to work in that sector

$$\begin{aligned}\phi_{N-1}(\theta, i^a) &= [\lambda^* w_i - \theta \tilde{e}_{N-1}(\theta, i^a)] \\ &\quad + \beta \lambda^* (q_i(\tilde{e}_{N-1}(\theta, i^a)) w_f + (1 - q_i(\tilde{e}_{N-1}(\theta, i^a))) p_i w_i),\end{aligned}$$

as $\tilde{e}_{N-1}(\theta, i^a)$ is uniquely determined by

$$\theta = \beta \lambda^* q'_i(\tilde{e}_{N-1}(\theta, i^a))(w_f - p_i w_i).$$

Alternatively, if the worker is not making use of that job opportunity, he remains unemployed.

Finally, if both job opportunities are available, the optimal choice must satisfy $\phi_{N-1}(\theta, b) = \max\{\phi_{N-1}(\theta, f), \phi_{N-1}(\theta, i), \phi_{N-1}(\theta)\}$.

Backward induction

Consider now any working period $1 \leq n < N - 1$ and notice that as we are solving this backwards, all the decisions regarding allocation of effort and jobs have been already made for any working period $t \geq n$. Let $\phi_{n+1}(\theta, s')$ be the next period net wealth for $s' \in \{f, i, b, u\}$.

If the worker receives a formal job opportunity the optimal choice then satisfies

$$\phi_n(\theta, f) = \max\{\phi_n(\theta, f^a), \phi_n(\theta, u)\}$$

and so $\tilde{e}_n(\theta, f)$ is corresponding optimal level of effort.

If the planner allocates the worker to this high productivity job, then

$$\begin{aligned}\phi_n(\theta, f^a) &= [\lambda^* w_f - \theta \tilde{e}_n(\theta, f^a)] + \beta (q_f(\tilde{e}_n(\theta, f^a)) \phi_{n+1}(\theta, f) \\ &\quad + [1 - q_f(\tilde{e}_n(\theta, f^a))] [p_f \phi_{n+1}(\theta, i) + (1 - p_f) \phi_{n+1}(\theta, u)])\end{aligned}$$

where $\tilde{e}_n(\theta, f^a)$ is uniquely determined by

$$\theta = \beta \lambda^* q'_f(\tilde{e}_n(\theta, f^a)) (\phi_{n+1}(\theta, f) - (p_f \phi_{n+1}(\theta, i) + (1 - p_f) \phi_{n+1}(\theta, u))).$$

If the worker receives an informal job opportunity, the optimal choice then satisfies

$$\phi_n(\theta, i) = \max\{\phi_n(\theta, i^a), \phi_n(\theta, u)\}$$

where $\tilde{e}_n(\theta, i)$ is corresponding optimal level of effort.

As the worker is allocated to this low productivity, informal job, the value is

$$\begin{aligned}\phi_n(\theta, i^a) &= [\lambda^* w_i - \theta \tilde{e}_n(\theta, i^a)] + \beta(q_i(\tilde{e}_n(\theta, i^a))\phi_{n+1}(\theta, f) \\ &\quad + [1 - q_i(\tilde{e}_n(\theta, i^a))][p_i\phi_{n+1}(\theta, i) + (1 - p_i)\phi_{n+1}(\theta, u)]),\end{aligned}$$

where $\tilde{e}_n(\theta, i^a)$ is uniquely determined by

$$\theta = \beta\lambda^* q'_i(\tilde{e}_n(\theta, i^a)) (\phi_{n+1}(\theta, f) - (p_i\phi_{n+1}(\theta, i) + (1 - p_i)\phi_{n+1}(\theta, u))).$$

Alternatively, if the worker is not allocated to either the formal or informal job, the worker stays unemployed and so these values coincide as before and satisfy

$$\begin{aligned}\phi_n(\theta, u) &= -\theta \tilde{e}_n(\theta, u) + \beta(q_u(\tilde{e}_n(\theta, u))\phi_{n+1}(\theta, f) \\ &\quad + [1 - q_u(\tilde{e}_n(\theta, u))][p_u\phi_{n+1}(\theta, i) + (1 - p_u)\phi_{n+1}(\theta, u)]),\end{aligned}$$

where $\tilde{e}_n(\theta, i^a) = \tilde{e}_n(\theta, u)$ and are uniquely determined by

$$\theta = \beta\lambda^* q'_u(\tilde{e}_n(\theta, u)) (\phi_{n+1}(\theta, f) - (p_u\phi_{n+1}(\theta, i) + (1 - p_u)\phi_{n+1}(\theta, u))).$$

Finally, if both job opportunities are available, the optimal choice must satisfy $\phi_n(\theta, b) = \max\{\phi_n(\theta, f), \phi_n(\theta, i), \phi_n(\theta)\}$.

The analysis above allows to solve for the full-insurance allocation. Importantly, it makes transparent how to characterize the optimal size of the informal sector which, probably confronting some of the conventional wisdom, is not necessarily 0. This follows because optimality in this setting dictates that some workers might indeed be allocated to work in the informal sector as the future costs of this low productivity job are not “sufficiently high” to overcome the instantaneous/current payoff.

In what follows, we study the impact of alternative systems. The key issue here is that governmental agencies must deal with multiple informational issues: both effort and job opportunities in the informal sector are unobservable and savings cannot be monitored.

4 An unemployment insurance economy

To provide an alternative for both positive and normative analysis, we will study a simple unemployment insurance scheme that captures most of the main features of the status quo in the economies under analysis. We assume that an individual who has been working in the formal sector at age $n - 1$, and losses his or her job at age n , receives an insurance payment during J periods, where the payment during his period $j = 1, \dots, J$ of unemployment is

denoted by $b_{n-1+j} = b_j \omega_{n-1}$. The replacement ratios will be referred to as $\{b_j\}$. Both as $n-1+j > N$ and as $j > J$, the worker receives nothing as unemployment insurance. Rejected formal job offers are unobservable by the government. The worker has right to file up for unemployment insurance even in the case that he rejects a formal offer. When the worker retires, the government provides d every period as retirement payment.

Period $n < N$

Now we describe the decision problem faced by a representative worker with working age $n < N$, who has received a preference shock θ , and who has m assets. In this scheme, we need to keep track of the history and we denote $z = (0, 1, \dots, J)$ as the number of periods the worker has been receiving unemployment insurance.

If the worker receives an offer in the informal sector, he must decide whether to accept the offer (a , accept) or not and remain unemployed (u , reject/unemployed).⁴ His maximized lifetime utility, $V_n^i(\theta, m, z)$, solves

$$V_n^i(\theta, m, z) = \max \{V_n^{i,a}(\theta, m, z), V_n^u(\theta, m, z)\}$$

Here, $V_n^{i,a}$ denotes the value of accepting the informal job offer and it satisfies

$$\begin{aligned} V_n^{i,a}(\theta, m, z) = & \max_{e, m'} u(mR - m' + \varpi_n + b_{z+1}\omega_n) - \theta e + \\ & \beta \left\{ (1 - q_i(e)) [p_{i,n}V_{n+1}^i(\theta, m', z+1) + (1 - p_{i,n})V_{n+1}^u(\theta, m', z+1)] + \right. \\ & \left. q_i(e) [p_{i,n}V_{n+1}^b(\theta, m', z+1) + (1 - p_{i,n})V_{n+1}^f(\theta, m', z+1)] \right\} \end{aligned}$$

where the corresponding policy functions for effort levels and savings are given by $e_n^{i,a}(\theta, m, z)$ and $m_n^{i,a}(\theta, m, z)$, respectively.

The value of rejecting the informal job remain unemployed, $V_n^u(\theta, m, z)$, is detailed below.

If the worker receives an offer in the formal sector, his maximized lifetime utility, $V_n^f(\theta, m)$, must solve

$$V_n^f(\theta, m, z) = \max \left\{ V_n^{f,a}(\theta, m, z), V_n^u(\theta, m, z) \right\}.$$

Here $V_n^{f,a}$ is the value of accepting or rejecting the offer and must solve

$$\begin{aligned} V_n^{f,a}(\theta, m, z) = & \max_{e, m'} \left\{ u(mR - m' + \omega_n(1 - \tau)) - \theta e + \right. \\ & \beta \left\{ (1 - q_f(e)) (p_{f,n}V_{n+1}^i(\theta, m', 0) + (1 - p_{f,n})V_{n+1}^u(\theta, m', 0)) + \right. \\ & \left. \left. q_f(e) (p_{f,n}V_{n+1}^b(\theta, m', 0) + (1 - p_{f,n})V_{n+1}^f(\theta, m', 0)) \right\} \right\}. \end{aligned}$$

⁴As these offers are unobservable, the government cannot distinguish if the worker indeed received an informal offer or if he received none. This makes possible to file for unemployment insurance while still working in the informal sector.

where corresponding policy functions for effort levels and savings are given by $e = e_n^{f,a}(\theta, m, z)$ and $m' = m_n^{f,a}(\theta, m, z)$, respectively.

If the worker receives offers in both the formal and informal offers, his maximized lifetime utility, $V_n^b(\theta, m, z)$, must solve

$$V_n^b(\theta, m, z) = \max \left\{ V_n^{f,a}(\theta, m, z), V_n^{i,a}(\theta, m, z), V_n^u(\theta, m, z) \right\}.$$

If the worker receives no offer, he is unemployed and his maximized lifetime utility, $V_n^u(\theta, m, z)$, satisfies

$$\begin{aligned} V_n^u(\theta, m, z) = & \max_{e, m'} \left\{ u(mR - m' + b_{z+1}\omega_n) - \theta e + \right. \\ & \beta \left[(1 - q_u(e)) (p_{u,n} V_{n+1}^i(\theta, m', z + 1) + (1 - p_{u,n}) V_{n+1}^u(\theta, m', z + 1)) + \right. \\ & \left. \left. q_u(e) (p_{u,n} V_{n+1}^b(\theta, m', z + 1) + (1 - p_{u,n}) V_{n+1}^f(\theta, m', z + 1)) \right] \right\} \end{aligned}$$

where the corresponding policy functions for effort levels and savings are given by $e_n^u(\theta, m, z)$ and $m_n^u(\theta, m, z)$, respectively. ⁵

Period $n = N$

Finally, consider the decision's problem faced by an agent at working age $n = N$. He does not exert any effort to find a job in the formal sector as he will be retired in the next period and so only decides how much to consume and save (θ is immaterial).

If employed in the formal sector, the worker solves

$$V_N^f(m) = \max \left\{ V_N^{f,a}(m), V_N^u(m) \right\},$$

where

$$V_N^{f,a}(m) = \max_{m'} \left\{ u(\omega_N(1 - \tau) + mR - m') + \beta H(m') \right\},$$

$$V_N^u(m) = \max_{m'} \left\{ u(mR - m') + \beta H(m') \right\}.$$

If employed in the informal sector, the worker solves

$$V_N^i(m, z) = \max \left\{ V_N^{i,a}(m, z), V_N^u(m, z) \right\},$$

where

$$V_N^{i,a}(m, z) = \max_{m'} \left\{ u(\varpi_N + mR - m' + b_{z+1}\omega_N) + \beta H(m') \right\}$$

⁵It is important to highlight that the value of rejecting all job offers available and receive none must necessarily coincide in equilibrium. The key difference is that in the first case the worker decides to be unemployed while in the second he is forced to be unemployed.

5 An UISA economy

This section describes a prototype UISA economy in which workers have personalized accounts to which they contribute in periods of employment and from which they draw funds when unemployed. The government administrates those account and has access to the high return asset. Interest payments are credited and balances become available to the workers at retirement age. This system can provide correct incentives because individuals partially internalize the cost of unemployment.

A typical design specifies rules for drawing from and contributing to the system and the interest rate applied to balances. The relevant parameters are (i) an upper bound for savings in the worker's account, \bar{s} , above which the worker does not contribute to the system; (ii) a contribution rate ψ on the age specific wage to the worker's saving account during employment in the formal sector if the total savings balance is smaller than the upper bound; (iii) an initial transfer to the saving account made by the government, s_0 ; (iv) a payment to those without a formal job, $b\omega_n$, which individuals receive only if $s > 0$; and (v) a general tax paid in the formal market, $\tilde{\tau}$.

Note that the government provides liquidity funds to the individuals when they just enter the job market. Workers are forced to deposit a fraction of their wages into a savings account, up to a limit. And later they withdraw from these accounts up to some amount while not working in the formal market, as long as they have funds available.

In addition to the parameters discussed above, there are two characteristics of the system that are taken as given. First, funds accumulated by the government on behalf of the workers are invested at the gross interest rate R . Second, balances on the account cannot reach negative amounts.

Workers also have access to the low return asset and so their balances m cannot be observed by any kind of governmental agency; i.e. hidden savings. Note that this means that the design of the UISA cannot be contingent on asset holdings, m . We will assume that agents do not save using the high return asset since those savings are observable and therefore the government can make the UISA payments to them and control consumption.

Period $n < N$

Here, we consider a worker with working age $n < N$. Suppose that the individual receives an offer in the informal sector. Her/his maximized lifetime utility, V_n^i , must solve

$$V_n^i(\theta, s, m) = \max \left\{ \underbrace{V_n^{i,a}(\theta, s, m)}_{\text{accept}}, \underbrace{V_n^u(\theta, s, m)}_{\text{reject}} \right\}.$$

The value of accepting the informal job offer, $V_n^{i,a}$, satisfies

$$\begin{aligned} V_n^{i,a}(\theta, s, m) &= \max_{e, m'} u(mr + \varpi_n + \eta_n - m') - \theta e + \\ &\quad \beta \left\{ (1 - q_i(e)) \left[p_i V_{n+1}^i(\theta, s', m') + (1 - p_i) V_{n+1}^u(\theta, s', m') \right] + \right. \\ &\quad \left. q_i(e) \left[p_i V_{n+1}^b(\theta, s', m') + (1 - p_i) V_{n+1}^f(\theta, s', m') \right] \right\}, \end{aligned}$$

where $\eta_n = \min\{b\omega_n, s - \underline{s}\}$ is the UI payment and $s' = R(s - \eta)$ denotes next period savings in the UI account.

Suppose that the worker receives an offer in the formal sector. Her/his maximized expected lifetime utility, V_n^f , must solve

$$V_n^f(\theta, s, m) = \max \left\{ V_n^{f,a}(\theta, s, m), V_n^u(\theta, s, m) \right\}.$$

The value of accepting the formal job offer, $V_n^{f,a}$, must solve

$$\begin{aligned} V_n^{f,a}(\theta, s, m) &= \max_{e, m'} u(mr + \omega_n(1 - \tilde{\tau}) - \varphi_n - m') - \theta e + \\ &\quad \beta \left\{ (1 - q_f(e)) \left[p_f V_{n+1}^i(\theta, s', m') + (1 - p_f) V_{n+1}^u(\theta, s', m') \right] + \right. \\ &\quad \left. q_f(e) \left[p_f V_{n+1}^b(\theta, s', m') + (1 - p_f) V_{n+1}^f(\theta, s', m') \right] \right\}, \end{aligned}$$

where $\varphi_n = \min\{\psi\omega_n, \bar{s} - s\}$ is the payment to the UISA and $s' = R(s + \varphi)$ denotes next period savings in the UI account.

Suppose that the worker receives both offers, formal and informal. His maximized expected lifetime utility, $V_n^b(\theta, s, m)$, must solve

$$V_n^b(\theta, s, m) = \max \left\{ V_n^{f,a}(\theta, s, m), V_n^{i,a}(\theta, s, m), V_n^u(\theta, s, m) \right\}.$$

Finally, suppose that the worker receives no offer and he is consequently unemployed. His maximized expected lifetime utility is

$$\begin{aligned} V_n^u(\theta, s, m) &= \max_{e, m'} u(mr + \eta_n - m') - \theta e + \\ &\quad \beta \left\{ (1 - q_u(e)) \left[p_u V_{n+1}^i(\theta, s', m') + (1 - p_u) V_{n+1}^u(\theta, s', m') \right] + \right. \\ &\quad \left. q_u(e) \left[p_u V_{n+1}^b(\theta, s', m') + (1 - p_u) V_{n+1}^f(\theta, s', m') \right] \right\}, \end{aligned}$$

where $\eta_n = \min\{b\omega_n, s\}$ and $s' = R(s - \eta)$.

Again, the value of rejecting all the job offers available and receive none must necessarily coincide in equilibrium. The key difference is that in the first case the worker decides to be unemployed while in the second he is forced to be unemployed. Note, in addition, that the differences with the case of an individual working in the informal/formal sector are in the probabilities of finding a job.

The corresponding policy functions for effort levels and private savings are $\tilde{e}_n^j(\theta, s, m)$ and $\tilde{m}_n^j(\theta, s, m)$, respectively, where $j \in \{f, i\}$.

Period $n = N$

The analysis at period N is similar but the continuation is simpler as the worker will be retired next period $N + 1$ and therefore he does not exert any effort. Here we detail the case where a worker receives a formal offer. The other cases are similar.

Her/his maximized expected lifetime utility, V_N^f , must solve

$$V_N^f(\theta, s, m) = \max \left\{ V_N^{f,a}(\theta, s, m), V_N^u(\theta, s, m) \right\}.$$

The value of accepting the formal job offer, $V_N^{f,a}$, must solve

$$V_N^{f,a}(\theta, s, m) = \max_{m'} \left\{ u(mr + \omega_N(1 - \tilde{\tau}) - \varphi_N - m') + \beta H(m' + s') \right\}$$

where $\varphi_N = \min\{\psi\omega_N, \bar{s} - s\}$ is the payment to the UISA and $s' = R(s + \varphi)$ is the amount of savings in the UI account at retirement age $N + 1$.

Alternative, the value of rejecting the formal offer and remain unemployed must satisfy

$$V_N^u(\theta, s, m) = \max_{m'} \left\{ u(mr + \eta_N - m') + \beta H(m' + s') \right\}$$

where $\eta_N = \min\{b\omega_N, s\}$ and $s' = R(s - \eta)$.

6 Optimal unemployment protection and liquidity provision

Here we define the optimality concept that we follow to select alternative schemes. Consider first a UISA economy. The corresponding set of policy parameters to provide both unemployment protection and liquidity provision is, $\Gamma = (\underline{s}, \bar{s}, \psi, b, s_0, \tilde{\tau})$. Let $\Gamma(\theta)$ be the θ -contract in a separating scheme, while a pooling scheme simply reduces to $\Gamma(\theta_L) = \Gamma(\theta_H)$. Let $V_1^\kappa(\theta, s_0, m_0 | \Gamma)$ be the utility of the representative worker with preference shock θ , initial asset holdings m_0 , and employment offer status κ . Let $T^{UISA}(\Gamma)$ and $G^{UISA}(\Gamma)$ denote the resources collected and spent by the scheme Γ , respectively.

Definition 3 We define the optimal UISA scheme, Γ^* , as the one that solves

$$\max_{\Gamma} \sum_{\theta} \sum_{\kappa} V_1^\kappa(\theta, s_0, m_0 | \Gamma(\theta)) \mu(\kappa) g(\theta),$$

subject to

$$\sum_{\theta} (T^{UISA}(\Gamma(\theta)) - G^{UISA}(\Gamma(\theta))) = S^{UI}.$$

and the incentive compatibility constraint

$$\tilde{V}_1^\kappa(\theta | \Gamma(\theta)) \geq \tilde{V}_1^\kappa(\theta | \Gamma(\tilde{\theta}))$$

for all κ .

Notice that, in this stationary environment, feasibility means that the fictitious planner can manipulate all the cross-sectional resources to maximize the ex-ante utility of the representative worker. In addition, to make the comparison with other systems, they must generate the same surplus denoted by S^{UI} .

In the alternative UI economy, the corresponding set of policy parameters to provide both unemployment protection and liquidity provision reduces to $\Gamma = (J, \{b_j\}_{j=1}^J, s_0, \tilde{\tau})$. The definition of optimality under this scheme is similar and thus avoided.

7 Informality and productivity: measurement

Here we provide a simple general equilibrium interpretation to construct appropriate TFP measures. We assume that there is a representative firm for each sector (formal and informal) which operates a constant returns to scale technology

$$y^h = \left[\sum_{n=1}^N \varphi_n^h l_n^h \right]$$

where h is the sector ($h = F, I$), n indexes ages, l_n^i is the amount of labour hired by sector h of age n and φ_n^h is the marginal productivity of the worker of age n in the sector h .

Firms solve the problem

$$\max \left[\sum_{n=1}^N \varphi_n^h l_n^h - \sum_{n=1}^N l_n^h w_n^h \right]$$

where w_n^h is the wage paid to workers of age n in sector h per quarter.

In a competitive equilibrium with free entry wage will be determined by marginal productivity at age n and so $w_n^i = \varphi_n^i$.

To construct TFP measures, we can re-write with the aggregate technology as follows

$$Y = \sum_{n=1}^N \{ [\varphi_n^F \pi_n^F + \varphi_n^I (1 - \pi_n^F)] l_n \} \quad (4)$$

where $l_n = l_n^F + l_n^I$ the total employment of age n and $\pi_n^F = \frac{l_n^F}{l_n}$ the fraction of people of age n employed in the formal sector. So the aggregate production function can be expressed as

$$Y = \tilde{A} \left[\sum_{n=1}^N l_n \right] \quad (5)$$

where

$$\tilde{A} = \sum_{n=1}^N [\varphi_n^F \pi_n^F + \varphi_n^I (1 - \pi_n^F)] \frac{l_n}{\sum_{n=1}^N l_n}$$

is the average productivity in the economy, weighted by sector and age dependent factors.

An alternative TFP measure uses not only total employed labour force but total active population of age n . This approach takes also into account unemployed workers in the scheme.

To see this, let L_n denote the total active population of age n and $\alpha_n^U = \left(1 - \frac{l_n}{L_n}\right)$ be the fraction of age n unemployed workers. Then, the aggregate production function can be written as follows

$$Y = \bar{A} \sum_{n=1}^N L_n$$

where

$$\bar{A} = \left\{ \sum_{n=1}^N [\varphi_n^F \pi_n^F + \varphi_n^I (1 - \pi_n^F)] (1 - \alpha_n^U) \frac{L_n}{\sum_{n=1}^N L_n} \right\}$$

is a TFP measure of the active population; i.e the average productivity among active workers.

So, we have constructed and consider two alternative measures of TFP.

Measure 1 is the average productivity of employed workers; i.e.

$$\tilde{A} = \sum_{n=1}^N [\varphi_n^F \pi_n^F + \varphi_n^I (1 - \pi_n^F)] \frac{l_n}{\sum_{n=1}^N l_n}$$

Measure 2 is the average productivity of active workers, "penalized by unemployment"; i.e.

$$\bar{A} = \left\{ \sum_{n=1}^N [\varphi_n^F \pi_n^F + \varphi_n^I (1 - \pi_n^F)] (1 - \alpha_n^U) \frac{L_n}{\sum_{n=1}^N L_n} \right\}$$

8 Calibration

To evaluate the quantitative impacts of policy reforms, we will proceed to calibrate and simulate the model to analyze the predictions in alternative settings. To do this, we must select the key parameter of the model. We will explain in detail the key choices, describe the parameters, and compare the model with the data.

Then, we will proceed to quantify alternative schemes in terms not only of productivity but also the size of the informal and formal sector, welfare, etc.

Since the goal is to evaluate the quantitative impact of policy reforms, we must select the key parameter of the model. This section briefly explains these choices, describe the parameters, and compare the model with the data (for more details see the Appendix).

The quantitative evaluation of alternative policies uses Argentina and Mexico for benchmark economies. To approximate the system of unemployment protection observed in Mexico, we model an economy in which an individual who has been working in the formal sector at age n , and loses his or her job at age $n + 1$, receives a severance payment as unemployment protection for one period, denoted by $b_n = b\omega_{n-1}$, where $b = 1$ represents the replacement ratio.⁶

The value of the parameters are set using three strategies. First, there is a group of parameters that can be obtained directly from data or taken from previous literature. Whenever possible, we follow that strategy. For the rest of the parameters, we search for values that imply that the model replicates specific targets as closely as possible. The artificial economy is generated by simulating many life cycles of individuals.

8.1 Funcional Forms

The utility function is the standard constant relative risk aversion (CRRA) form,

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

with relative risk aversion parameter $\sigma > 0$. The functions describing the probability of getting formal job offers are,

$$q_i(e) = 1 - \exp(-\xi_I e),$$

$$q_u(e) = 1 - \exp(-\xi_U e),$$

$$q_f(e) = 1 - \exp(-\chi e),$$

⁶Note that the worker has no right to receive severance payments in the case that he/she rejects a formal offer.

8.2 Calibration Results

As mentioned above, several parameters were obtained directly from data. The retirees survival probability, $\rho = 0.977$ and $\rho = 0.9875$, are set to match the Argentinian and Mexican lifetime expectancy, respectively. The retirement payment, $d = 0.57$ and $d = 0.6$ is set to match the average amount of payment of retired people for each country.

Other parameters are set at standard values in the literature. The coefficient of relative risk aversion is set at $\sigma = 2$. The discount factor is set at $\beta = 0.96^{1/4}$ and the returns on savings is set at $R = \frac{1}{\beta}$. Since there is no direct evidence on the initial stocks of assets either Mexico or Argentina and young workers in United States have very little savings, we set m_0 such that the ratio of initial savings to yearly income is 10 percent for Mexico and half of an average formal salary for Argentina ⁷

The parameters that cannot be determined ex-ante were jointly calibrated. In the next tables, we present the parameters and show how the predictions of the model match the targeted moments⁸.

As shown in the next tables, in the case of Argentina the model reproduces aggregate states quite well, with some problem for the youngsters. Also, it reproduces almost exactly the transition matrix of formal and informal workers. In the case of Mexico, the benchmark also reproduce almost exactly the transition probabilities and does a good job with the states.

Table 1: Argentina

(a) Parameters		(b) Fitted Moments		
ξ_U	0.6		Data	Model
ξ_I	0.205	Unemployment Rate	6.09	6.17
χ	1.1	22-35 years	8.67	6.42
p_f	0.7	36-64 years	5.87	5.9
p_u	0.8			
p_i	0.91	Informality Rate	38.95	40.50
$\underline{\theta}$	0.18	22-35 years	40	38.76
$\bar{\theta}$	1.1	36-64 years	38.2	42.42
μ_i	0.5			
μ_f	0	Quarterly transition prob. from formal to formal	90.72	88
Share of $\underline{\theta}$	0.65	Quarterly transition prob. from formal to informal	8.08	8.4
τ	0.07	Quarterly transition prob. from informal to informal	81.09	81.2
		Quarterly transition prob. from informal to formal	13.85	10.7

⁷Both quantities are similar and small, and our results are not sensitive to changes in this parameter.

⁸The difference in the moments chosen to match are due to the availability of trustful data. Instead of being a weakness, this strengthened our predictions by showing the versatility of our benchmark

Table 2: Mexico

(b) Fitted Moments

(a) Parameters			Model	Data
ξ_U	0.002181	Unemployment Rate	2.8	2.7
ξ_I	0.001663	20-24 years	4.7	4.8
χ	0.051699	25-39 years	2.3	2.2
p_f	0.666013	40+ years	2.7	1.0
p_u	0.937407			
p_i	0.969193	Informality Rate	56.4	54.2
$\underline{\theta}$	0.009711	20-24 years	52.2	48.6
$\bar{\theta}$	0.02287	25-39 years	50.2	49.5
μ_i	0.578	40+ years	67.3	64.1
μ_f	0.1			
Share of $\underline{\theta}$	0.6058	Yearly transition prob. from formal to formal	84.8	86.0
τ	0.2345	Yearly transition prob. from formal to informal	13.3	12.9
		Quarterly transition prob. from formal to unemployed	1.6	1,5
		Quarterly transition prob. from informal to unemployed	3.0	3.1

9 Quantitative evaluation

In this section we present the results obtained after the implementation of alternative systems. First, we show how benchmark allocations relate to the first best and so we can identify the main inefficiencies that the design must try to alleviate. Then, we study how alternative schemes work to solve those problems and its impact on Total Factor Productivity (TFP).

There are two mayor findings stemming from our analysis. First, there is no unique system that dominates for all the economies. In fact, predictions could change radically Secondly, we try to identify the reason behind this fact; i.e. in presence of agents' heterogeneity, the key role of the system is to provide the proper set of incentives for each type, which could be very different across economies.

The novelty of this exercise is to compare alternative unemployment insurance schemes with heterogeneous agents and a hidden labor market. This combination is essential for our conclusions since incentives provided by one system could be appropriate for some types of agent but creates tension with the incentives of some others.

Identifying inefficiencies

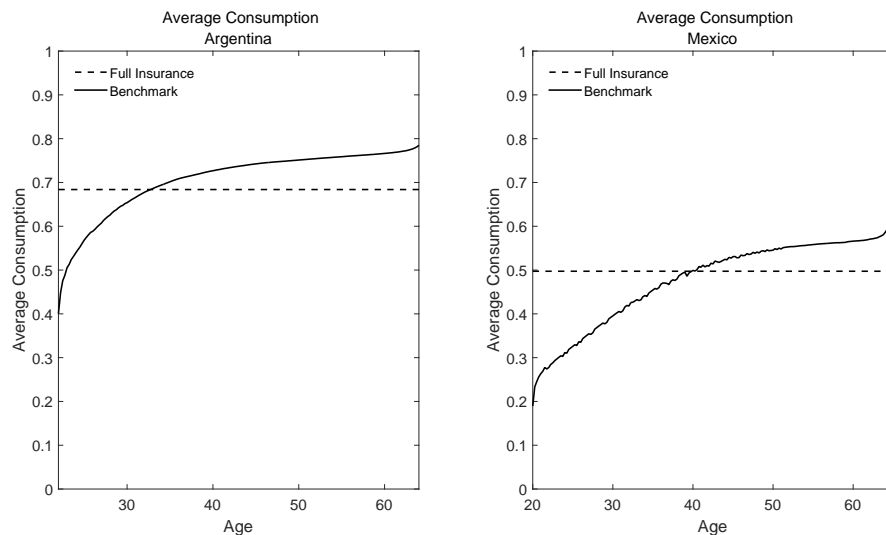
There might be several dimensions of inefficiency in which an equilibrium allocation is distorted. The design of an optimal system should alleviate these distortions to increase

welfare. We will concentrate in the following channels: intertemporal smoothing, redistributive issues and insurance for the risk of unemployment.

The intertemporal channel relates with the shape of the wage profile and the lack of a more sophisticated credit market. Since salaries are, in average, increasing with age, agents would like to bring future incomes to their early ages in order to smooth consumption. However, as the access to credit market is limited, they have no way to do this intertemporal transfer. So, an optimal scheme might need to subsidize young workers' consumption.

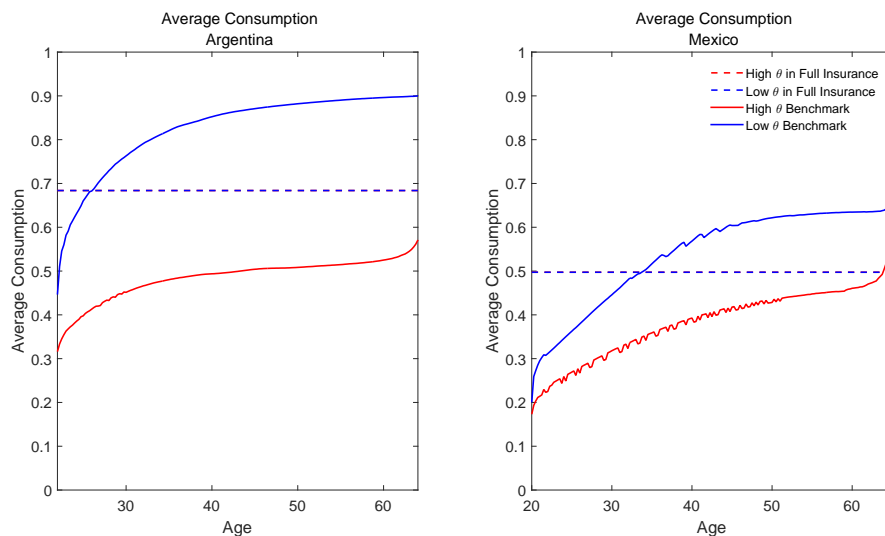
Figure 1 compares first best consumption with consumption in benchmark economies, and it shows that it is optimal to increase consumption of young workers while decreasing that for the old.

Figure 1: First Best and Benchmark Average Consumption



The redistributive channel relates to the lack of insurance market against workers' type; i.e. their unobservable ability to find high productivity formal jobs. Since efficient workers can find a higher formal wage with less effort, in order to maximize the ex-ante welfare, it is optimal to redistribute consumption from efficient to inefficient workers. That is, an optimal scheme must provide cross-subsidies between types. Figure 2 below shows that efficient allocation provides full insurance in the sense that consumption of both types coincide.

Figure 2: First Best and Benchmark Average Consumption by type

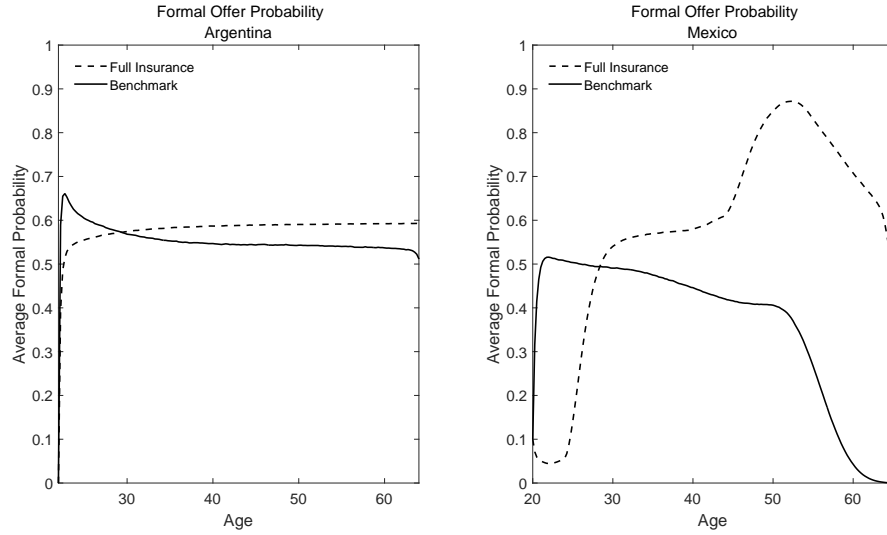


Finally, an optimal scheme must try to alleviate the income volatility stemming from the possibility of losing a job and becoming unemployed; i.e. insurance for the risk of unemployment. Again, a contingent market could solve this problem, but its existence is not possible due to the presence of an unobservable labor market.

The optimal design of a scheme confronts with two major problems. First, the government collects revenues taxing wages in the labor market. If taxes are high, agents move to the informal market to perceive a salary free of taxes and exert less effort. This problem creates a Laffer-type effect: at some point, the higher the taxes, the fewer the workers in the formal market. Secondly, it must provide the correct incentives in the labor market for each type of worker. It may happen that it is optimal to make inefficient workers effort and work in the (costly) formal market while reducing the effort of the efficient workers; or it could be that it is better if all the work is done by the efficient workers while inefficient workers are relegated to the informal market.

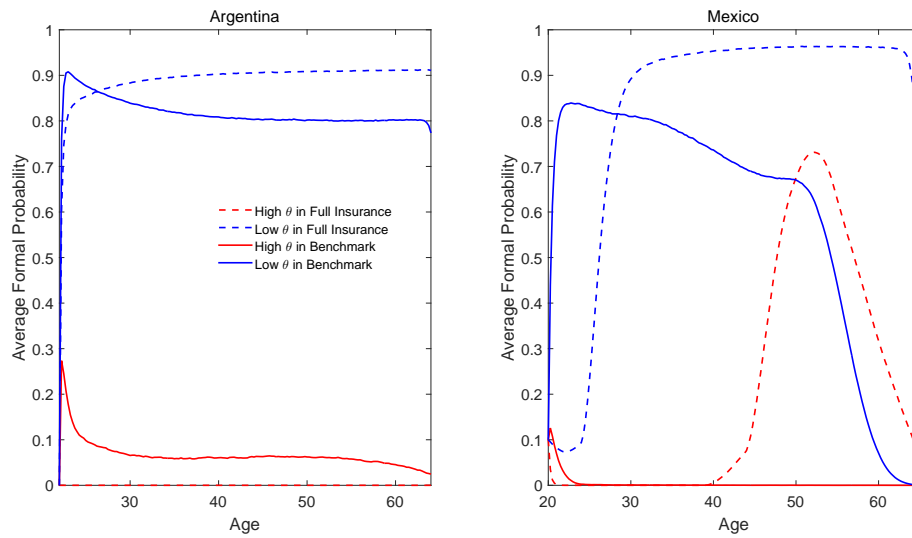
This tension is key for the optimal design of alternative schemes as different economies might require different changes in the effort profile. Argentina and Mexico are examples of this issue.

Figure 3: First Best Average Probabilities



The previous Figure 3 shows first best probabilities. In the case of Argentina, patterns of finding probabilities are similar for the first best and the benchmark economy. The difference is that probabilities should be lower for young workers while a bit higher for older ones. On the other hand, Mexico might need more significant changes in effort incentives and so probabilities; i.e. a large reduction of probabilities during the first years while a large increase for old workers. Figure 4 below displays the corresponding efforts that must be efficiently exerted.

Figure 4: First Best and Benchmark Average Probabilities by type



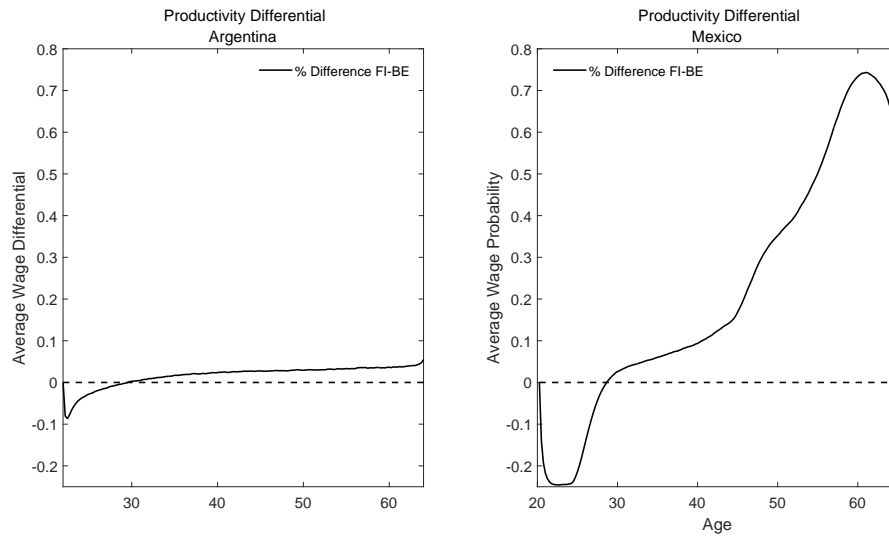
In the case of Argentina, it is optimal to take inefficient workers out of formality, by

reducing their effort, and increase the effort made by efficient workers and to make them participate more in the formal market. This is a challenge as the same scheme must provide opposite incentives to both types of agents.

In Mexico, on the contrary, it is optimal not only to increase the effort exerted by efficient workers but also to make high cost type effort more in their most productive years. Although this might seem simpler than in Argentina, as incentives go in the same direction, the size of the change needed in Mexico is large. Also, to provide incentives to reduce effort is easy, but to increase effort is definitely challenging, mostly if they are addressed to the ones with the highest cost.

Figure 5 shows the impact on TFP by age as the porcentual change after the implementation of the first best allocation. It is optimal to take agents out of formality in their early ages as effort costs are higher in present value while wages are relatively low. However, this lowers their productivity because they are taken out from the most productive sector. On the other hand, it is efficient to allocate agents to the formal sector when they are old. This not only produce an increase in welfare but also in aggregate productivity, since those are the most productive ages.

Figure 5: TFP Difference



There is a salient feature that needs to be emphasized. The efficient size of the informal sector in the full Insurance economy is non-negligible; i.e. 51.45% for Mexico. This occurs because a fraction of the working population has the cost of exerting the required effort to find a formal, high productivity job too high, compared to the benefits in terms of the expected duration of a formal job. In the benchmark economies, informality is higher because

individuals do not receive the total amount of resources they generate in formal employment, but only those after taxes. Thus, the need of taxing formal jobs for redistribution is one of the sources for this excessive level of informality.

In what follows, we will explore the effects of the implementation of alternative unemployment insurance schemes. First we consider liquidity provision and unemployment insurance schemes.

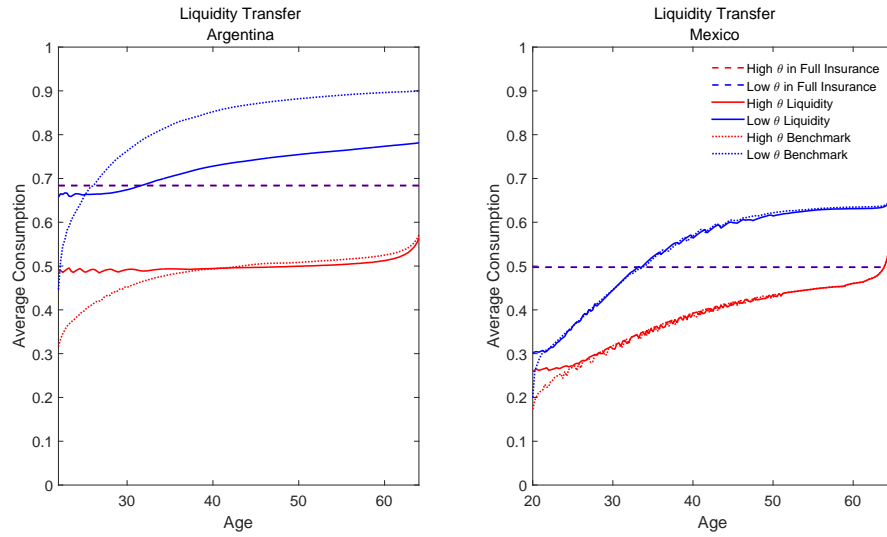
9.1 Liquidity Provision

Liquidity provision is key to increase ex-ante welfare. In this class of life-cycle models in which individuals are restricted to borrow, liquidity can potentially help mitigate severe allocative distortions. The supply of liquidity enables young workers to consume their assets without making effort in the labor market, which is optimal for both economies. Additionally, it helps to relocate resources from efficient to inefficient agents, since efficient agents afford most of the effort cost and the transfer is the same for both. Finally, liquidity transfers also help workers to self-insure against unemployment.

The need to finance liquidity transfer is troublesome due to the presence of a hidden labor market. If agents have assets when they enter the labor market, they will avoid exert effort and choose to consume part of their assets while working informally. This, combined with the higher taxes needed to support larger transfers, might reduce the tax base drastically.

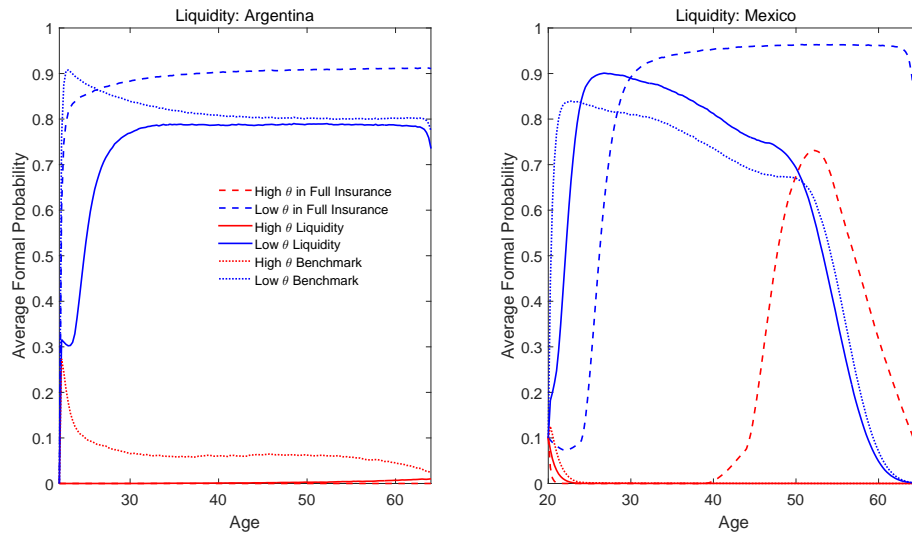
These economies display different features. In Argentina it is affordable and optimal to make a large liquidity transfer; i.e five average formal salaries approximately. In Mexico, on the other hand, the optimal level of initial liquidity transfers is small as the needed taxes become too distortive. As a consequence, Argentinean workers could make their consumption smoother and inefficient agents increase average consumption due to redistribution. The same happens in Mexico but at a much smaller scale.

Figure 6: Average Consumption by type



The reason behind these different outcomes are related to the incentives that each system provides. In Mexico it is optimal to make inefficient agents work formal in their most productive years, but higher taxes and liquidity go in the opposite direction. On the contrary, in Argentina it is optimal to take inefficient agents out of formality while keeping efficient ones in the formal market. The system can partially accomplish both tasks, generating large welfare gains for Argentina.

Figure 7: Average Probabilities by type

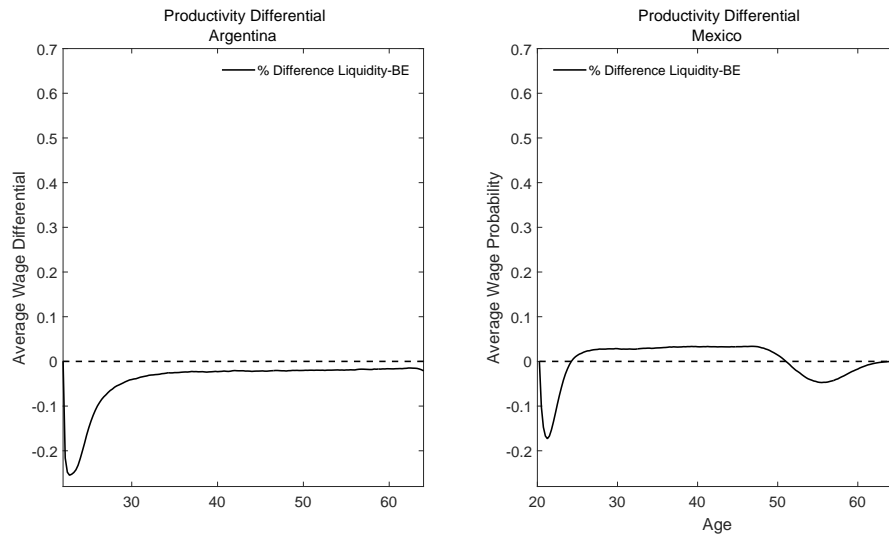


How do these systems affect TFP? Since young workers choose the costless less productive market, productivity for younger workers is lower in both economies. Aggregate

changes depend on what older, more productive workers do.

Due to higher taxes in Argentina after the implementation, the formal market is less attractive, causing a decrease in effort and a consequent large drop in TFP. In the case of Mexico, the change of the old unemployment insurance scheme for a liquidity transfer scheme lowers the payroll tax in the formal market. This effect compensates the decrease in Aggregate TFP caused by young workers and produce a tiny increase in TFP.

Figure 8: TFP Difference



The effects of liquidity provision are minor in Mexico as the size of the optimal feasible transfer is very small. The informality rate is higher for younger individuals, for whom the liquidity effect is stronger and the welfare gains relative to first best is 20%.

Effects are larger for the Argentinean economy. Informality shows a large increase (from 40% to 51%) while unemployment also increases. However, this undesirable increase in informality and unemployment comes with an increase of 43% of the potential welfare gains.

9.2 Unemployment insurance

An unemployment insurance scheme consists on two parts: 1. the duration of the payments that defines how many quarters will the agent receive payments while he is out of formality (after losing a formal job); 2. the amount of those payments, which could vary with the unemployment spell; i.e. the replacement ratios. In our parametrized model, replacement ratios are a fraction of formal wages. It is important to recall that Mexico was calibrated with unemployment payments that consist on 100 % of the formal wage in the first period

after losing a job.

In the economies under study, the optimal unemployment insurance scheme does neither produce large welfare gains nor is too distortive. The main reason is that unemployment is not the main distortion in these economies. However, some other features of the optimal design are interesting.

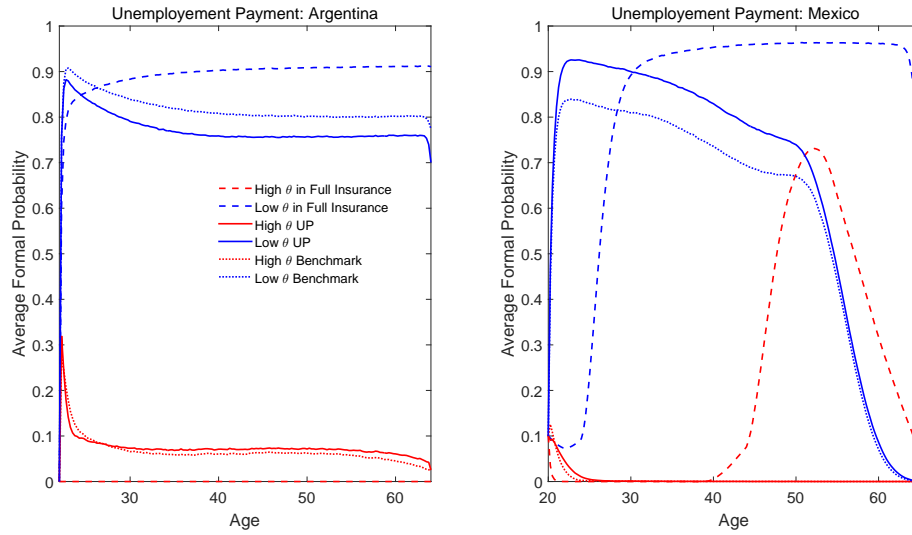
The largest welfare contribution of this scheme is the reduction of the necessity to save for precautionary purposes, which allows workers to consume a larger fraction of their income. The system redistributes income from the currently formally employed workers to those who have just lost formal jobs. This indirectly redistributes income from efficient agents to inefficient, since the last could benefit from payments after a short spell in the formal market.

These benefits come with a large negative incentive problem. Agents have less incentives to preserve a formal job and to look for one when they are receiving the unemployment benefit. In an extreme case agents would choose to stay informally employed and receive the unemployment benefit while receiving an informal salary. However, the impact on the tax base is not obvious, since agents could have incentive to exert effort, obtain a formal job and then lost it in order to receive the benefits.

The profile of replacement ratios of the optimal system is different for each country. While in Argentina it consists of an increasing but small transfers (of 6%, 7%, 9% and 12% in each quarter), in Mexico it is optimal to make a large initial transfer and then they abruptly decrease (of 25%, 5% and 5%, respectively) . This is a novel finding that contradicts previous literature and deserves deeper attention to find the main causes of these differences.

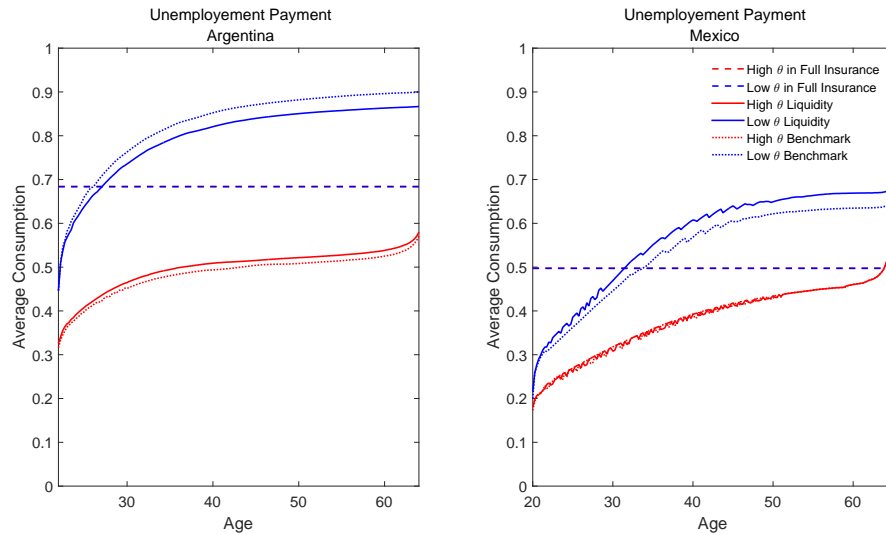
There are at least three forces shaping the profile of replacement ratios stemming from the need to provide incentives in this setting with hidden savings. First, the profile tends to be decreasing as this makes the path of consumption (and so utility) decreasing in the state of being unemployed. This provides incentives to exert effort. Secondly, as the worker remains unemployed, it is optimal for him to consume a fraction of his wealth (he becomes poorer). As absolute risk aversion is decreasing under CRRA, the cost of providing incentives to exert effort decreases and therefore it is optimal to increase the transfer to provide more insurance. Finally, as the worker remains unemployed, the ex-post probability of that the designer faces a low ability agent increases. It is desirable to provide more transfers.

Figure 9: Average Probabilities by type



Since Argentina is assumed not to have an unemployment benefits scheme in the benchmark, the implementation of the system increases taxes (from 7% to 10%). This, coupled with the implementation of payment benefits, reduces the incentives to become formal on average. However, in Mexico the implementation of the optimal system reduces taxes (from 23% to 17%), which makes the formal market more attractive and this results in an increase in effort.

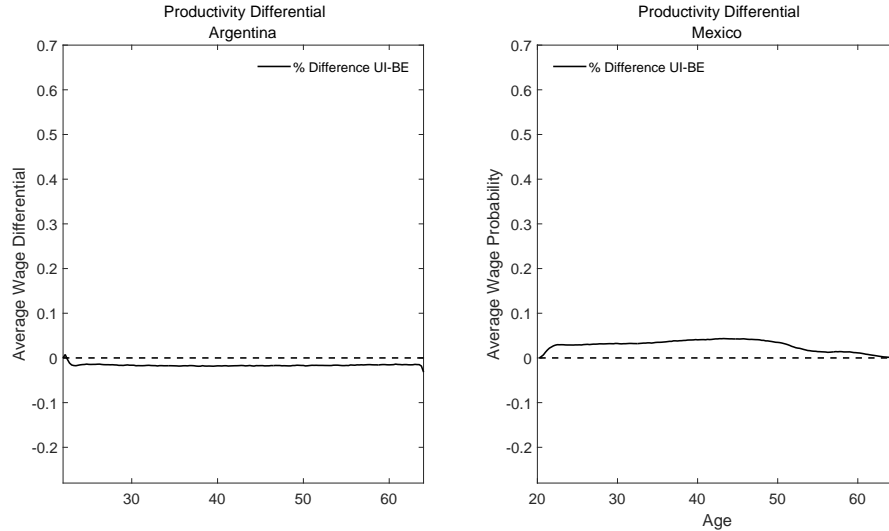
Figure 10: Average Consumption by type



As expected, in Mexico most of the welfare gains comes from the tax reduction that allows efficient agents to increase effort and consumption. In Argentina, however, efficient

workers reduce effort and consumption since taxes are higher and have less incentives to preserve formal jobs. To balance this welfare reduction, inefficient workers enjoy the benefits of the payments after loosing a formal job.

Figure 11: TFP Difference



Reallocations generated after the implementation of the UI scheme generates some changes in the TFP. In Argentina, as expected, this change is negative not only in average but for all ages. In Mexico, due to tax reduction, an average TFP increase is of the order of 3% relative to the benchmark.

With respect to the other statistics, the implementation of UI scheme in Argentina produces an increase in informality of 3% and unemployment. This comes with an increase in welfare of only 3% of the potential gains.

It is different for the Mexican case as the effects are dominated by the tax reduction, which contributes to reduce informality. As a result, both unemployment and informality remain almost unchanged while welfare increases in 6.9% out of the potential gains.

9.3 Liquidity Provision and Unemployment insurance

In this section we present the results of the optimal design of a scheme that combines liquidity provision and UI. Surprisingly, in Argentina the combination of the systems does not improve upon the welfare gains obtained with only liquidity provision. In the case of Mexico, however, it is optimal to reduce the amount of liquidity and implement a one quarter payment of 25% of the current formal salary in the first quarter after loosing a

formal job. Nevertheless, the changes in welfare due to the combination of the systems is minimal; only 0.07% increase in consumption equivalent relative to liquidity provision.

This allows us to conclude that the bulk of the benefits are due to liquidity provision and that the combination of both systems does not increase welfare under our assumptions.

9.4 Unemployment Insurance Saving Account

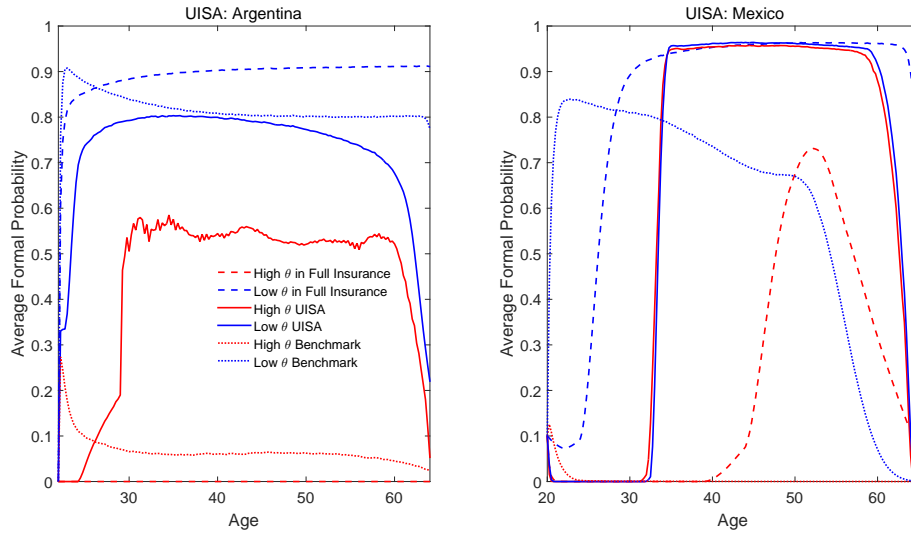
UISA with observable savings

The UISA system with observable savings is parametrized as follows. A setting where savings are observable is equivalent to one in which agents cannot save privately, so they are forced to consume their net income. If an agent is formally employed he must save a fraction of his salary given by the contribution rate while consumes the rest, net of taxes. While he is out of formality, he can work informally, consume his salary and a fraction of their savings at a given extraction rate if he has enough funds. The parameters of the optimal system for Argentina are: $\underline{s} = 0, \bar{s} = 7, \psi = 0.3, b = 0.4, s_0 = 8.55, \tilde{\tau} = 0.24$ and for Mexico $\underline{s} = 0, \bar{s} = 1.4, \psi = 0.1, b = 0.48, s_0 = 11.4, \tilde{\tau} = 0.47$.

This structure of the system might be useful to provide incentives. When agents run out of savings in their accounts, they do not have assets for insurance purposes. This forces them to search for formal jobs as they can accumulate in the savings account. When they enter the formal labor market, they take advantage of the persistency in this sector and thus they stay there longer.

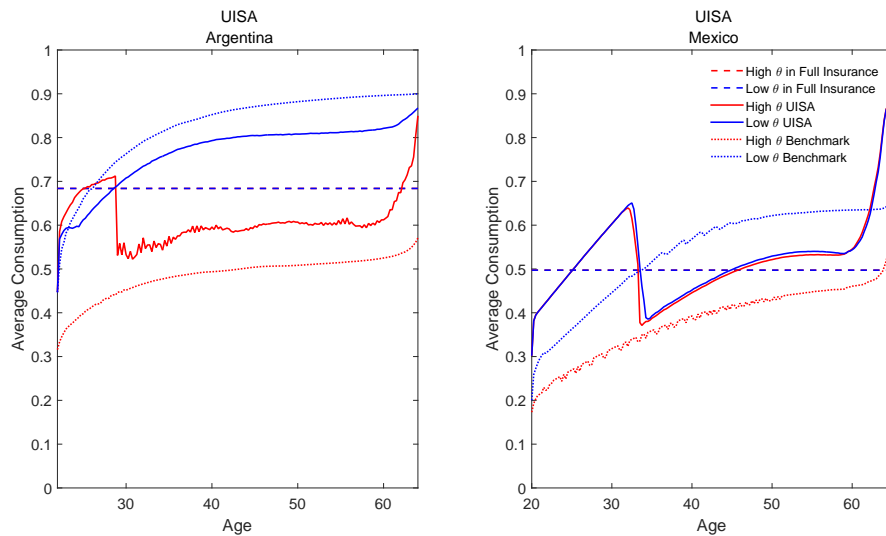
This is the reason why this system is beneficial in Mexico. Agents consume initial transfers and avoid exerting effort when they are young and so they are forced to work formally in their most productive years, which is optimal. This is also the main reason why this system does not produce welfare gains for Argentina: inefficient workers exert costly effort, which is not optimal in this economy.

Figure 12: Average Probabilities by type



As expected, the optimal scheme must provide a large liquidity transfer in both economies. In this system it is easy to collect taxes since workers have no alternative but to work formally many periods. Additionally, while formal it is optimal to force them to save ($\psi > 0$ for both countries). These savings are used in case they are unemployed or in the periods before retiring.

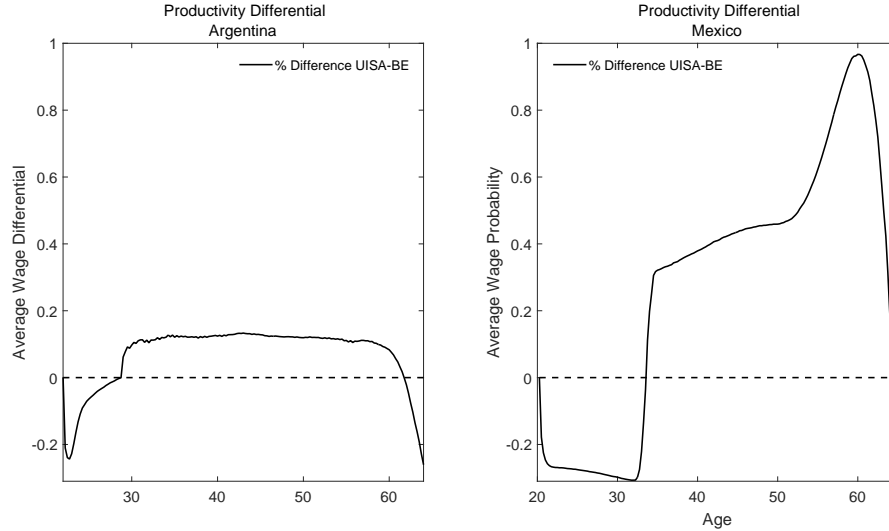
Figure 13: Average Consumption by type



The system produces large reallocations. Although in their early ages agents are in the less productive sector, in their most productive ages both types are in the formal market.

Consequently, the system greatly increases aggregate TFP. However, this benefits in terms of productivity could be associated with large welfare costs, as in the case of Argentina.

Figure 14: TFP Difference



The other statistics confirm what was described above: reductions in informality (more substantial for Argentina than for Mexico) and increase in unemployment. Also, the welfare gains for Mexico are large (47% of potential gains), contrary to Argentina that the systems reduces welfare.

UISA with hidden savings, $R = r$

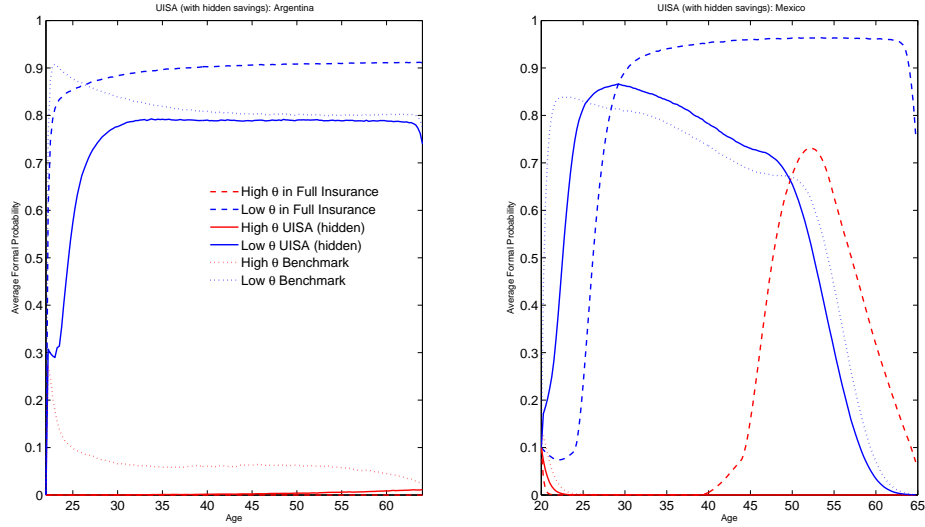
If we consider agents with access to save in an unobserved account, our predictions on the impact of the UISA scheme change. The ability of the government to manipulate consumption almost vanish since now agents can save the resources they draw, instead of consuming. The degree of the change is closely related with the technology to borrow that the agents have. In this section we evaluate to what extent our predictions change when agents can privately save at the same saving rate.

When agents have the possibility to save at the same rate of return of the government, the UISA scheme benefits vanish and it reduces to a liquidity transfer. In both economies it is optimal to set the mandatory saving rate, in the saving account, equal to zero. This is not a surprising result, since private savings could be used in any state while the ones in the saving account demands to be out of formality.

However, the benefits from this system are less than in liquidity transfer for both economies. The reason is that they cannot freely use their savings to consume as they

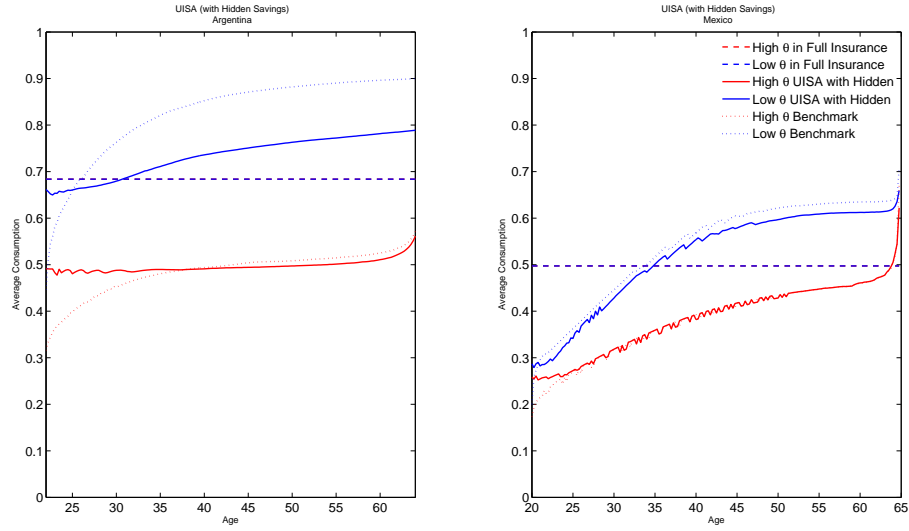
wish when they are young and, in order to subtract the amount transferred, agents stay longer in informality.

Figure 15: Average Probabilities by type



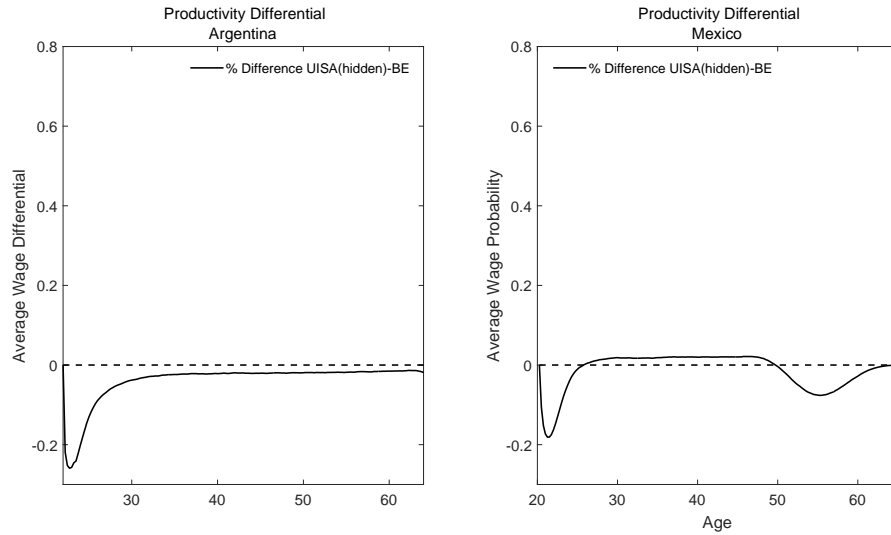
Because the outcome of implementing the system reduces to the optimal liquidity provision (also the extraction rate matters, but only for the few quarters that the saving account have positive amounts) a parallel to the conclusion drawn in that section is appropriate: Argentina supports larger transfers than Mexico, which allows agents to increase consumption in their early years in order to smooth intertemporally. The difference with that system is that now agents choose informality in their early years also to subtract the assets and save in their private accounts.

Figure 16: Average Consumption by type



The reallocations deliver a large drop for young workers, which go to informality in order to subtract funds while there is almost no change for the elderly.

Figure 17: TFP Difference



UISA with hidden savings, $R < r$

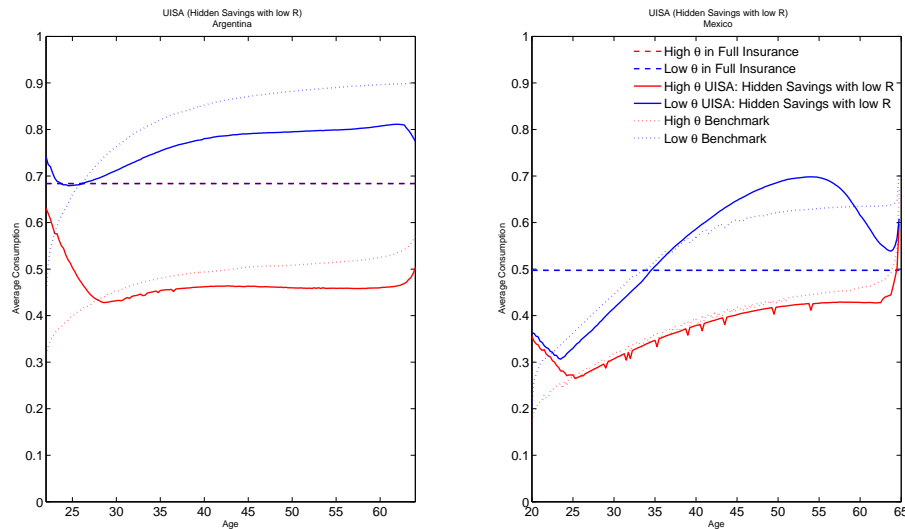
When the technology to privately save is less efficient than the saving account, the UISA becomes useful. This gives the government some ability to manipulate consumption. In an extreme case, when the technology of hidden savings is completely inefficient, this systems becomes an UISA with observable savings. The case under study in this section takes

$R = -0.1$, that is an annual real saving rate of -10 percent for both economies, trying to represent the idea of saving in cash in economies with inflation.

The welfare results depends on what is better between a liquidity transfer or a UISA scheme in the economies under study. If an UISA system with observable savings is better than a liquidity transfer, then a low rate of return in private assets increase the welfare for that economy. If liquidity is better than UISA, then a lower rate of return on hidden savings reduces welfare relative to the case with the higher rates.

In a case with low return, larger initial transfer can be supported as compared with the case of higher returns, as self-insurance and living off private assets is now costly. Therefore, as soon as they enter the labor market, they deplete the liquidity provided, but instead of keeping it for many periods, they consume it fast so that they do not lose real amounts. This can be seen in Figure 18:

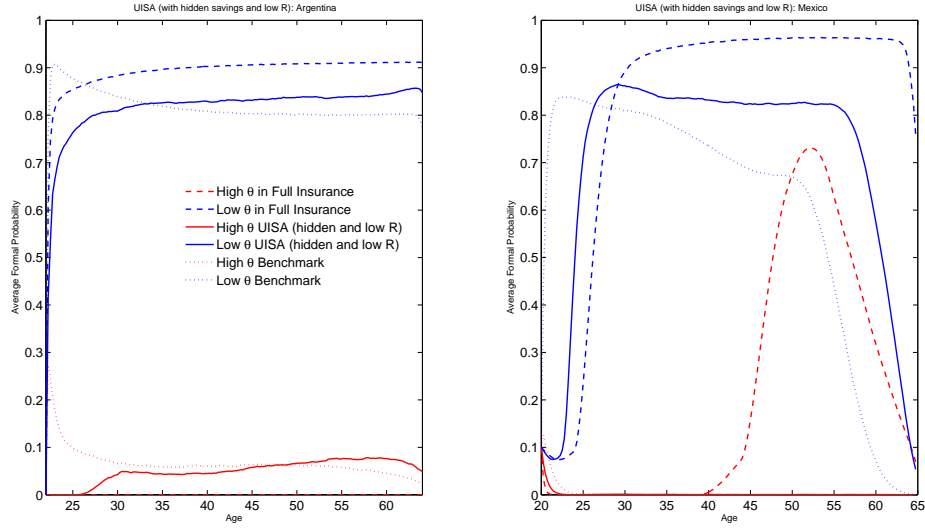
Figure 18: Average Consumption by type



Regarding effort, in the case of Argentina, efficient workers avoid making as much effort as in the benchmark when they enter the labor market, because they now have an insurance account. Conversely, inefficient workers prefer avoid making effort and use instead their savings to consume. However, due to the bad technology to self insurance, they choose to exert some effort when they are old.

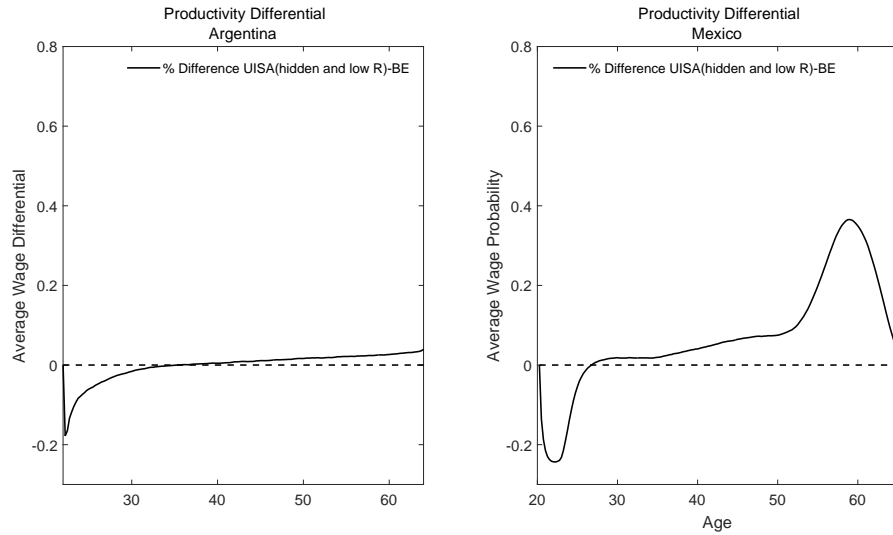
In Mexico, the worse technology does not create enough incentives to make inefficient agents exert effort. However, the lack of a technology to accumulate efficiently forces efficient workers to exert more effort than in the benchmark in order to accumulate assets in the saving account.

Figure 19: Average Probabilities by type



The reallocations are the expected from the previous figure: a large drop for Argentinian and Mexican youngsters, and an increase for Mexican elderly.

Figure 20: TFP Difference



9.5 Extensions

Here we provide a non-exhaustive list of exercises with potential extensions to deeper understand the role played by some assumptions.

The Role of a Credit Market

In this section we assume that agents can save and borrow at the same rate of return of the government while they are active. The idea is to see how much of the welfare gains of the systems could have been obtained with the existence of a credit market.

Figure 21: The Role of a Credit Market

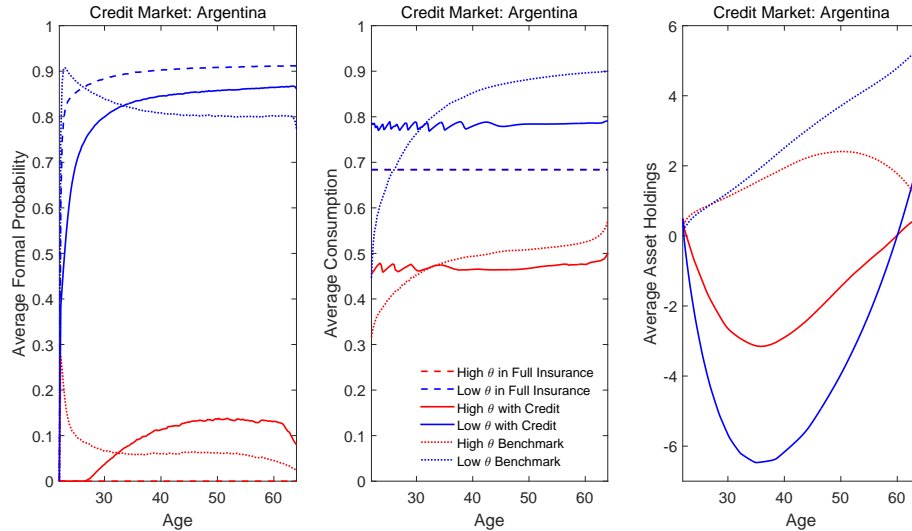


Figure 21 above represents the results. As expected, the introduction of a credit market let workers smooth their consumption, which alleviates the intertemporal distortion. Also, it allows both types of agents to reduce effort while young to finance consumption borrowing, and paying back when salaries are higher.

As a result, the introduction of the credit market delivers 28 % of the potential gains in Argentina. This is much less than, for instance, the 44 percent that liquidity provision delivers. The reason is that liquidity also contributes to redistribute income between types.

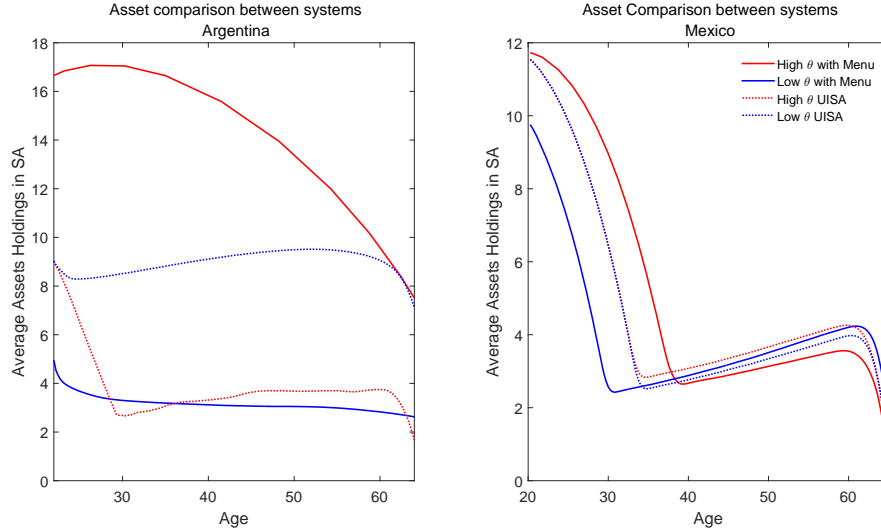
The Role of Heterogeneity - UISA with menu

The purpose of this section is to explore the impact of offering to the workers a menu of contracts that are incentive compatible. Different parameters for each type will give the designer the possibility personalize incentives in every scheme. The idea is to increase the tools to mitigate the problems due to heterogeneity and study how predictions change.

Personalized schemes in this version of UISA are helpful in both countries. In absence of different contracts, the same amount of transfer, rate of contribution and extraction must be offered to each type. In the case of Argentina, this is a waste of resources as efficient workers use only a tiny part of the transfers before looking for a formal job, which

desincentive them to withdraw savings. Also, liquidity was not enough to prevent inefficient workers to exert effort. In Mexico, without menu, both types of agents behave almost in the same way. Although this was useful since it makes inefficient agents work, which is optimal, they exert too much effort. This deficiencies are alleviated by means of a menu, as it can be seen in the figures below.

Figure 22: Average Assets Holdings

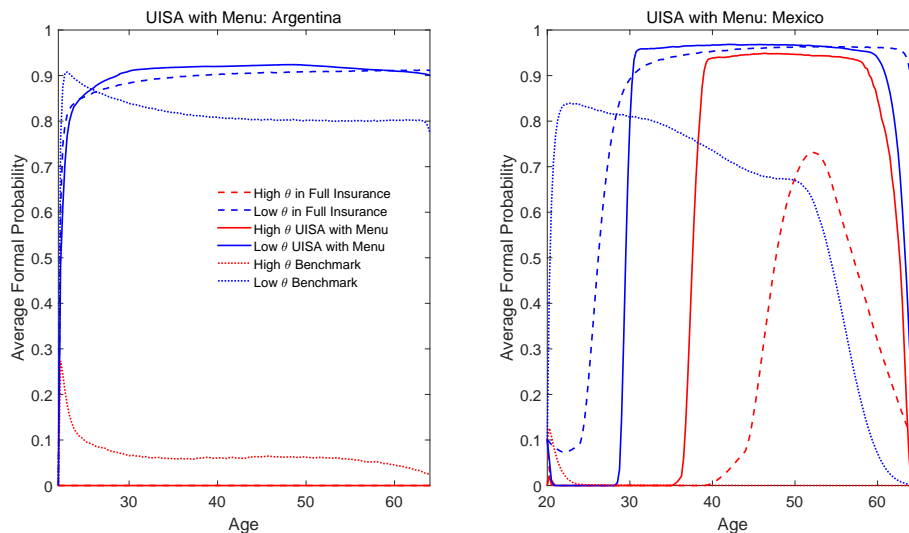


An efficient menu of contracts increases the transfer to the inefficient workers while lowers those to the efficient ones. This must be done considering the incentive compatibility constraint where taxes play a key role: agents who choose larger transfer also pay higher taxes.

In the presence of menu, in Argentina, the liquidity transferred to the efficient workers reduces drastically and they are offered a extraction rate larger than that without menu. For the inefficient workers, a large liquidity transfer is made together with a low extraction rate, enough to make assets last without working formally, which is optimal.

For Mexican agents, the changes are similar but less remarkable. The reason is that it is better to keep inefficient agents working formally for some periods. The way a menu attains that is increasing the transfer to inefficient workers, but not so much so that they run out of assets and go to the formal market.

Figure 23: Average Probabilities by type



This leads to a drastic increase in the welfare in Argentina relative to the UISA system without menu of contracts: from a -65% of the potential gains to 16% . Also, a considerable increase for Mexico: from 47% to 56% . This make us to conclude that with observable savings an UISA menu could do a great job to increase welfare.

Finally, it is important to notice that the system boosters TFP, since it allocates agents mostly in the formal market.

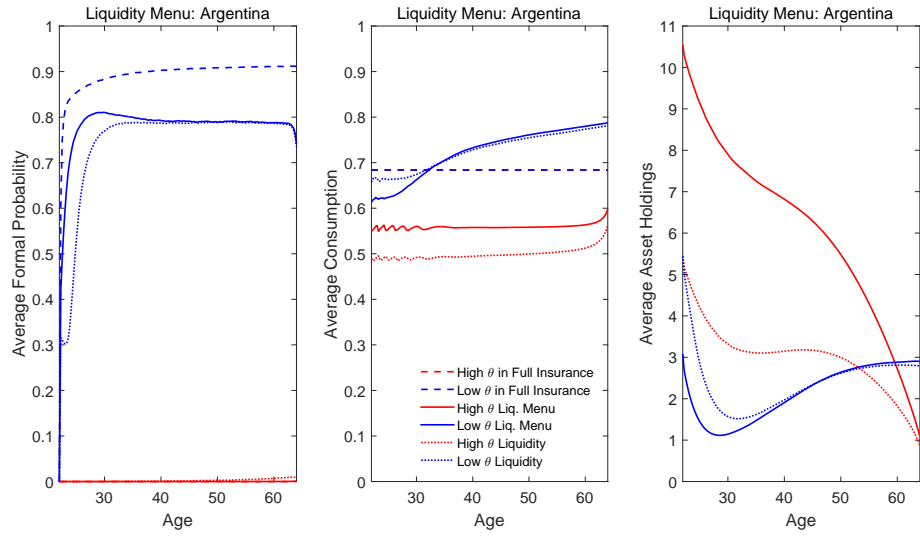
The Role of Heterogeneity - Liquidity Provision with menu

A personalized liquidity provision scheme for Argentina could be very useful. The planner could allocate a larger transfer to inefficient workers. Conditional to this large transfer, a high income tax to attain two tasks: prevent inefficient from working formally and disincentive efficient workers to choose this contract.

The large transfer to the inefficient workers allows them to increase the level of consumption during their hole life cycle, relative to the scheme without menu. Conversely, the lower transfers to the efficient workers force them to increase effort earlier than under the scheme without menu, which allows to sustain larger transfers.

This ends up in an increase in the welfare obtained by the system of 67% of potential gains. In fact, the possibility to separate contracts increase welfare in 53% relative to without menu.

Figure 24: Liquidity Provision Menu



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Appendix

Data used for calibration

Argentina

The moments used for calibration were estimated by us using Argentinian Household Survey which is a short panel that follows each household for one year and covers urban areas of Argentina. Its main purpose is to measure unemployment and other labor market indicators. Since our predictions are steady state ones, we use quarterly data from year 2010 to 2014 and keep with temporally means of the moments.

We use people from 22 to 64 years to estimate moments. Since our model do not have 'inactive' state (every agent receive jobs offers) we discard people younger than 22. We do so in order to keep with an stable 'active' fraction of the population and avoid big migrations, from inactive to active, which create unemployment that is impossible for our model to replicate.

In order to call a person 'informal' we made a personal classification since the Household Survey do not identified them. An issue we have to deal with is that the survey may classify workers as self-employed, a category our model do not have. So, we follow two methods: first, if the interviewed declared himself as employee but do not make social security payments, we call him 'informal'; secondly, if he declares self-employed but do not have university degree nor work for the State, but work in a place with less than six people, we also call him informal,

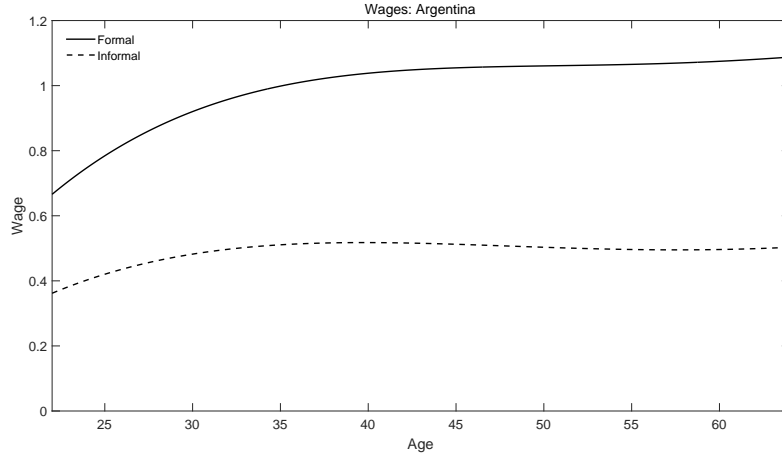
The first one is the standard classification and the second follows the 'productivity method'⁹. With this data we compute the Informality Rate as the fraction of informal workers and Unemployment Rate as the fraction of unemployed among population, both among all and by ages.

Incomes were also estimated using the mean of the reported in the survey. We were aware of the problems that this carry, but considered them innocuous here because the only thing that matters is the relative income between formal and informal. So, we normalized them by the average formal income and approximate polinomially.

Finally, taking advantage of the fact that each household is four quarters in the sample, we compute the transition matrix among the estates, as the fraction of people that begin at state $i = f, i, u$ in t and is at i in $t + 1$.

Estimated wages are presented in the next figure:

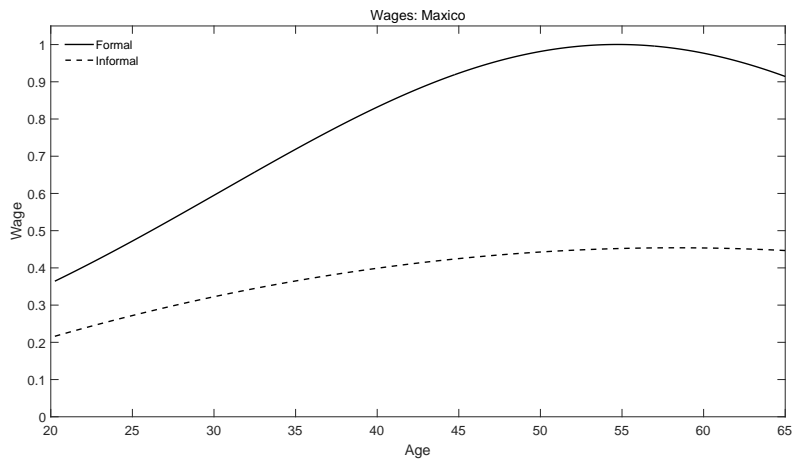
⁹In particular, we follow the same methodology as SEDLAC, 'Guia Metodologica (2015)'



Mexico

The moments used for calibration were taken from the National Institute of Statistics and Geography of Mexico (the INEGI).

The formal wages ω follow the life-cycle profile estimated profile for Mexico by Polachek (2007). Informal wages, ϖ , are calibrated such that the relative wage (before taxes) of informal workers to formal workers is 45.5%, and the growth rate of wages over the lifecycle of informal wages is about two thirds of the growth rate of formal jobs, as documented by Cano-Urbina (forthcoming, Table 1). Salaries were then normalized by the maximum formal salary ¹⁰



¹⁰This is different from Argentina, but it is just a normalization.

Tables

Argentina

Table 3: Argentina Employment Status I

	Benchmark	Full Insurance	Liquidity Transfer	Unemployment Insurance	UISA
Informality	40.5	39.8	50.9	43.1	33.7
Age 22-35	38.7	41.4	55.8	41.3	39.9
Age 36-64	42.4	38	45.6	45.1	26.8
Unemployment	6.2	5.9	7	6.5	8.9
Age 22-35	6.4	6.8	7.9	6.8	8.7
Age 36-64	5.9	4.9	6.1	6.3	9.2

Table 4: Argentina Employment Status II

	UISA with hidden savings	UISA w/ hidden savings at a lower saving rate	UISA MENU	Liquidity MENU	Credit Market
Informality	50.4	43.5	37.9	47.9	43.2
Age 22-35	54.9	46.3	40.4	49.2	48.9
Age 36-64	45.3	40.4	35	46.6	37.1
Unemployment	7	6.4	8.8	6.7	6.4
Age 22-35	7.8	7.2	8.9	7.2	7.4
Age 36-64	6.1	5.6	8.7	6.1	5.3

Table 5: Argentina Welfare Gains

	Consumption (in %) Equivalence Gains	As % of Full Insurance Gains
Full Insurance	12.08	-
Liquidity	5.3	44%
Unemployment Insurance	0.33	3%
UISA	-8.13	-67%
UISA w/ hidden savings	5.20	43%
UISA w/ hidden savings at a lower saving rate	0.72	6%
UISA MENU	1.92	16%
Credit Market	3.44	28%
Liquidity MENU	8.15	67%

Table 6: Argentina: TFP Gains

	TFP			
	Measure 1	Gains from Benchmark	Measure 2	Gains from Benchmark
Benchmark	0.7589	-	0.7119	-
Full Insurance	0.7669	1.08%	0.7214	1.33%
Liquidity	0.7190	-5.24%	0.6685	-6.10%
Unemployment Insurance	0.7463	-1.64%	0.6970	-2.10%
UISA	0.8000	5.43%	0.7290	2.40%
UISA w/ hidden savings	0.7212	-4.96%	0.6710	-5.75%
UISA w/ hidden savings at a lower saving rate	0.7507	-1.06%	0.7020	-1.40%
MENU UISA	0.7760	2.23%	0.7100	-0.28%
Liquidity MENU	0.7279	-4.06%	0.6844	-3.86%
Credit Market	0.7555	-0.43%	0.7072	-0.66%

Table 7: Argentina: Parameters

		Liq. Transfer	b	ψ	\bar{s}	\underline{s}	τ
UISA		8.55	0.4	0.3	7	0	0.24
UISA w/ hidden savings		4.73	1	0	-	0	0.21
UISA w/ hidden savings at a lower saving rate		4.59	0.8	0.14	2	0	0.18
Liquidity		4.97	-	-	-	-	0.22
Unemployment Insurance		-	$b_1:0.06 - b_2:0.07$ $b_3:0.09 - b_4:0.12$	-	-	-	0.1
Benchmark		-	-	-	-	-	0.07
MENU UISA	Low θ	4.46	0.7	0.05	3	0	0.26
	High θ	16.17	0.2	0.1	6	0	0.4
MENU Liquidity	Low θ	2.58					0.21
	High θ	10					0.55

Mexico

Table 8: Mexico: Employment Stats I

	Benchmark	Full Insurance	Liquidity Transfer	Unemployment Insurance	Liquidity Transfer and Unemployment Insurance
Informality	56.4	51.5	57.2	51.8	56.4
Age 20-24	52.1	94.3	71.8	47.9	67.2
Age 25-39	50.2	54.2	46.0	44.8	46.2
Age 40+	67.3	27.4	66.2	63.7	66.0
Unemployment	2.8	2.4	2.6	2.5	2.6
Age 20-24	4.6	5.8	4.7	4.1	4.7
Age 25-39	2.3	2	1.9	1.9	2.0
Age 40+	2.7	1.4	2.5	2.5	2.6

Table 9: Mexico: Employment Status II

	UISA	UISA w/ hidden savings	UISA w/ hidden savings at a lower saving rate	UISA MENU
Informality	52.5	59.8	58.1	49.6
Age 20-24	99.2	76.2	91.7	99.1
Age 25-39	68.6	48.6	50.0	63.1
Age 40+	2.9	66.1	51.2	2.8
Unemployment	3.4	2.7	2.6	3.2
Age 20-24	5.5	4.8	5.3	5.4
Age 25-39	3.2	2	2.0	2.8
Age 40+	2.6	2.5	2.1	2.6

Table 10: Mexico: Welfare Gains

	Consumption (in %) Equivalence Gains	As % of Full Insurance Gains
Full Insurance	23.27%	100.00%
Liquidity Transfer	4.83%	20.8%
Unemployment Insurance	1.60%	6.9%
Liquidity Transfer and Unemployment Insurance	4.90%	21.1%
UISA	11%	47%
UISA w/ hidden savings	3.08%	13.24%
UISA w/ hidden savings at a lower saving rate	4.73%	20.33%
UISA MENU	13.02%	55.95%

Table 11: Mexico: TFP Gains

	TFP			
	Measure 1	Gains from Benchmark	Measure 2	Gains from Benchmark
Benchmark	0.4904	0.0%	0.4765	0.0%
Full Insurance	0.5514	12.4%	0.5379	12.9%
Liquidity Transfer	0.4930	0.5%	0.4800	0.7%
Unemployment Insurance	0.5050	3.0%	0.4928	3.4%
Liquidity Transfer and Unemployment Insurance	0.4943	0.8%	0.4814	1.0%
UISA	0.5719	16.6%	0.5522	15.9%
UISA w/ hidden savings	0.4853	-1.0%	0.4723	-0.9%
UISA w/ hidden savings at a lower saving rate	0.5065	3.3%	0.4932	3.5%
UISA MENU	0.5777	17.8%	0.5593	17.4%

Table 12: Mexico: Parameters

		τ	b	\underline{s}	\bar{s}	ψ	Liq. Transfer
Benchmark		0.235	$b_1:1$				0.00
Liquidity Transfer		0.214	-	-	-	-	0.74
Unemployment Insurance		0.173	$b_1:0.25 - b_2:0.05$ $b_3:0.05$	-	-	-	-
Liquidity Transfer and Unemployment Insurance		0.216	$b_1:0.25$	-	-	-	0.64
UISA		0.468	0.48	0.01	1.4	0.1	11.4
UISA w/ hidden savings		0.235	0.897	0.01	1	0	0.92
UISA w/ hidden savings at a lower saving rate		0.249	0.6	0.01	1.6	0.05	1.94
UISA MENU	Low θ	0.371	0.55	0.01	1.4	0.17	9.61
	High θ	0.540	0.38	0.01	1.4	0.12	11.6