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HOUSEHOLDS' FINANCIAL VULNERABILITY

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HOUSEHOLDS' FINANCIAL VULNERABILITY

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Resumen

La vulnerabilidad financiera de los hogares determina el riesgo de no pago de sus deudas. La estabilidad financiera podría verse afectada por el comportamiento de los hogares bajo condiciones macroeconómicas difíciles. La vulnerabilidad financiera del los hogares depende de su nivel de endeudamiento y de la fragilidad de sus fuentes de ingreso y su capacidad de cumplir sus obligaciones financieras. La principal fuente de incertidumbre proviene de la generación de ingreso laboral, esencialmente determinada por el desempleo. La heterogeneidad del endeudamiento y de la incertidumbre en materia de ingreso exige un análisis microeconómico. Este artículo utiliza un análisis de sobrevivencia con datos de panel para estimar la probabilidad de los individuos de perder el empleo. Utilizando métodos semiparamétricos, se encuentra heterogeneidad significativa en el impacto del desempleo agregado a nivel de individuos. Se realizan simulaciones de Monte Carlo para el estrés financiero de los hogares y luego para estimar la deuda agregada en riesgo en escenarios de alto desempleo. Dado que la mayor parte de la deuda corresponde a quienes cuyo ingreso es menos vulnerable, se concluye que un alto nivel de desempleo no tiene efectos significativos sobre la estabilidad financiera.

Abstract

Households financial vulnerability determines households' default risk. Financial stability could be affected by households behaviour under stressing macroeconomic conditions. Households financial vulnerability depends on their indebtedness levels and on the fragility of their income sources to be able to fulfill their obligations. The main source of households uncertainty comes from labour income generation, which is critically determined by unemployment. Heterogeneity of indebtedness levels and of income uncertainty calls for microeconomic analysis. This paper uses panel data survival analysis to estimate the probability of job loss at the individual level. Using semiparametric methods, a significant heterogeneity is found for the impact of aggregate unemployment among individuals. Monte Carlo simulations are run to assess households financial stress and then to estimate aggregate *debt at risk* under high unemployment rates scenarios. Since the majority of debt is held by those with lower levels of income vulnerability, it is found that financial stability is not significantly affected by high unemployment levels.

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Introduction

Households' indebtedness in Chile has received considerable attention in recent years because of the financial deepness process that has been experimented in the economy. Although different indicators from a macroeconomic point of view have shown significant increases during the last decade, there are few elements that allow evaluating the real vulnerability of this sector from a financial stability perspective. One of the tools that permit to assess household's financial vulnerability is stress testing by using microeconomic information.

Even though the financial risks that a household may face are varied and can come from different sources, the household sector will be more sensitive to changes in household income such as that caused by unemployment (Debelle 2004). Moreover, household vulnerability to aggregate shocks that generate increases in unemployment rates will depend both on debt distribution and household characteristics. The heterogeneity of indebtedness levels and of income uncertainty calls for microeconomic analysis.

The main objective of this paper is to carry out a household stress test at the microeconomic level that allows quantifying the household *debt at risk* when facing aggregate shocks. Since evidence from debt issuers indicates that the main reason for household to default is unemployment, this paper will focus in labour income risk associated to the probability of job losing when aggregate unemployment rate shifts. For this purpose, this paper uses panel data survival analysis to estimate the probability of job loss at the individual level. Then, Monte Carlo simulations are run in order to assess household financial stress by estimating aggregate debt at risk under high unemployment rate scenarios.

Financial data at the household level is scarce, and this is one of the reasons why there is no abundance of household level studies to assess household financial indebtedness. The recent Chilean Survey of Household Finances (Encuesta Financiera de Hogares - EFH) run by the Banco Central de Chile contributes with novel information for this type of analysis.

Nordic countries have been leading this sort of analysis. In fact, the Sweedish Central Bank, (Riskbank) has published a series of simulations based on micro data (Riksbank, 2006, 2007). They found that Sweedish households are not particularly vulnerable to shifts in interest rates and/or unemployment rates. They find that 6.3% of households have what they call negative margin, concentrating 5.6% of total household debt (debt at risk). Unemployment rates increases of 1-3 percentage points imply that households without margin increase to 6.7% and debt at risk increases to 6.3%. Norwegian Central Bank (2006) also carries out a similar exercise, finding that 19% of households have negative margin, and that 16% of total debt is held by those households. They conclude that low and median income groups hold the majority of the exposed debt and have increased they participation over time.

However, the Nordics do not take into account that aggregate unemployment affects in a different manner agents across households. In fact, they consider that the probability of falling into unemployment is uniform for all workers. This is a very strong assumption and

can bias the results depending on the distribution of debt among individuals. In Chile, there is evidence that unemployment is less frequent among those with high education groups and of middle age (Neilson and Ruiz-Tagle, 2007), supporting heterogeneous responses.

Section 2 analyses the distribution of household indebtedness in Chile and discusses *debt at risk* using the EFH 2007 data. Section 3 estimates job loss probabilities using the Social Protection Survey Panel (Encuesta de Proteccion Social - EPS) data waves 2002 and 2004, covering a 10-year period 1995-2004. Non parametric and Semiparametric methods are used to estimate the impact of aggregate unemployment rates on individual job loss probabilities. Section 4 carries out simulations of *debt at risk* under different scenarios. For this purpose, job loss probabilities are imputed into the EFH data, and then Monte Carlo simulations are run to assess the distribution of the stress test. Finally, section 5 concludes.

Household indebtedness and *debt at risk*

Household borrowing debt has grown considerably in Chile, both in absolute terms and relative to household income. In fact, debt's growth rate has constantly surpassed that of real GDP during the last decades. This has raised concerns about the household sector´s vulnerability and possible implications for the stability of the financial system. The ability to pay back debts by households and the amount of debt they hold determine how much of this debt could be considered *at risk* of not being recovered by credit issuers.

Households' real banking debt represents more than 70% of total household debt (see Figure 1) and has grown almost 15% in average in real annual terms between 2003 and 2008. Therefore, real banking debt has almost doubled during this period while real GDP increased almost 30% during the same time.

Total household debt growth, has also surpassed households' disposable income growth; hence debt to disposable income ratio has grown significantly over the last years. In the fourth quarter of 2008, this aggregate indicator has reached almost 69% from 44% in the fourth quarter of 2003. Furthermore, the financial service burden to disposable income ratio has also expanded from 14% to 20% over the same period (see Figure 1).

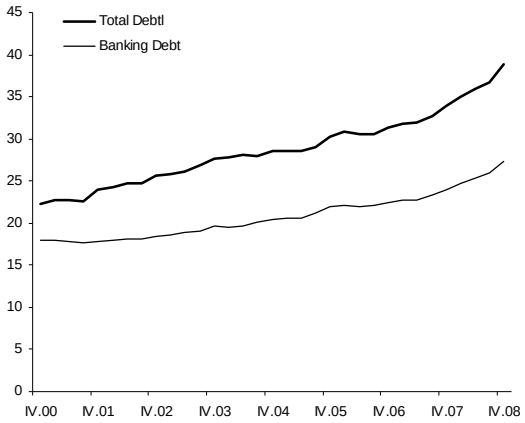
Since banking debt is by far the most important household debt, exposure of the banking system to household sector is a matter of concern from a financial stability perspective. Banking exposure, measured as the sum of total mortgage and consumer loans as a percentage of total banking loans, has increased to more than 33% in 2008 from 15% at the beginning of the 1990s.

Even though Chilean households are increasing their debts, there are no clear signs that Chile is following a trend significantly different from other countries. In fact, the relationship between households debt to GDP and per capita GDP suggests that household debt is not a significant share of GDP. Nevertheless, the financial service burden to disposable income ratio is not particularly low compared to its economic development

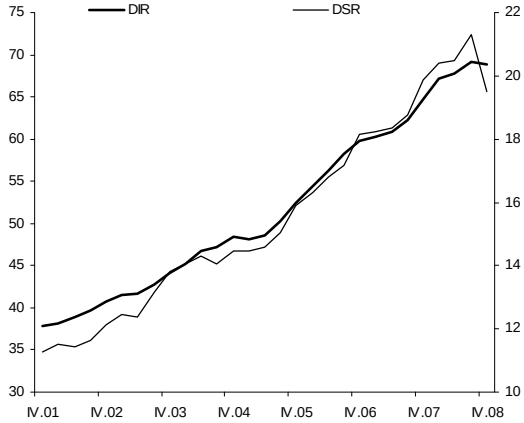
measured as the per capita GDP (see Figure 2). This last observation is related to the length of the loans and the high interest rates, when compared to developed economies[1].

Figure 1: Chilean Households indebtedness at the macro level

A. Households' debt as percentage of GDP (percentage)



B. Debt to income ratio (DIR) and debt service to income ratio (DSR) (percentage)

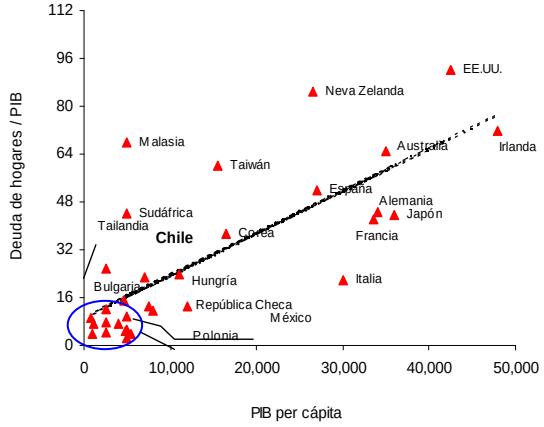


Source: Central Bank of Chile

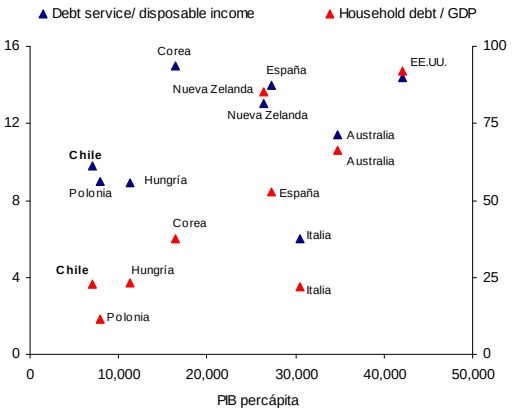
In parallel, analysis at a microeconomic level shows an important heterogeneity among Chilean households. The most noticeable fact is that the vast majority of debt is held by high income groups. This is particularly important in Chile because of the high levels of income inequality. In fact, debt distribution maps rather well income distribution.

Figure 2: Household debt: International Comparison

(a) Households debt and economic development (percentage, US dollars)



(b) DSR and household debt (percentage)



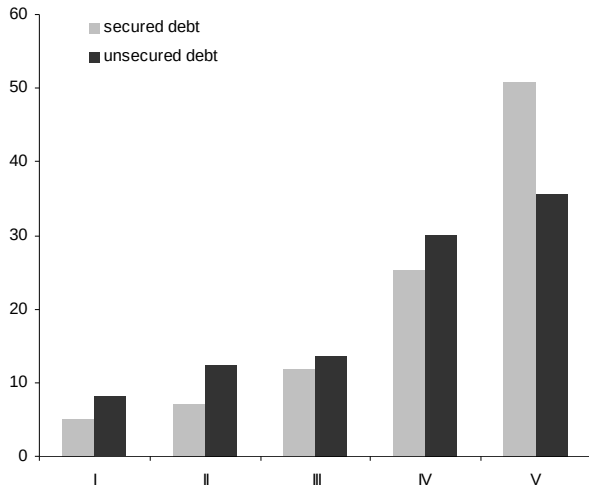
(*) Countries inside the circle: Venezuela, Philippines, Russia, Colombia, Indonesia, Peru, Brazil, Romania, Argentina, India, China and Turkey. Source: IMF, Global Financial Stability Report 2006

[1] There are some caveats about the financial service burden since in some countries, debt service refers only to interest payments while in others it includes required loan payments which include both interest and principal repayments (including Chile).

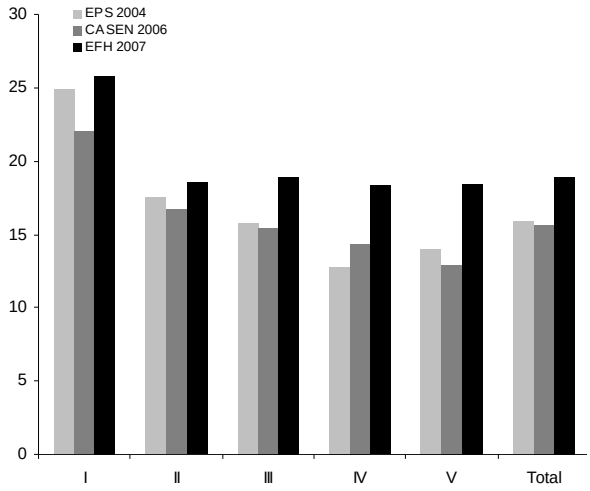
Different microeconomic surveys show this similar pattern, though it may be slightly changing over time, suggesting a financial deepening process (see Figures 3 and 9 of the appendix). Moreover, households' behavior in terms of their ability to pay back debts may vary considerably depending on their debt levels and on their income levels. This is an important reason to consider households heterogeneity when analyzing households financial vulnerability.

Figure 3: Chilean Households indebtedness at the micro level

(a) Distribution of debt by income quintiles: EFH 2007
(by total household income quintile as percentage)



(b) DSR by income quintiles
(percentage)



Source: Authors' own calculation based on EPS 2004, CASEN 2006 and EFH 2007

In what follows of this section datasets are described and a discussion of the *debt at risk* methodology is presented.

The Chilean Survey of Households Finances

In order to assess household financial vulnerability, detail financial data at the household level is necessary. The recent Chilean Survey of Household Finances (Encuesta Financiera de Hogares - EFH), contributes with novel information for this type of analysis.

The EFH has been conducted by the Central Bank of Chile for the first time during 2007. This initiative, pioneer in the region, asks detailed questions about labour status, real estates ownership, financial assets, debts, perceptions about debt service, access to credit, pensions, insurances and savings. The EFH 2007 included 4,021 households, being representative at a national urban level. Furthermore, since there are many assets held by only a small fraction of the population, this survey also has an over-sample of the wealthier households. Thanks to the collaboration of the Tax Office (Servicio de Impuestos Internos) it was possible to obtain a sample with a significant oversampling of the high wealth households. Therefore, the EFH 2007 constitutes the only statistical source in Chile that

provides complete information about the balance sheets of the households as well as their ability to service financial commitments[2].

Debt Distribution and *debt at risk*

There is no such a common knowledge definition of *debt at risk*. So far, the Chilean Central Bank[3] has used a definition of debt at risk based on high levels of "Debt Service Ratio" (debt service over income ratio). On the other hands, Nordic countries have considered "negative margins" (total spendings > total income). Also, they included liquid and illiquid assets as debt backup. For household *h*, the "margin" is computed as:

$$M_h = Y_h - DS_h - E_h, \quad (1)$$

Where Y_h is household total income, DS_h is debt service, and E_h is household total expenditures.

In this paper, the base scenario of *debt at risk* is built considering two dimensions: Negative financial margin and high DSR. Data collection posses two problems for interpretation: First, there is a risk of double counting, e.g., clothes expenditure could also appear as debt if payed in statements; second, if a significant part of total expenditure is made through credit in statements (including supermarket expenditure for example) the DSR indicator could actually overestimate the financial stress of the households.

Taking into account these caveats, a base scenario for *debt at risk* is built considering both negative financial margin and high DSR. Negative financial margin is set at 20% excess expenditure over income and DSR is considered at above 50 and above 75. Table 2 presents results for the base scenario of *debt at risk* based on the debt service ratio (DSR) and the financial margin. It can be observed that 13.6% of households exhibit negative margin and DSR larger than 50 percent, holding 20% of total debt. A more refined assessment of *debt at risk* considers DSR above 75 percent, indicating that 9.5% of households are highly financial stressed and total debt at risk reaches 16% (15% of secure debt and 19% of unsecured debt).

Assessing Financial Vulnerability

Households' financial vulnerability in Chile is mainly due to the income sources. This is because only a negligible part of household debt has variable interest rate. The principal households' income source is labour income of their members[4]. Labour income can be lost if the job ends due to any reason, either voluntary or involuntary. At any time, workers face a certain probability of losing their jobs. Estimating these job loss probabilities allow to

2 Description, methodology and results of the Chilean Survey of Household Finances 2007 are explained in Banco Central de Chile (2009)

3 See Cox, Parrado and Ruiz-Tagle (2007).

4 Neilson et al. (2008) document that labour dynamics is the main factor driving entry and exit from income stressing conditions. In the EFH, labour income accounts for more than 60\% of total households income.

impute them to working individuals in order to be able to assess their financial vulnerability when financial information is available.

There are no available estimations of job loss probabilities in Chile[5]. Therefore, this section provides estimations of job loss probabilities using survival analysis with non-parametric and semi-parametric methods. In particular, the interest is focused on the effect of aggregate unemployment rate on job loss probabilities.

Both in a static and in a dynamic framework, the effects of aggregate unemployment are heterogeneous. Given that the distribution of households debt is diverse, the impact of higher unemployment levels generates non-homogeneous effects on *debt at risk*. The Nordics proposed a simplified analysis assuming that unemployment shocks affects all individuals in the same manner. Although limited, that methodology makes sense for them because the distribution of debt in those countries is much flatter than in Chile (particularly in Norway), and also because they have large unemployment benefits that cover a substantial part of lost income for a long period. In contrast, for Chile it is more adequate to estimate disaggregate job loss probabilities to assess heterogeneous impacts.

Job loss probability

Estimating job loss probabilities requires survival analysis. In this case, job loss probability mirrors the probability of staying employed. What is estimated then is the probability of surviving employed at a given moment of time *t*.

Let *T* be a non-negative random variable denoting the time to failure event (in this case failure is job loss). The survival function is the reverse of the cumulative distribution function of *T* (*F*(*t*)):

$$S(t) = 1\text{-}F(t) = \Pr(T>t), \tag{2}$$

And it reports the probability of surviving beyond time *t*, where the density function is simply $f(t) = -S'(t)$.

The cumulative hazard function is defined as:

$$H(t) = -\ln\{S(t)\}, \tag{3}$$

So that,

$$f(t) = h(t)\exp\{-H(t)\}. \tag{4}$$

For the purpose of this paper, what is interesting is how some covariates affect the hazard function, which requires multivariate analysis. Nevertheless, simpler non-parametric analysis can be used to compare different group's hazard functions. This is done by estimating the survival function through the Kaplan-Meier (1958) estimator given by:

[5] There are only estimations for unemployment duration.

$$\hat{S}(t) = \prod_{j|t_j \le t} \left(\frac{n_j - d_j}{n_j}\right), \tag{5}$$

Where n_j is the number of individuals at risk at time t_j and d_j is the number of failures at time t_j.

On the other hand, the Cox (1972) semi-parametric model requires no parametric form of the survival function, and assumes that covariates shift multiplicatively the baseline hazard function. For the *j*-th subject, the hazard function is:

$$h(t \mid X_{j,t}) = h_0(t) \exp(X_{j,t}\beta_x) \tag{6}$$

Where the $\beta_x's$ are to be estimated from the data.

The baseline function $h_0(t)$ is not parameterized (actually it is not estimated), because the model is proposed in terms of ratios (individual *j* compared to individual *m*):

$$\frac{h(t \mid X_{j,t})}{h(t \mid X_{m,t})} = \frac{\exp(X_{j,t}\beta_x)}{\exp(X_{m,t}\beta_x)} \tag{7}$$

The Cox model is rather convenient for the purpose of this paper because it is easy to compute and can provide predicted probabilities given the covariates.

Parametric methods require imposing a functional form to the baseline hazard function. The most common are Weibull, Exponential, Lognormal, Gamma and Loglogistic. These models are computationally costly, and have also the disadvantage of bias in case of an inappropriate distributional assumption.

This papers combines different non-parametric, semi-parametric, and parametric methods in order to be able to predict accurately job loss probabilities.

The Data

Since 2002 a novel panel survey called Social Protection Survey (Encuesta de Proteccion Social, EPS) has been carried out in Chile every two years. The survey was designed to assess the well being of workers and nonworkers and their households[6]. The EPS accounts for 16,727 observations that represents the population of Chile aged 18 and more in 2004.

In the 2002 wave, the individuals were asked to remember every single labor story since 1980 up to date in a chronological way. Each story had a beginning date and an ending date. For each story the individual was asked about his employment status, characteristics

[6] The EPS was designed jointly by the Ministry of Labor and the Center for Microdata of the University of Chile, with the close collaboration of the University of Pennsylvania.

of the job and some qualitative questions. In the 2004 wave, individuals were asked to remember the missing history, i.e., the stories that occurred between 2002 and 2004.

The data is then set up so that we have a monthly panel of individuals with the corresponding employment information in each period of time. Then, for each month, we know the employment status of a sample that is representative of the Chilean population aged 18 and more in 2004. Representativeness in past years is narrowed to a varying age group. For instance, in 2004 the data is representative of the people between 18 and 65 years old, in 2003 the data is representative of the people between 18 and 64 years old, and so on.

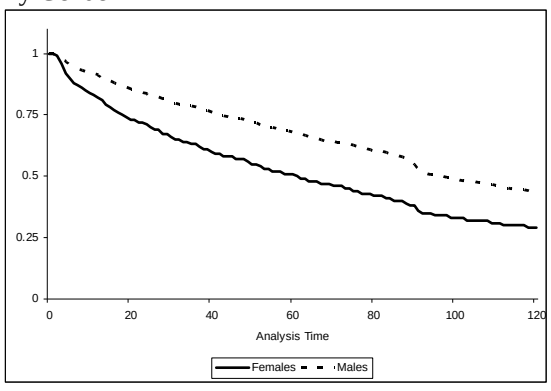
In this paper, a ten year period, from 1995 until 2004, has been chosen. This is because in this period Chile experienced the effects of the Asian crisis with a relatively short mild recession in 1999 and 2000. Unemployment rate rose significantly and remained higher for a long period afterward. This implies that the sample is compound by 16,727 individuals observed around 120 months, which implies that the dataset has around 2 million records.

Estimation Results

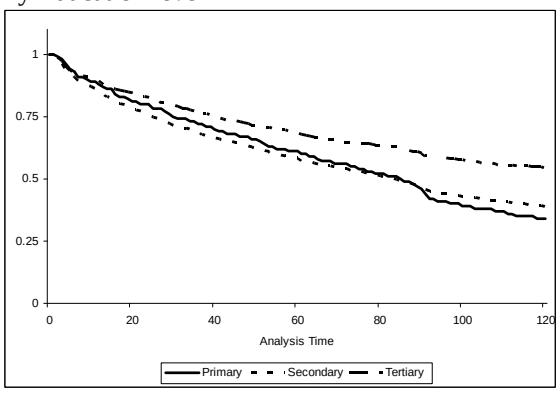
Using the labour stories from the EPS 2002 and 2004, job loss probabilities are estimated. Those probabilities are estimated using a set of individual characteristics X_{jt} and a set of time variant aggregate variables Z_{jt}. The X_{jt} vector of variables includes gender, age, education, job contract, marital status, economic sector of the job, size of the firm, among others. The Z_{jt} vector of variables considers aggregate unemployment rate and monthly activity indexes.

Figure 4: Job Loss Probabilities

(a) Kaplan Meier survival estimates
By Gender



(b) Kaplan Meier survival estimates
By Education level



Source: Authors' own calculations using EPS 2002 and 2004.

It is important to mention that job loss is defined as any exit from job, both to unemployment and to inactivity. This is because the objective of this exercise is to assess the ability of households to cope with their financial obligations, so that any decay in income will affect household financial stress.

In order to assess survival heterogeneity, it is useful first to look at the Kaplan-Meier non-parametric estimates of the survival functions. Figure 4 presents estimations of the survival function by gender and educational level. What is interesting to note is that males are less likely to lose employment at any time. In fact, the mean estimator indicates that males remain employed 50% longer times than females, and the probability of losing employment reaches 50% only after 80 months for both genders.

On the other hand, those with tertiary education have a much lower probability of losing employment than those with primary and secondary education. In parallel, workers with secondary education compared to those with primary education have a larger job loss probability at shorter employment duration and a lower job loss probability after ninety months.

Multivariate analysis using the Cox's semi-parametric estimations of the proportional hazard model was carried out for multiple specifications. Table 1 presents our preferred model. A series of interesting results emerge clearly from the data. First, males have around 30% lower probability than females to lose employment and the unemployment rate shifts that probability in 17%. However, unemployment seems to have a much larger effect on males than females (around 8% per unemployment percentage points).

Second, age has a negative decreasing effect on job loss probabilities. This indicates that younger workers are much more likely to lose employment at any given moment of time. However, that effect fades as age increases.

Third, workers with higher levels of education face a significantly lower probability of employment loss. Those with tertiary education have about 30% lower probability than those with primary education only. Also, those with tertiary education have about 60% less probability of employment loss.

Table 1: Cox Estimations of Job Loss Probabilities
(Coefficients in exp(β) form)

Variable	Haz. Ratio	Std. Err.	z	P>|z|	[95\% Conf.	Interval]
Males=1	0.3326779	0.0236855	-15.46	0	0.2893485	0.3824957
Age	0.8659158	0.0045911	-27.15	0	0.8569641	0.874961
Age^2	1.001452	0.0000652	22.28	0	1.001325	1.00158
Unemp.Rate	1.121433	0.0058121	22.11	0	1.110099	1.132882
Unemp.R.*(Males=1)	1.064744	0.0065273	10.23	0	1.052027	1.077614
Unemp.R.*(EducS=1)	0.960692	0.0017416	-22.12	0	0.9572847	0.9641115
Unemp.R.*(EducT=1)	0.9768453	0.0044419	-5.15	0	0.9681781	0.9855902
No. Subjects	12906					
No. failures	10907					
No. Observations	1295487					
Time at risk	1301439					
Log likelihood	-99708.428					
LR chi2(7)	3661.31					

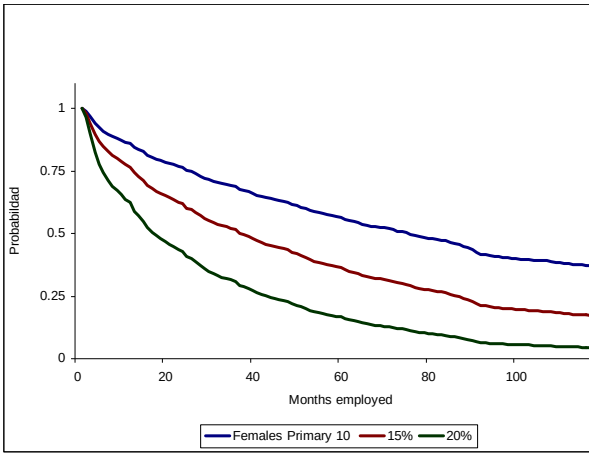
The effect of the unemployment rate is also heterogeneous among different education groups. In fact, workers with tertiary education have a 5% lower probability per

unemployment percentage point (implying about 45% lower probability on average) than those with primary education only. Workers with secondary education face a 3% lower probability per unemployment percentage point (implying about 27% lower probability on average) than those with primary education only.

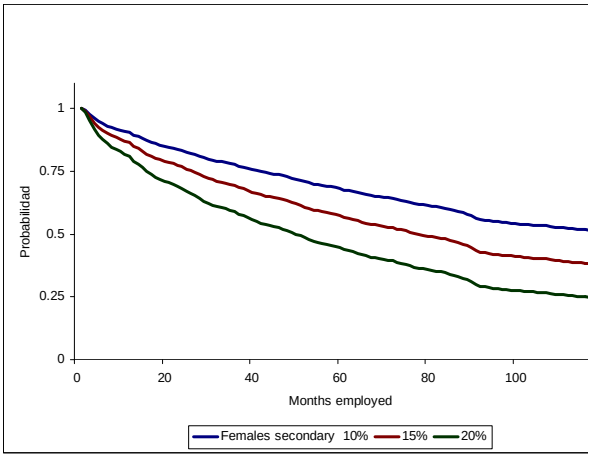
From the Cox's estimations we can predict job loss probabilities through the survival functions. Figures 5 and 6 show the survival functions estimations for females and males respectively. Age was set at mean values (around 41 years old), and unemployment shifts were set at 10%, 15%, and 20%. Its is clear from the graphs that higher educational attainment diminishes job loss probabilities and, more importantly for our purposes, also diminishes the impact of a an aggregate unemployment shift. It can also be observed that females exhibit higher probabilities of job loss (the survival functions are lower), but that aggregate unemployment shifts affect considerably more males than females.

Figure 5: Job Loss Probabilities

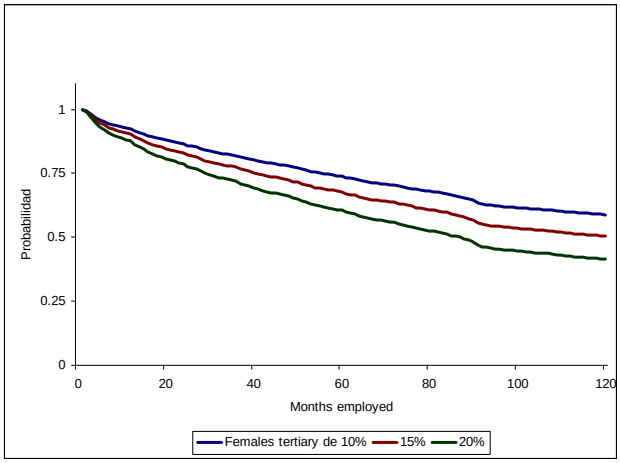
(a) Survival Function. Unemployment at 10,15 and 20% (women with primary education)



(b) Survival Function. Unemployment at 10,15 and 20% (women with secondary education)



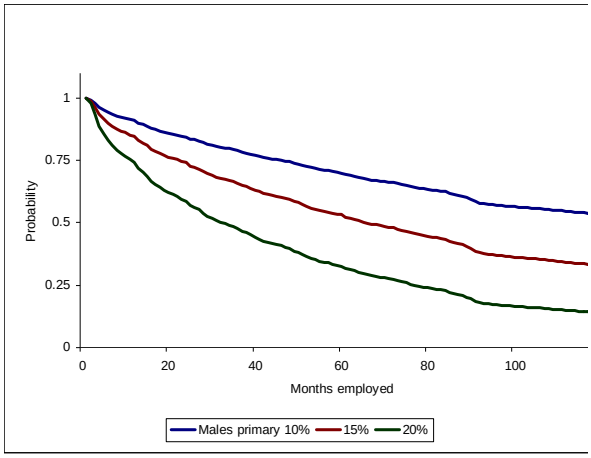
(c) Survival Function. Unemployment at 10,15 and 20% (women with tertiary education)



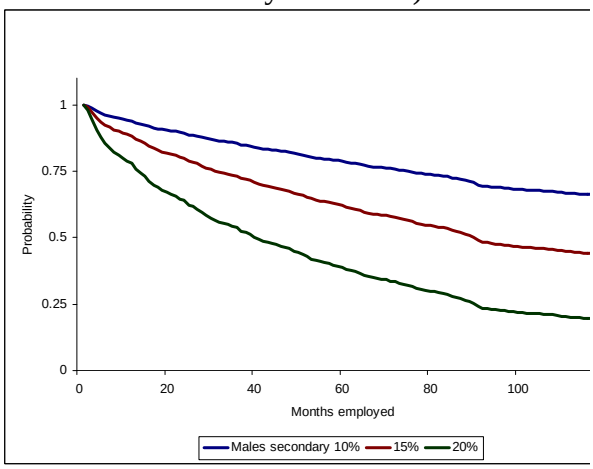
Source: Authors' own calculations using EPS 2002 and 2004.

Figure 6: Job Loss Probabilities

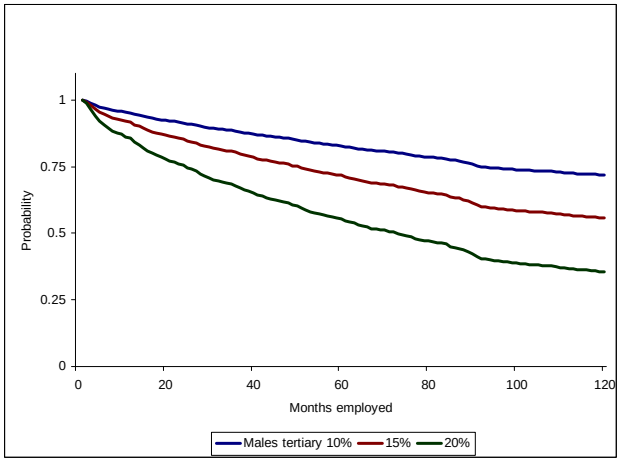
(a) Survival Function.
Unemployment at 10,15 and 20% (men with primary education)



(b) Survival Function.
Unemployment at 10,15 and 20% (men with secondary education)



(c) Survival Function.
Unemployment at 10,15 and 20% (men with tertiary education)



Source: Authors' own calculations using EPS 2002 and 2004.

Financial Stress Simulation

This section is devoted to the analysis of higher unemployment rates simulations and their effects on *debt at risk*. Monte Carlo simulations are run on the probability of losing employment for each of the worker individuals in each household. Employment loss probabilities are taken from section · and then imputed to the EFH dataset.

The first problem faced for this exercise is that the EFH does not contain information about employment duration. Employment loss probabilities depend critically on the duration of the job, hence employment duration has to be imputed. In order to do so, workers are separated into cells by age group and educational attainment. For each cell, the whole

distribution of employment duration is computed as $\hat{d}_c$. Then, every worker *j* in cell *c* will be assigned a random employment duration following the actual distribution $\tilde{d}_c \sim \hat{d}_c$. Hence, this is the first source of randomization[7].

Then, simulations are ran as follows. First, a uniform random number u_{jh} is assigned to each worker in the EFH. For each worker in the EFH with an assigned employment duration $\tilde{d}_c$ with characteristics X_{jh} and under the scenario given by Z^t, a job loss probability is computed using the estimated parameters from the hazard function. If that probability falls below the threshold given by the random number, the worker will be considered as employed. If not, the worker will be considered as if he had lost his employment, so that his labour income will become equal to zero.

$$\hat{Y}_{jh}^t = Y_{jh}^t \times 1\left(\hat{\Pr}_{jh}^t(X_{jh}^t, Z^t) > u\right) \tag{8}$$

The second source of randomization comes from the fact that the simulated employment loss probability contains the uncertainty respect to the survival model estimation through the probability of losing the job.

After the employment condition of the worker is redefined and his corresponding labour income recomputed, overall household income is computed again. Then, DSR must be refreshed to reflect the simulated total household income. Finally, aggregate indicators of *debt at risk* are computed again for the whole sample.

In the base scenario, 61% of total households hold any sort of formal debt. In fact, 16% of households hold secure debt and 57% hold unsecured debt. Secure debt is 60% of total debt (unsecured debt is 40%). On the other hand, 45% of total debt is held by the upper richest quintile (51% of secure debt and 36% of unsecured debt). Besides, median DSR is 19.5% for all indebted households.

Table 2 presents the results of the simulations[8]. In the base scenario, considering DSR above 75% and negative margin above 20%, it is obtained that 9.5% of households are considered with debt at risk. Those households accounts for 16.1% of total households debt.

Then, underlying job loss probabilities are included in order to add to the current debt at risk, the households that could have members losing their jobs at any moment of time, and then fall into higher financial stress. This shifts the number of households under financial stress to between 13% and 16%, and total debt at risk to between 20% and 25% in a 95% confidence interval[9].

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[7] The actual cumulative density function, $\Phi\hat{d}_c$, was approximated by a 9-degree polynomial in order to be used for simulations. Figures 10 and 11 of the appendix show those estimations.

[8] 500 Monte Carlo simulations were used. Exercises with 1,000 and 5,000 simulations implied no significant changes.

[9] 95\% confidence intervals were build non parametrically using simulation percentiles.

Next, unemployment rate is increased by 5%. This is an increase larger than the one occurred during the Asian crisis. Under this scenario, the number of households under high financial stress increases to between 16% and 19%, and debt at risk increases to between 22% and 28%. A more stressing scenario with an increase of unemployment in 15% is also simulated. It can be observed that this scenario increases the number of highly stressed households to between 25% and 28%, and debt at risk to between 31% and 38%. These results indicate that significant increases in aggregate unemployment rate do not imply necessarily a significant increase in *debt at risk* compared to the actual situation.

The implications of these results are that higher levels of unemployment similar to what was observed during the Asian crisis do not necessarily imply that the financial system will suffer a significant default shock by households. In fact, this would increase debt at risk only in around 4 percentage points (comparing to the base scenario including underlying job loss probabilities). Nevertheless, this does not mean that the financial system can overlook households debt. In fact, from Table 2 one can estimate that for a one percentage point increase in the unemployment rate, there is between 0.6 and 0.8 percentage points increase in *debt at risk*[10].

Table 2: Households with negative margin
(Intervals for simulations are p(2.5) to p(97.5))

	% Households	% Secured Debt	% Unsecured Debt	% Total Debt
Base Scenario				
DSR>50	13.6	17.1	26.1	20.2
DSR>75	9.5	14.5	18.8	16.1
Base scenario + underlying job loss probability				
DSR>50	18.2 - 20.8	20.3 - 26.3	30.8 - 36.5	24.3 - 29.4
DSR>75	13.2 - 15.6	17.1 - 22.6	23.1 - 29.0	19.7 - 24.6
Delta+ 5\% Unemployment				
DSR>50	21.5 - 24.4	22.9 - 30.2	34.1 - 40.4	27.1 - 33.0
DSR>75	15.9 - 18.8	19.2 - 26.2	26.2 - 33.3	22.3 - 28.1
Delta+ 10\% Unemployment				
DSR>50	26.1 - 29.5	26.7 - 35.3	38.7 - 45.6	31.2 - 38.3
DSR>75	20.1 - 23.3	22.8 - 30.2	30.9 - 38.8	25.9 - 32.6
Delta+ 15\% Unemployment				
DSR>50	31.0 - 34.6	31.9 - 40.9	44.3 - 51.4	36.6 - 44.3
DSR>75	24.5 - 28.0	27.0 - 35.3	36.4 - 44.3	31.0 - 37.9

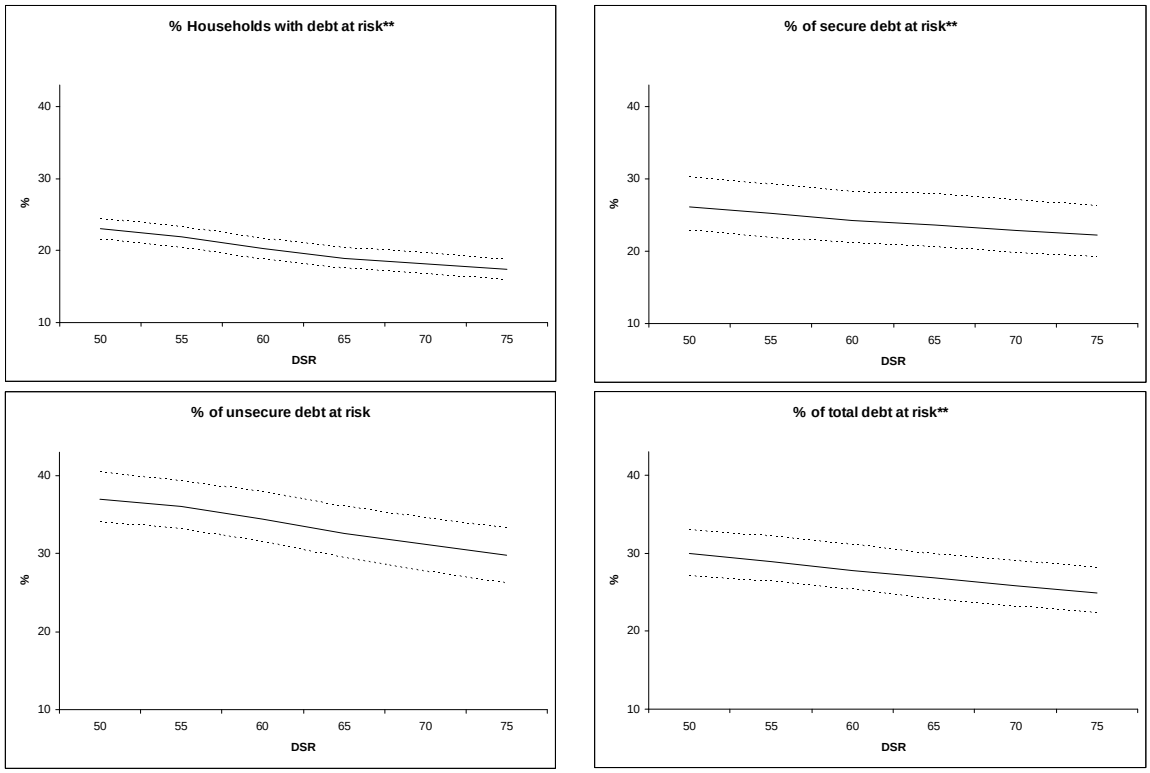
The DSR cut level of 75% can be considered as a not so demanding condition for considering a household under high financial stress. Although Table 2 also includes the cut level at 50%, Figure 7 complements the analysis by presenting a variety of DSR cut levels under an unemployment shift of 5% and with negative margin at 1.2. The conclusion of the

[10] Jappelli, Pagano and DiMaggio (2008), in a sample of 11 EU countries, estimated 0.37 percentage points increase in arrears for each percentage point increase in the unemployment rate.

inspection of those graphs is that results are fairly stable, without presenting extreme shifts in debt at risk[11].

An additional interesting analysis is to look at the distribution of the effects by income quintiles. Figure 8 presents the base scenario plus the extreme scenarios (percentiles 2.5 and 97.5) under a 5% increase in aggregate unemployment rate. It can be observed that when unemployment increases, for the debt at risk to increase significantly, it has to occur that the households in high income quintiles suffer significantly from unemployment. From the estimations of the job loss probabilities, we know that this is less likely to occur under all circumstances. However, the bottom line is that monitoring should be placed on high-income high-debt households.

Figure 7: Debt at Risk Simulations at different DSR cut-levels



Unemployment shift of 5%

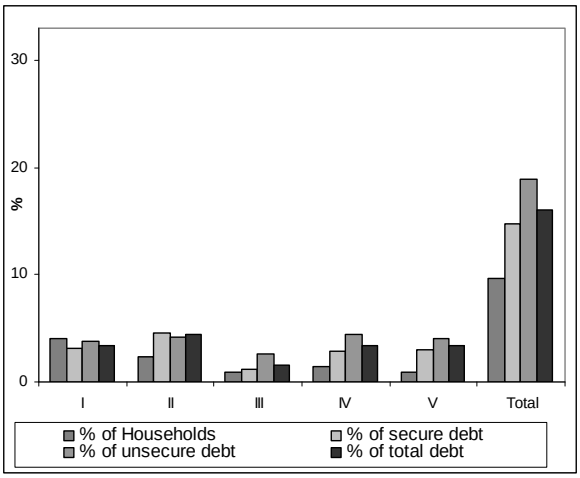
Finally, some caveats about this results should be considered. There is a number of issues that are not considered in this simulation exercise. First, as workers face non-negative unemployment probabilities, unemployed (and inactive) workers face a non-negative probability of becoming employed and then to be able to contribute with labour income to household financial resources, making financial situation less stressing. Second, workers that become unemployed may have unemployment insurance, although in Chile this does

11 Figure 12 in the appendix also presents the exercise with negative margin at 1.1.

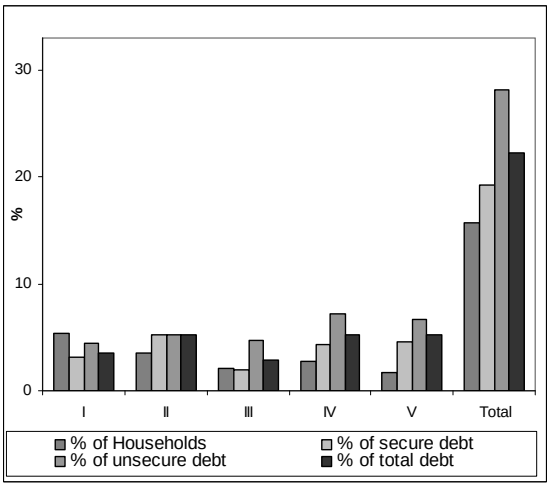
imply a significant source of income[12]. Third, workers who retire to inactivity may have pension income. Fourth, households that suffer from unemployment may use other sources of income to face their financial obligations, making default less likely to occur. Fifth, households who suffer from unemployment may sell assets in order not default. Finally, since household level default data is not available, the increase in *debt at risk* after a shock should be interpreted as household debt that could come under financial strain, rather than an increase in nonperforming loans. Nevertheless, all these caveats go in the same direction, which is to make this simulation exercise less stressing for households' financial situation. Consequently, this exercise should be considered as an upper bound situation which should be unlikely to occur.

Figure 8: Debt at Risk Simulations by Quintiles

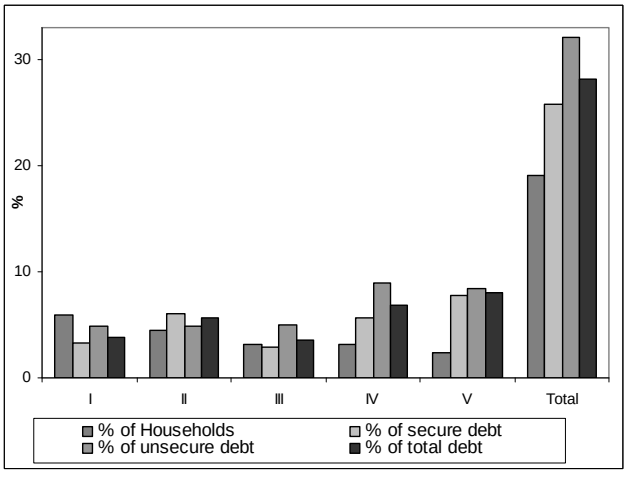
(a) Distribution of debt at risk by quintiles
Baseline Scenario



(b) Distribution of debt at risk by quintiles
Scenario: 5% increase in unemployment p(2.5)



(c) Distribution of debt at risk by quintiles
Scenario: 5% increase in unemployment p(97.5)



Source: Authors' own calculations using EPS 2002 and 2004.

[12] Unemployment insurance covers 30\% of earnings for 3 months for a worker who was been employed at least 40 consecutive months.

Conclusions

Indebtedness of the household sector has increased significantly in recent years in Chile. However, no analysis had been carried out so far to assess how vulnerable could households be in terms of their financial stress under aggregate unemployment shifts.
This paper contributes with a novel analysis in order to attempt quantifying the associated risks for financial stability.

Fragility of households' main income source, labour income, shows significant heterogeneity, implying that micro level studies must be used to assess aggregate impacts of unemployment on financial stress. It has been found that gender, age, and education determine the size of the impact of unemployment shocks on the probability of losing a job.

It has been estimated that for a one percentage point increase in the unemployment rate, there is between 0.6 and 0.8 percentage points increase in *debt at risk*. However, the concentration of household debt in high income households recalls that heterogeneous responses to unemployment may have important implications for financial stability. In fact, the simulations carried out on the different shocks scenarios show that debt at risk is rather bounded.

The implications of these results are that higher levels of unemployment do not necessarily imply that the financial system will suffer a significant default shock by households. Nevertheless, this does not mean that the financial system can overlook households' debt.

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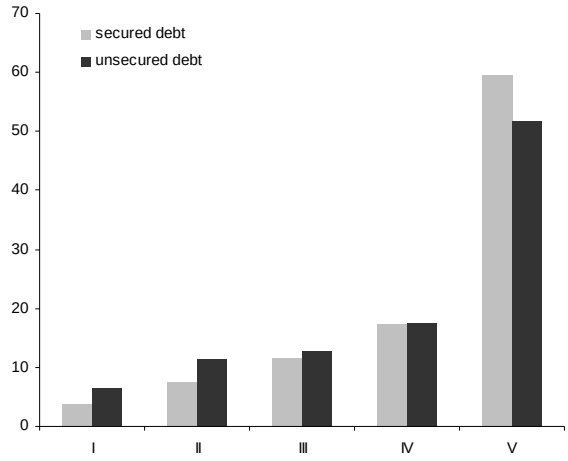
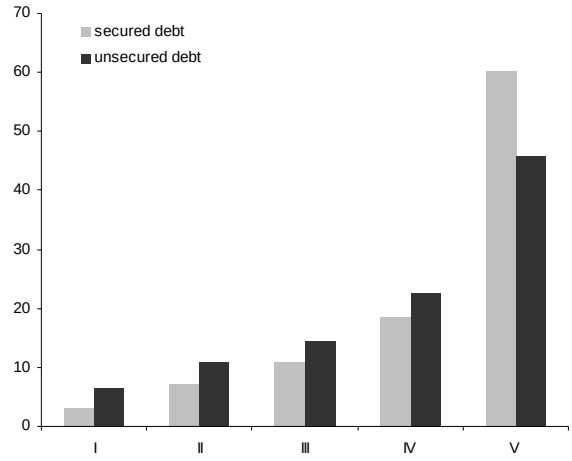
Appendix

Figure 9: Chilean Households' indebtedness

(a) Distribution of debt by income quintiles: EPS 200
(by total household income quintile as percentage)



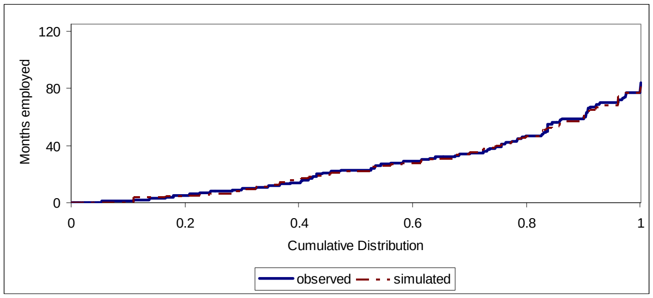
(b) Distribution of debt by income quintiles: CASEN 2006
(by total household income quintile as percentage)



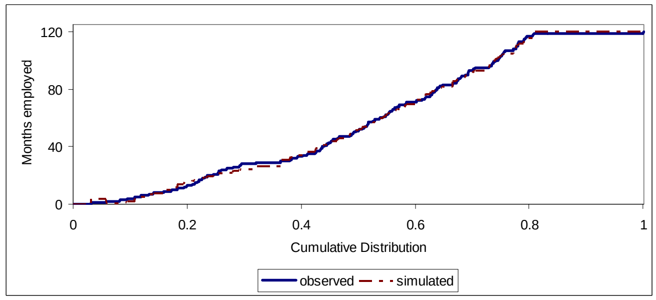
Source: Authors' own calculations based on EPS 2004 and CASEN 2006

Figure 10: Job Tenure for Females

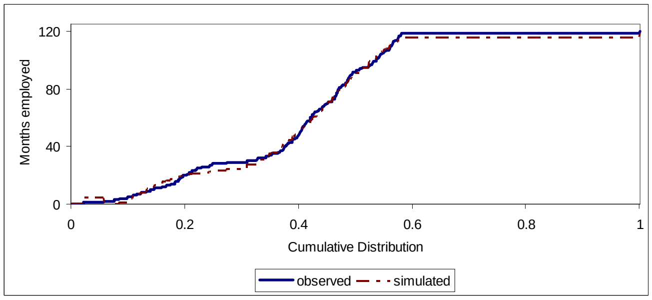
Employment duration distribution
(Females aged 18-24)



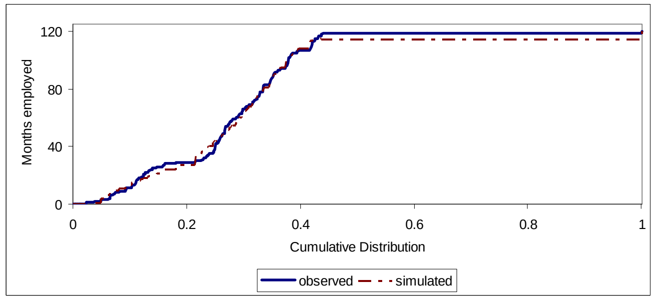
Employment duration distribution
(Females aged 18-24)



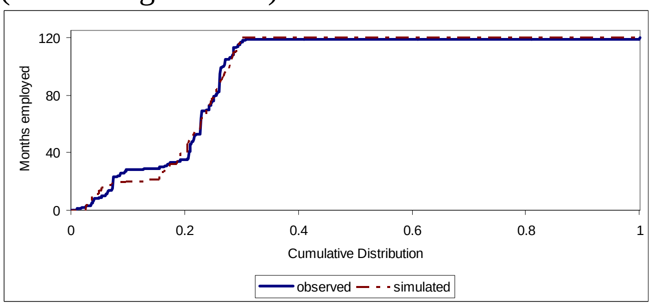
Employment duration distribution
(Females aged 18-24)



Employment duration distribution
(Females aged 18-24)



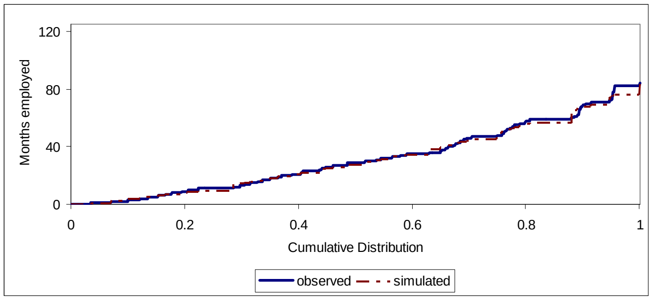
Employment duration distribution
(Females aged 18-24)



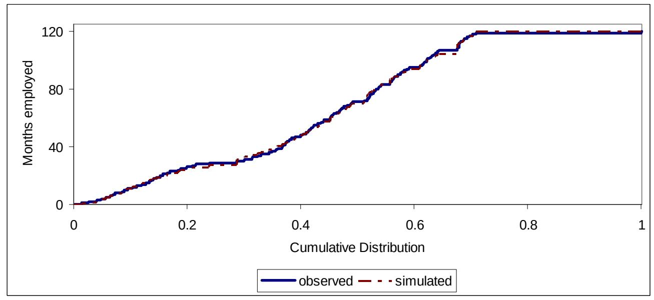
Source: Authors' own calculation based on EPS 2002 and 2004

Figure 10: Job Tenure for Males

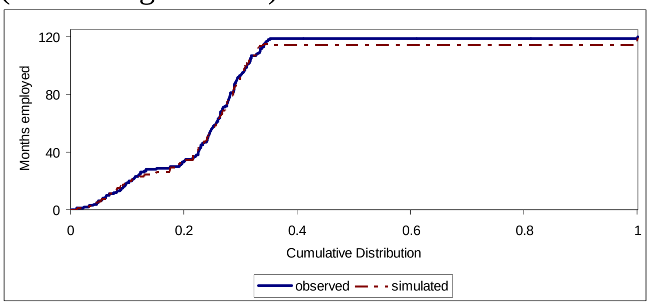
Employment duration distribution
(Females aged 18-24)



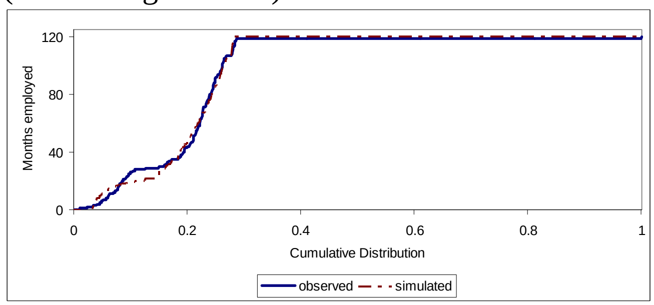
Employment duration distribution
(Females aged 18-24)



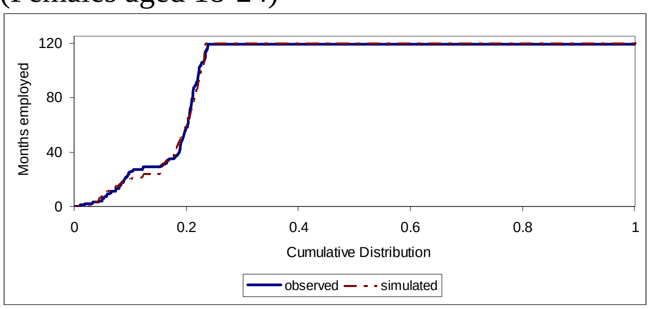
Employment duration distribution
(Females aged 18-24)



Employment duration distribution
(Females aged 18-24)

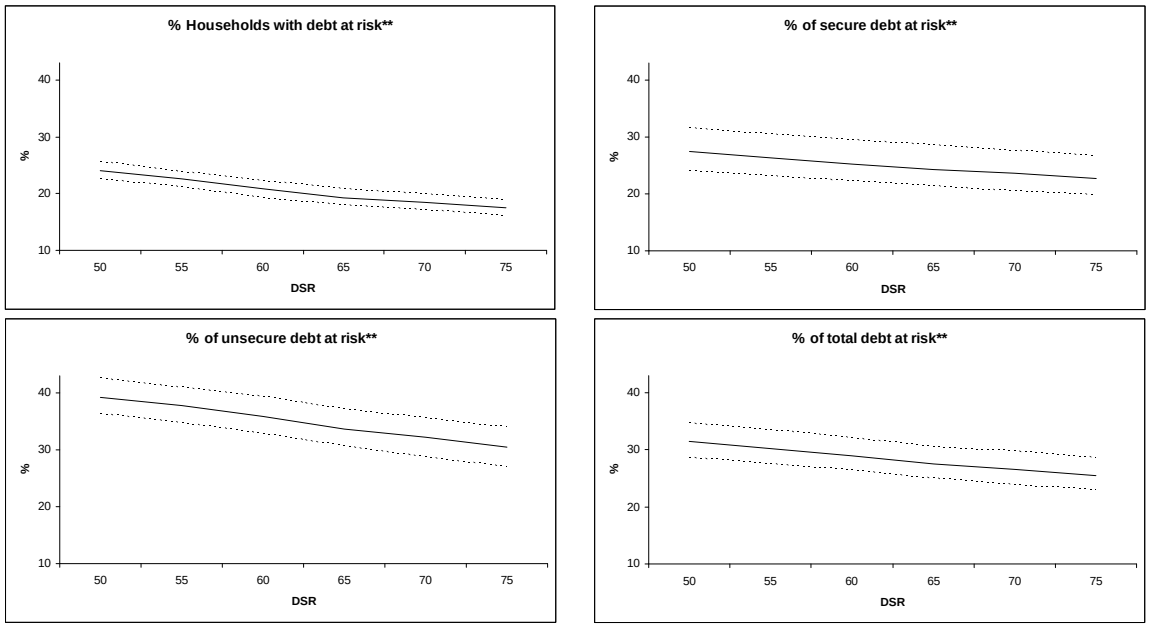


Employment duration distribution
(Females aged 18-24)



Source: Authors' own calculation based on EPS 2002 and 2004

Figure 12: Debt at Risk Simulations at different DSR cut-levels



Note: Unemployment shift of 5% and 1.1 margin

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