Banco Central de Chile
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Central Bank of Chile
Working Papers

N° 650

Diciembre 2011

SELF – EMPLOYMENT, LABOR MARKET RIGIDITIES AND UNEMPLOYMENT OVER THE BUSINESS CYCLE

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Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
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SELF – EMPLOYMENT, LABOR MARKET RIGIDITIES AND UNEMPLOYMENT OVER THE BUSINESS CYCLE

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Abstract

In a general equilibrium context, we analyze the impact of changes in institutional labor market conditions, such as access to financing and efficiency, on the composition of employment and unemployment, considering the nature of formal labor contracts and the entrepreneurial capacity of the labor force. We extend the Mortensen - Pissarides model to allow for two types of formal job contracts: temporary and permanent; and we also allow for self-employment. We show that labor market efficiency as well as access to self-employment financing played a key role in the evolution of employment in Chile during the last 15 years. Additionally, and not surprisingly, tougher access to financing adversely affects self-employment

Resumen

En un contexto de equilibrio general, analizamos el impacto de un cambio en las condiciones del mercado laboral, tales como el acceso a financiamiento y la eficiencia del mercado, en la composición del empleo y en el desempleo, considerando la naturaleza de los contratos de trabajo y la capacidad de emprendimiento de la fuerza laboral. Extendemos el modelo de Mortensen - Pissarides para permitir que existan dos tipos de contratos de trabajo en el mercado formal: temporales y permanentes; y también permitimos que haya empleo por cuenta propia (empleo informal). Encontramos que la eficiencia del mercado laboral, así como el acceso al financiamiento de actividades independientes, ha jugado un rol clave en la evolución del empleo en Chile durante los últimos 15 años. Además, y previsiblemente, las dificultades de acceso al financiamiento afectan al empleo por cuenta propia.

We would like to thank the comments of Bejamín Villena, William Hawkins, the participants of the internal as well as the Macroeconomic and Labor Markets Fluctuations seminars at the Central Bank of Chile, the Universidad de Santiago de Chile, the 2010 Stockman Conference, the 2011 LACEA-LAMES Conference and the Universidad Católica de Chile seminar participants. We would like to thank Carlos Alvarado Díaz-Romero for his excellent research assistance. All remaining errors are ours. E-mail: gcastex@bcentral.cl - mricaurte@bcentral.cl

1 Introduction

This paper analyzes the evolution of the Chilean labor market during the 1990s Asian crisis and the international financial crisis in 2008-2009. During the first of these crises, the seasonally adjusted unemployment rate increased almost 5 percentage points, reaching over 10% between May and December of 1999. On the other hand, the latter event had an slightly smaller impact on output and unemployment, which increased 2.5 percentage points, reaching over 10% between June and August 2009. Likewise, the composition of changes in employment was different in both of this episodes. During the initial part of the Asian crisis, self-employed work grew nil while dependent employment decreased. The late recovery of employment was fuelled by dependent employment. During the most recent crisis, the negative dependent job growth was hampered by self-employment, which boosted overall employment growth to positive territory by early 2011. This paper shows that the differences in the outcome of the labor market between these two crises cannot be explained solely by the negative productivity shock the economy faced. Instead, it is necessary to account for changes in labor market conditions and access to financial markets between these episodes.

Several institutional elements, in general, and labor market characteristics, in particular, changed over the last decade. On the one side, financial deepening occurred during this time, as reported in Zahler (2008), Banco Central de Chile (2009) y Fuenzalida (2009), which implies better access to funding sources for the development of entrepreneurial activities of different sorts. The impact for individuals (*e.g.*, self-employed workers) was especially important. This change is a possible explanation as to why, during the worst part of the 2008-2009 crisis, net self-employed job creation contributed positively to employment, while this was not the case during the Asian crisis.[1] Additionally, a series of policies aimed at labor market flexibility, such as an unemployment insurance system, where implemented.

Several aspects of the Chilean labor market have been thoroughly studied under a descriptive and partial equilibrium scope (Bravo et al. 2005, Cowan et al. 2004, Céspedes and Tokman 2005, Martínez et al. 2001). This paper contributes to the literature by proposing a theoretical general

[1]For a detailed description of the evolution of the labor market, refer to Section 2.

equilibrium model that allows to quantify the impact of changes in the access to financial markets as well as other institutional changes that affect the functioning of the Chilean labor market under the context of a negative shock. We extend the model of Mortensen and Pissarides (1994) in which workers are offered one of two types of contracts: temporary and permanent or indefinite contracts. Under our framework, unemployed agents can choose to work in a self-employed fashion (Fonseca, López-García, and Pissarides 2001, Uren 2007) or join the "formal" labor force. This in itself is a contribution over other attempts which model informality as an involuntary state (*e.g,* Albrecht et al. 2009). The model allows us to analyze the impact of labor market rigidities on its performance, something which has been documented in a descriptive fashion (*e.g*, Marinakis 2005). The model not only allows us to replicate changes in the unemployment rate, but also reallocation of employment across different sectors in the economic cycle.

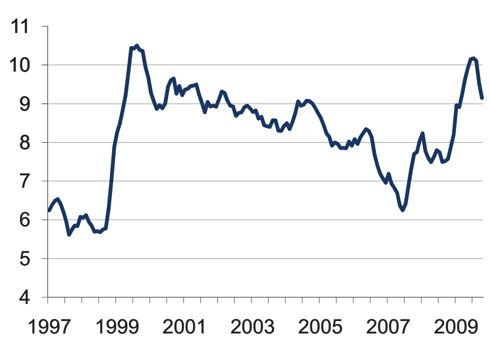
Once solved for, we calibrate the model for the Chilean economy at two points in time consistent with the crises described before. We employ micro-data from the National Employment Survey (ENE in Spanish) and the Social Protection Survey (EPS in Spanish), among other sources. Our results imply that the increase in the unemployment rate triggered by the international financial crisis was smaller than that of the Asian crisis not only because the productivity shock was presumably smaller, but because labor market conditions differed as well. In this economic environment, the model shows that self-employment remains stable during the financial crisis as long as financing costs for entrepreneurs are smaller than those faced by agents during the Asian crisis. The counterfactual experiments show that worse access to financing and a less efficient labor market during the most recent crisis would have resulted in a higher unemployment rate than the one recorded in the data.

The rest of the document is organized in the following way. Section 2 describes the Chilean labor market, putting emphasis in the two crisis episodes of the last decade. The theoretical model and its stationary equilibrium are derived in Section 3. Section 4 discusses the calibration strategy and Section 5 the main results and counterfactual exercises. Section 6 concludes.

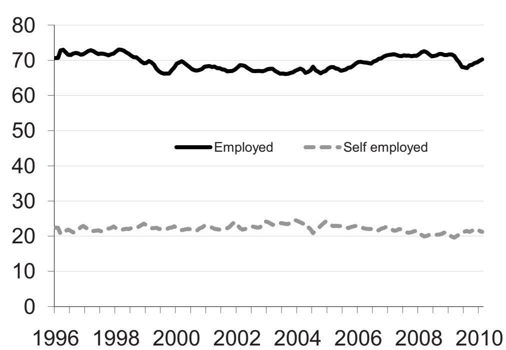
2 The Chilean labor market

In this section we characterize the Chilean labor market in the 1996-2010 period, stressing the changes occurred during the two crisis periods. Figure 1 shows the evolution of employment and unemployment as reported by the National Employment Survey (ENE).[2] The seasonally adjusted unemployment series is shown on panel (a). Before the Asian crisis, the unemployment rate was below 6%, after which it fluctuated around 10% until 2005. Towards 2007, it decreased three percentage points. Because of the financial crisis of 2007-2008, the unemployment rate surpassed 10%, although towards the end of the period, the figure displays a faster recovery after the crisis.[3] During the same period, the distribution of employed workers between dependent and self-employed workers has been stable, although the share of the latter group was, on average, four percentage points lower after the Asian crisis and until mid-2005, as shown on panel (b) of Figure 1.[4] In general, before the Asian crisis and between 2006 and 2008, roughly 70% of the working age population constituted dependent labor.

Figure 1: Unemployment and employment in Chile, seasonally adjusted (SA) series



(a) Unemployment rate, SA



(b) Type of work as a fraction of the Labor Force

Note: Consistent with INE's methodology, labor force and employed worker series are seasonally adjusted and the umployed worker series is constructed as a residual.

Source: ENE, Central Bank of Chile.

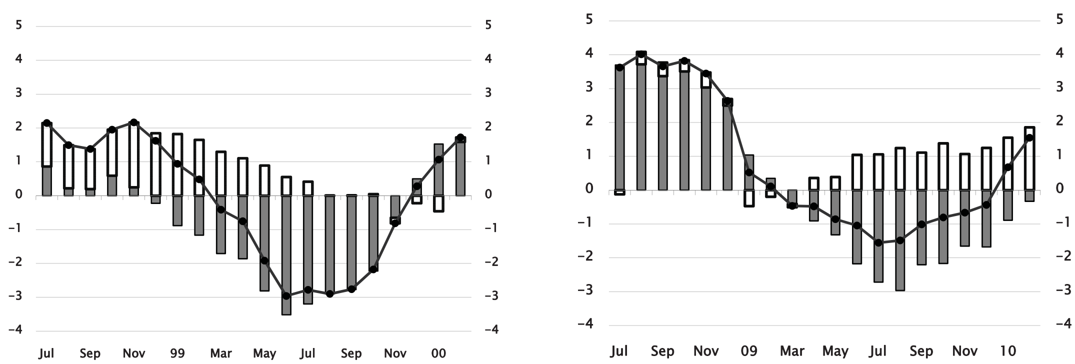
[2]The ENE conducted by Instituto Nacional de Estadísticas (2010) ceased to be the official employment survey on February 2010, but it is employed due to its larger span of coverage.

[3]The New National Employment Survey, which substituted the ENE, confirms this trend towards the end of 2010.

[4]The "dependent worker" category corresponds to the category of the same name in the ENE survey, while the "self-employed worker" category corresponds to the rest of occupied workers.

In spite of the relative stability of the dependent and self-employed workers, their contribution to the changes in overall employment was different between the two crisis episodes, as shown on Figure 2. Prior to the Asian crisis, employment growth was fuelled by self-employment. On the onset of the crisis, dependent labor dropped rapidly, while the contribution of self-employment slowly decreased. The recovery process that followed was fuelled by dependent labor growth, while self-employment had little or no contribution. On the contrary, prior to the financial crisis, employment was growing due to dependent labor growth, whose contribution became negative during the crisis. Nevertheless, it was self-employment the group whose recovery started earlier and pulled employment growth upwards until mid-2010. These differences in the behavior of employment favor the hypothesis that changes in structural and legal frameworks had an impact on the behavior of labor markets during the last decade.

Figure 2: Impact of dependent and self-employed workers on yoy employment growth



(a) Asian crisis
(Jul 97-Feb 99)

(b) Financial crisis
(Jul 08-Feb 10)

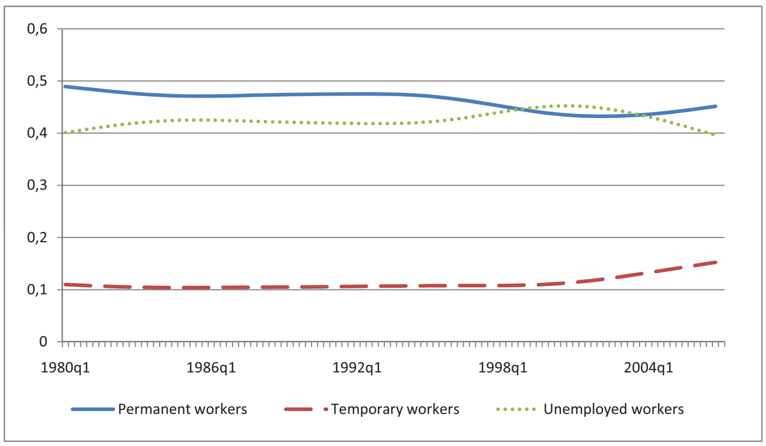
Note: **Gray line**: employment growth rate; **white bars**: impact of self-employed worker growth; **dark bars**: impact of dependent worker growth.
Source: Constructed from the ENE.

Moreover, the composition of dependent workers according to the nature of their contracts (temporary versus permanent) display changes that appear to be consistent with changes in the social protection schemes. While this distinction is not available from the ENE survey,[5] this information

[5] The New National Employment Survey identifies the temporary nature of contracts. Unfortunately, its coverage is only recent and does not allow for the study of labor market behavior over different economic cycles.

may be obtained from the Social Protection Survey, conducted by the Pension Supervisor. Figure 3 shows that in the period that followed the Asian crisis, the fraction of workers with temporary contracts increased in approximately 5 percentage points. This could be explained by labor market institutions that are relatively more rigid (see Bentolila, Cahuc, Dolado, and Le Barbanchon (2009) for a comparison between Spain and France) and high firing costs for permanent workers.

Figure 3: Employment by type of contract



Note: Seasonally adjusted.
Source: Authors' calculations with data from the Social Protection Survey, Pension Supervisor.

The model developed in the next section aims at explain the origin of the data regularities described in this section.

3 Model

3.1 Economic Environment

In this section we present the search model employed to describe the Chilean labor market. It is based on Mortensen and Pissarides (1994) model with endogenous job destruction to allow for the distinction between temporary and permanent jobs entailing different dismissal costs. Within employed workers, the model allows for dependent or wage-earning workers and self-employed or independent ones.

We assume there is a mass one of infinitely-living agents. Like firms, workers are risk-neutral and discount future utility at rate r. Although workers are assume to be identical within the "formal," wage-earning market, they have a type ρ which identifies them according to their productivity level in the self-employed or independent sector. This productivity level comes from an ability distribution $G(\rho)$ defined between $[\underline{\rho}, \overline{\rho}]$. This assumption will have an impact on the self-employment decision certain workers take, as we argue later on.

Firms must pay a cost h to keep a vacancy open. When filled, the worker-firm pair yields ε units of production for which the worker gets paid a salary $w(\varepsilon)$. The worker-firm relationship is identified by an idiosyncratic productivity shock $\varepsilon \sim F(\varepsilon)$, distributed in the $[\underline{\varepsilon}, \overline{\varepsilon}]$ interval. The shock arrives according to a Poisson process with parameter μ. To simplify our analysis, and following Bentolila et al. (2009), we assume that all new jobs are created with the maximum productivity level, $\overline{\varepsilon}$.

Both types of wage-earning (dependent) jobs – temporary and permanent – are subject to the same idiosyncratic shock process, but differ in two important aspects. First, temporary workers cannot bargain for their wages, implying that temporary wages are not function of the match specific. A temporary job opportunity arrives with probability p, and ends exogenously with probability λ. At this time, the employer chooses whether to turn it into a new permanent job or to destroy it at not cost for the employer or worker. Second, if an employer decides to end a permanent job, she must pay a firing cost f, defined in terms of the previous period's wage. All workers who are unemployed have the option of receiving unemployment insurance payments of b, also a function of the previous period's wage.[6]

Unlike other papers in the literature, where the "informal" sector is modelled as an involuntary state (see, for example Albrecht et al. 2009), workers in this environment choose between seeking for employment in the formal sector or working independently (self-employed) in the informal sector.

[6]As argued in the previous section, they payments will be zero during the Asian crisis, and positive in the latter crisis, since no unemployment insurance was available during the first period.

When a worker chooses to latter, she must pay a cost c related to this activity. Workers are identified by an ability level, orthogonal to the productivity shock, which projects on the managerial abilities of self-employed workers. This ability is summarized by the parameter ρ.

Labor market frictions are summarized in the matching function $m(u, v)$, as in Pissarides (2000), where the matching rate $q(\theta)$ for firms with open vacancies and $\theta q(\theta)$ for unemployed agents. Labor market tightness is summarized in the parameter $\theta = v/u$, where u is level of unemployment and v the number of available vacancies in the economy.

We consider an environment where wages are semi-rigid. This means that wages are calculated in pre-crisis equilibrium periods and maintained during crisis periods. Hence, wages for different types of contracts reflect initial conditions. However, overall wage payments vary as the fractions of workers in each type of contract changes at the onset of the slowdown.

3.2 Bellman equations

Summarizing the discussion of the previous subsection, agents can be in one of the following categories: employed in the formal sector (as a dependent worker), self-employed in the informal sector, or unemployed (U). In the formal sector, workers are employed as a dependent worker with a permanent contract (W_p), a new permanent contract (W_0), or a temporary or fixed-term contract (W_t).

We next show the Bellman equations for workers in each of the states listed above. First, we must note that a worker chooses between looking for a job in the formal sector or becoming self-employed. Were she to choose the latter, she remains unemployed until she receives a job offer. Hence, the value of been unemployed is given by

$$r\widetilde{U}(\rho) = max \left\{ \rho\overline{\varepsilon} - c, b + \theta q(\theta) \left[p(W_t(\overline{\varepsilon}, \rho) - U(\rho)) + (1-p)(W_0(\overline{\varepsilon}, \rho) - U(\rho)) \right] \right\}.$$

The above condition can be divided into two, depending on the value ρ takes. More specifically, since the first term in the expression is monotonically increasing in ρ, it can be inferred that there exists a value $\rho^\star$ above which no worker will opt to engage in the formal sector, and will always choose to do so below it.[7] From the vantage point of a worker who has chosen to participate in the "formal" market, the value of ρ is irrelevant since it does not affect her productivity. Consequently, her valuation of the different states does not depend on her type ρ in this case. Hence, the value of unemployment for any worker can be written as the value this state has for a worker who chose to participate in the "formal" sector. Thus, the Bellman equations for the different states are:

$$rU = \{b + \theta q(\theta) \left[p(W_t(\bar{\varepsilon}) - U) + (1-p)(W_0(\bar{\varepsilon}) - U)\right]\}, \tag{1a}$$

$$rW_p(\varepsilon) = w_p(\varepsilon) + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\{W_p(x) - W_p(\varepsilon), U - W_p(\varepsilon)\} \, dF(x) \tag{1b}$$

$$rW_0(\varepsilon) = w_0(\varepsilon) + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\{W_p(x) - W_0(\varepsilon), U - W_0(\varepsilon)\} \, dF(x) \tag{1c}$$

$$\begin{aligned} rW_t(\varepsilon) = & w_t + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \{W_t(x) - W_t(\varepsilon)\} \, dF(x) \\ & + \lambda \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\{W_0(x) - W_t(\varepsilon), U - W_t(\varepsilon)\} \, dF(x) \end{aligned} \tag{1d}$$

In equation 1a, the unemployed worker receives the unemployment benefit, that is a function of previous wage, and with probability $\theta q(\theta)$ the unemployed worker match a firm, in which case the job becomes a transitory one with probability p or permanent otherwise. Workers at a permanent job, as described in equation 1b receives their wage compensation that is a function of the current productivity level ε, with probability μ another productivity shock arrives and the match may be destroyed if does not generate a positive surplus. If the new productivity level is high enough, the worker firm pair is not destroyed. The case for the worker at a new permanent job is identical. Workers at a temporary job (1d), does not negotiate wages, so their wage is not a function of current productivity level, with probability μ another productivity shock arrives and the match may be destroyed if does not generate a positive surplus. If the new productivity level is high enough, the

[7] In the most general case, it can be argued that there exists a set of values of ρ for which this condition is satisfied. Nevertheless, the empirical results suggest that the strict monotonicity assumption is satisfied for a large set of parameter values.

worker firm pair is not destroyed. The temporary job ends with probability λ, in which case is evaluated to destroy the match at no cost or to hire the worker in a permanent contract.

It should be noted that $\rho^\star$ is an element of the equilibrium, as we show when discussing the market clearing conditions.

Firms are interested in the value of a vacancy depending on whether it is empty (V) or filled by a temporary worker (J_t), a permanent worker (J_p), or a new permanent worker (J_0). Hence, the value can be written as:

$$rV = -h + q(\theta)(p(J_t(\bar{\varepsilon}) - V) + (1-p)(J_0(\bar{\varepsilon}) - V)) \tag{2}$$

As we argued before, this value is independent of the type ρ of the worker (as are the remaining Bellman equations for the firms). Firms have to pay cost h for keeping open a vacancy, with probability $q(\theta)$ they match to a worker and with probability p the realized match is for a temporary job or, with probability $1-p$ for a new permanent job. The value of the firm filled with a temporary or permanent jobs are the following:

$$rJ_t(\varepsilon) = \varepsilon - w_t + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \{J_t(x) - J_t(\varepsilon)\}\, dF(x) + \lambda \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\, \{J_0(x) - J_t(\varepsilon), V - J_t(\varepsilon)\}\, dF(x) \tag{2a}$$

$$rJ_p(\varepsilon) = \varepsilon - w_p(\varepsilon) + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\, \{J_p(x) - J_p(\varepsilon), V - J_p(\varepsilon) - f\}\, dF(x) \tag{2b}$$

$$rJ_0(\varepsilon) = \varepsilon - w_0(\varepsilon) + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max\, \{J_p(x) - J_0(\varepsilon), V - J_0(\varepsilon) - f\}\, dF(x) \tag{2c}$$

Firms filled with temporary jobs obtain the match productivity and pay a wage w_t. A new productivity shock arises with probability μ in which case the match may be dissolved if there is no surplus to share. Temporary jobs ends with probability λ and forms decided between to create a new permanent job or destroy the match at no cost. Firms filled with a permanent job receives the match productivity level and pay a negotiated wage that depends on worker productivity, as temporary jobs, with probability μ a new productivity level arises and firms decide between to continue or destroy the match paying a cost f that is a function of worker previous wage level.

3.3 Stationary equilibrium

From equation (2), we derive the firm free-entry condition that guarantees that the value of a vacancy is equal to zero:

$$\begin{aligned} V =& -\frac{h}{r+q(\theta)} + \frac{q(\theta)}{r+q(\theta)} \left[pJ_t(\bar{\varepsilon}) + (1-p)J_0(\bar{\varepsilon}) \right] = 0 \\ \Rightarrow h =& q(\theta) \left[pJ_t(\bar{\varepsilon}) + (1-p)J_0(\bar{\varepsilon}) \right] \end{aligned} \tag{3}$$

From (1b) and (1c), and from (2b) and (2c), respectively, we obtain:

$$\begin{aligned} r\left[W_p(\varepsilon) - W_0(\varepsilon)\right] &= w_p(\varepsilon) - w_0(\varepsilon), \\ r\left[J_p(\varepsilon) - J_0(\varepsilon)\right] &= w_p(\varepsilon) - w_0(\varepsilon), \end{aligned}$$

which provides a relationship between the values of existing permanent jobs and new permanent jobs for workers and firms, which will be useful further ahead:

$$W_p(\varepsilon) - W_0(\varepsilon) = J_0(\varepsilon) - J_p(\varepsilon). \tag{4}$$

Workers and firms bargain for wages under a Nash bargaining scheme. The objective is to split the surplus arising from the worker-firm pair. This surplus, according to the different type of contracts is equal to:

$$S_t(\bar{\varepsilon}) = J_t(\bar{\varepsilon}) - V + W_t(\bar{\varepsilon}) - U \tag{5a}$$

$$S_0(\varepsilon) = J_0(\varepsilon) - V + W_0(\varepsilon) - U \tag{5b}$$

$$S_p(\varepsilon) = J_p(\varepsilon) - V + f + W_p(\varepsilon) - U \tag{5c}$$

We assume the workers' bargaining power is $\beta \in (0,1)$ (firms' power is $1-\beta$), such that they obtain a fraction β (firms obtain a fraction $1-\beta$) of the surplus from the negotiation. Hence, from (3) and the surplus bargaining, we obtain:

$$\frac{h\theta}{1-\beta} = \theta q(\theta) \left[pS_t(\bar{\varepsilon}) + (1-p)S_0(\bar{\varepsilon}) \right]. \tag{3$'$}$$

In order to get explicit expressions for the surpluses, we have that, from (1a) and (2):

$$U = \frac{1}{(r+\theta q(\theta))} \left\{ b + \theta q(\theta) \left[pW_t(\bar{\varepsilon}) + (1-p)W_0(\bar{\varepsilon}) \right] \right\}; \tag{1a$'$}$$

$$V = \frac{1}{(r+q(\theta))} \left\{ -h + q(\theta) \left[pJ_t(\bar{\varepsilon}) + (1-p)J_0(\bar{\varepsilon}) \right] \right\} \tag{2$'$}$$

Adding these two terms and using the definition for the worker and firm surpluses, we have:

$$\begin{aligned} U + V = & \frac{b}{(r+\theta q(\theta))} - \frac{h}{(r+q(\theta))} + \frac{\beta\theta q(\theta)}{(r+\theta q(\theta))} \left[pS_t(\bar{\varepsilon}) + (1-p)S_0(\bar{\varepsilon}) \right] \\ & + \frac{(1-\beta)q(\theta)}{(r+q(\theta))} \left[pS_t(\bar{\varepsilon}) + (1-p)S_0(\bar{\varepsilon}) \right] \\ & + \frac{\theta q(\theta)}{(r+\theta q(\theta))} U + \frac{q(\theta)}{(r+q(\theta))} V. \end{aligned}$$

Together with the firm free-entry condition (*i.e.*, $V = 0$), the expression above becomes:

$$U = \frac{b}{r} + \frac{h\theta\beta}{r(1-\beta)} \tag{6}$$

This condition, together with (1a$'$) and (2$'$), into the firms' Bellman equation (2b) yields the surplus conditions as a function of productivity shocks:

$$(r+\mu)S_p(\varepsilon) = \varepsilon + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max[S_p(x), 0] dF(x) + rf - b - \frac{\beta\theta h}{(1-\beta)} \tag{7a}$$

$$(r+\mu)S_0(\varepsilon) = \varepsilon + \mu \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} max[S_p(x), 0] dF(x) - \mu f - b - \frac{\beta\theta h}{(1-\beta)} \tag{7b}$$

where the second equation employed the $S_p(\varepsilon) - S_0(\varepsilon) = f$ condition, which comes from the surpluses and equation (4).

Let $S_p(\varepsilon) = 0$, then (7a) becomes the long-term job destruction condition:

$$(r+\mu)S_p(\varepsilon^d) = 0 = \varepsilon^d + \mu \int_{\varepsilon^d}^{\bar{\varepsilon}} S_p(x)dF(x) + rf - b - \frac{\beta\theta h}{(1-\beta)} \tag{LTJD}$$

where ε^d is the productivity threshold such that pairs with productivity levels $\varepsilon < \varepsilon^d$ are destroyed. Likewise, with $S_0(\varepsilon^c) = 0$, (7b) becomes the long-term job creation condition:

$$(r+\mu)S_0(\varepsilon^c) = 0 = \varepsilon^c + \mu \int_{\varepsilon^d}^{\bar{\varepsilon}} S_p(x)dF(x) - \mu f - b - \frac{\beta\theta h}{(1-\beta)} \tag{LTJC}$$

where the productivity level ε^c is such that pairs with productivity $\varepsilon > \varepsilon^d$ are profitable enough for a job to be created. From these two expressions, we obtain a relationship between the job creation and job destruction productivity thresholds (ε^c and ε^d):

$$\varepsilon^c = \varepsilon^d + (r+\mu)f \tag{8}$$

Substituting (LTJD) and (LTJC) into (7a) and (7b), respectively, results in and expression for surplus that only depends on productivity shocks:

$$S_p(\varepsilon) = \frac{\varepsilon - \varepsilon^d}{r+\mu}; \varepsilon \geq \varepsilon^d \tag{9a}$$

$$S_0(\varepsilon) = \frac{\varepsilon - \varepsilon^c}{r+\mu}; \varepsilon \geq \varepsilon^c \tag{9b}$$

Equation (9a) together with (LTJD) yields:

$$\varepsilon^d = -\mu \int_{\varepsilon^d}^{\bar{\varepsilon}} \frac{x - \varepsilon^d}{r+\mu} dF(x) - rf + b + \frac{\beta\theta h}{(1-\beta)}; \quad \varepsilon \geq \varepsilon^d. \tag{10}$$

Next, substitute (10) into the integrated version in the of $[\underline{\varepsilon}, \overline{\varepsilon}]$ interval of:

$$(r+\mu+\lambda)S_t(\varepsilon) = \varepsilon + \mu \int_{\underline{\varepsilon}}^{\overline{\varepsilon}} S_t(x)dF(x) + \lambda \int_{\underline{\varepsilon}}^{\overline{\varepsilon}} max[S_0(x), 0]dF(x) - b - \frac{\beta\theta h}{(1-\beta)}. \tag{11}$$

Then, after some algebraic manipulation, we obtain the short-term version for (JC):

$$\begin{aligned}\frac{h\theta}{1-\beta} = \theta q(\theta) \left\{ \frac{p}{r+\mu+\lambda} \left[\overline{\varepsilon} + \frac{\mu}{r+\lambda} \int_{\underline{\varepsilon}}^{\overline{\varepsilon}} x dF(x) \right] + \frac{p}{r+\lambda} \left[\lambda \int_{\varepsilon^c}^{\overline{\varepsilon}} \frac{x-\varepsilon^c}{r+\mu} dF(x) \right.\right. \\ \left.\left. - \frac{\theta h \beta}{(1-\beta)} - b \right] + (1-p) \frac{\overline{\varepsilon} - \varepsilon^c}{r+\mu} \right\}\end{aligned} \tag{JC}$$

We next derive expressions for the different wages in the economy. From the surplus maximization problems, we obtain the following first order conditions (which are satisfied with equality when they bind):

$$(1-\beta)\left[W_t(\overline{\varepsilon}) - U\right] = \beta\left[J_t(\overline{\varepsilon}) - V\right],$$

$$(1-\beta)\left[W_0(\varepsilon) - U\right] = \beta\left[J_0(\varepsilon) - V\right],$$

$$(1-\beta)\left[W_p(\varepsilon) - U\right] = \beta\left[J_p(\varepsilon) - V\right].$$

Substituting the Bellman equations for workers and firms, along with (6) and after some algebraic manipulation, we obtain wage expressions for temporary (w_t), new permanent ($w_0(\varepsilon)$), and existing permanent wages ($w_p(\varepsilon)$):

$$w_t = \beta\left(\overline{\varepsilon} + h\theta\right) + (1-\beta)b, \tag{12a}$$

$$w_0(\varepsilon) = \beta\left(\varepsilon - \mu f + h\theta\right) + (1-\beta)b, \tag{12b}$$

$$w_p(\varepsilon) = \beta\left(\varepsilon + rf + h\theta\right) + (1-\beta)b. \tag{12c}$$

Along with wages for each type of contract, we need to compute the mass of labor participation in each group in order to determine the average wages in the economy. These values are key to determine firing costs and unemployment benefits (which are functions of wages). With this objective in mind, we first analyze the net changes (flows into minus flows out from each state) in the number of workers with temporary contracts (N_t), existing permanent contracts (N_p), new permanent contracts (N_0), and temporary contracts converted into permanent contracts which have not received a new productivity shock (N_{0t}). These are given by:

$$\begin{aligned}
\dot{N}_t &= pu\theta q(\theta) - \lambda N_t \\
\dot{N}_p &= (1-p)u\theta q(\theta) + \lambda N_t[1 - F(\varepsilon^c)] - \mu N_p F(\varepsilon^d) \\
\dot{N}_0 &= (1-p)u\theta q(\theta) - \mu N_0 \\
\dot{N}_{0t} &= \lambda N_t[1 - F(\varepsilon^c)] - \mu N_{0t}
\end{aligned}$$

From the expression above, we obtain the steady state values for employment in each labor state:

$$N_t^* = \frac{\theta q(\theta) pu^*}{\lambda} \tag{13a}$$

$$N_p^* = \frac{\theta q(\theta) u^*[1 - pF(\varepsilon^c)]}{\mu F(\varepsilon^d)} \tag{13b}$$

$$N_0^* = \frac{(1-p)u^*\theta q(\theta)}{\mu} \tag{13c}$$

$$N_{0t}^* = \frac{pu^*\theta q(\theta)[1 - F(\varepsilon^c)]}{\mu} \tag{13d}$$

Given these expressions, we can write the steady state unemployment rate as:

$$
\begin{aligned}
u^* &= \mathbf{p} - N_t^* - N_p^* \\
&= \frac{\lambda\mu F(\varepsilon^d)\mathbf{p}}{\lambda\mu F(\varepsilon^d) + \theta q(\theta)[\lambda(1 - pF(\varepsilon^c)) + p\mu F(\varepsilon^d)]}
\end{aligned} \tag{14}
$$

where the *ex-ante* probability that a worker is in the self-employment sector is $\mathbf{p} \equiv P[\rho < \rho^\star]$. The first line in (14) says that the fraction of unemployed workers is equal to the measure of workers minus those with temporary contracts and permanent contracts. The second lines employs (13a) and (13b). Hence, the economy's average wage, which corresponds to the weighted average of wages in each sector of the economy, is given by:

$$
\overline{w} = \frac{N_t w_t + \frac{N_{0t}}{1-F(\varepsilon^c)} \int_{\varepsilon^c}^{\overline{\varepsilon}} w_0(x) dF(x) + N_0 w_0(\overline{\varepsilon}) + \frac{N_p - N_{0t} - N_0}{1-F(\varepsilon^d)} \int_{\varepsilon^d}^{\overline{\varepsilon}} w_p(x) dF(x)}{\mathbf{p} - u}. \tag{15}
$$

4 Data and calibration

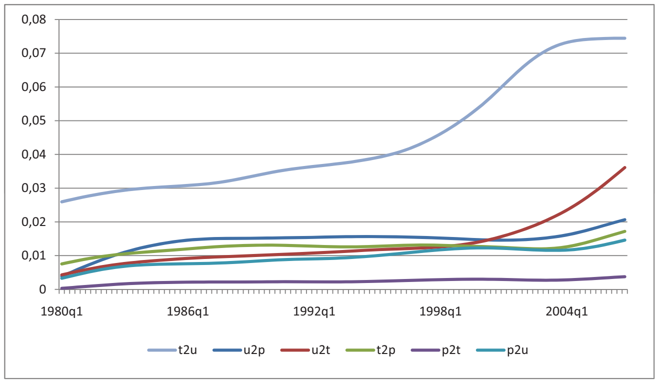
In this section we describe the data sources employed (used to characterize the Chilean labor market in Section 2) and the model's calibration strategy.

4.1 Data

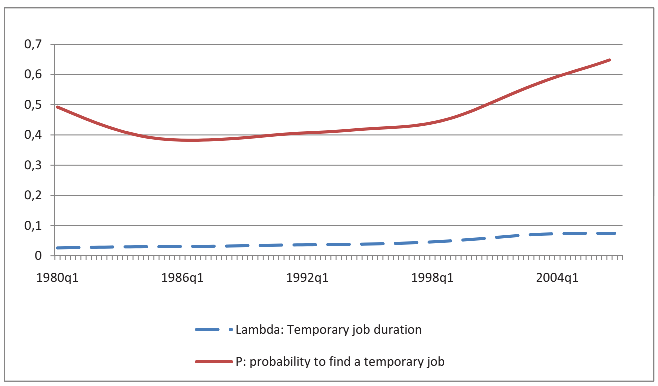
We use different micro-data sources to calibrate the model. The main data sources are: the national employment survey (Encuesta Nacional de Empleo, ENE), the Social Protection Survey (Encuesta de Protección Social, EPS), and data from the Statistics Center of Pension Supervisor of Chile.

The National Employment Survey (ENE) is conducted by the National Statistic Institute (INE) and corresponds to a monthly survey that generates employment series by moving quarters, which interview 36,000 households. The survey is developed under international standards defined by the ILO in cooperation with the OECD. This survey was the official one until February 2010, when was replaced by a new survey, which is not useful for our study due to its short lifespan.

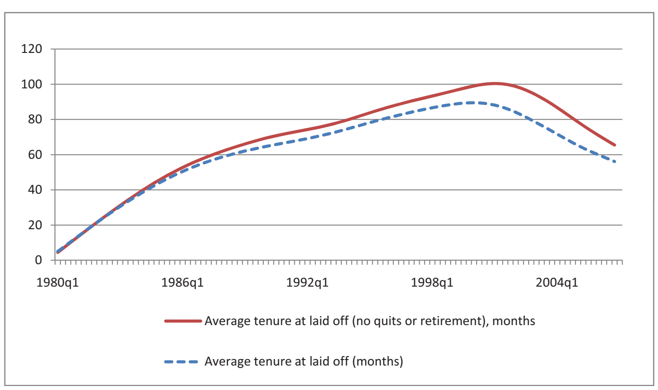
Figure 4: Employment statistics



(a) Transition rate between states



(b) Temporary job finding probability and duration



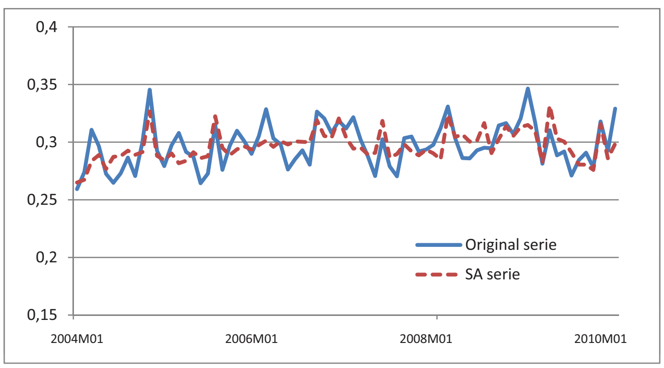
(c) Average employment duration (in months)

Source: Constructed with data from the Social Protection Survey, Superindency of Social Prevision. Trend, HP filter.

The Social Protection Survey (EPS) is a panel survey developed by the Department of Social Protection which interviews and follows a group of people on a bi-yearly basis (2002, 2004 and 2006). We construct labor market dynamics for the sample using EPS. The survey contains information about 20,000 individuals and it is representative at a national level. From this survey we obtain information on labor market history, which allows us to generate unemployment durations and firing costs. Figure 4 shows selected statistics obtained from the sample employed in the model calibration.

Finally, the Pension Supervisor reports monthly information on the unemployment insurance coverage. The data allow us to estimate the average unemployment benefit, as a function of previous wages for permanent workers. Temporary workers are not eligible for the unemployment benefits in Chile. Figure 5 shows the average unemployment benefit payment as a fraction of the workers last earnings.

Figure 5: Unemployment benefit as a fraction of previous wages (replacement ratio)



Source: Constructed with information from the Retirment Funds Superindency.

4.2 Calibration

In this section we describe the procedure to calibrate the model described in Section 3. There are 16 parameters that require calibration. We divide the parameter space into three subsets. The first one corresponds to the set of parameters that we directly impose in to the model. These come from values that are standard and widely used in the literature. The second set corresponds to parameters that are directly estimated from the data. Finally a set of parameters that are selected so that the model matches some important moments observed in the data. In particular, we are interested in the unemployment rate and the fraction of temporary workers, among others. The model is calibrated such that a period corresponds to one quarter.

We calibrate the model for two episodes of time considered as periods of "normal" economic growth, both of which were followed by economic slowdowns. As mentioned earlier, these correspond to the Asian and the financial crisis.

The parameter values we impose directly to the model, that do not change between the two periods are shown on Table 1. The quarterly interest rate is fixed at 1%. We define the matching function as a Cobb-Douglas function, following the standard Hosios condition (Hosios 1990). We set the matching function elasticity with respect to unemployment (α) equal to the Nash bargaining power (β). As is standard in the literature, we set both values equal to 0.5, Rogerson, Shimer, and Wright (2005). For simplicity we assume a uniform distribution for the matched worker-firm idiosyncratic shock. We normalize the maximum value of the shock equal to 1.

Table 1: Imposed parameters

Parameter	Value	Description
r	0.01	Quarterly interest rate
β	0.5	Worker bargaining power
α	0.5	Matching unemployment elasticity
$\bar{\varepsilon}$	1.0	Normalization

The parameter set estimated from the data is shown on Table 2. As mentioned in the previous subsection, the unemployment benefit (b) is calibrated considering the average coverage since the program inception (October 2002). Hence, the parameter b is set to be equal to zero during the first period analyzed, and equal to 0.3 (1 month of compensation per quarter) for the second period. The parameter λ captures the probability that a temporary job converts into a permanent one or get destroyed, meaning corresponds to the average duration for a temporary job. The labor market legislation in Chile requires that each permanent-contract worker who is fired must be compensated in an amount equal to one month of his wages per year of tenure (with a 11-year cap). From the EPS, we find that the average tenure for people who have been fired in the period under analysis is close to 60 months.

Table 2: Estimated Parameters

Parameter	98-Period	08-Period	Description
b	0.000	0.300	Unemployment insurance
f	1.886	1.439	Firing Cost
p	0.433	0.559	Temporary job probability
λ	0.043	0.074	Temporary job duration

Finally, the parameters shown on Table 3 are calibrated such that the model matches the unemployment rate and the share of self-employed workers. More specifically, the support of the distribution of ρ and the cost of engaging in self-employment, related to the degree of accessibility to financing, c, are calibrated to be consistent with the fraction of self-employed workers as we discussed in Section 2 and showed in Figure 4 (a). We check the performance of the model by comparing its predictions regarding the destruction rate of permanent jobs, the fraction of temporary temporary contracts in the economy, and the transition rate between temporary and permanent jobs.

For the crisis periods, we adjust the productivity shock distribution and other parameters related to the associated productivity drop. Table 4 shows the estimated moments in the data and the model for different periods.[8]

5 Results and counterfactual exercises

We next discuss the counterfactual exercises performed to quantify the effects of changes in structural conditions of the economy on labor market outcomes. The analysis concentrates on the in-

[8]Given the marked heterogeneities in the individuals, which are absent in the model, we consider a sample restricted to those workers between 25 and 55 years of age. This allows us to disregard issues such as youth unemployment and retirement decisions, which are absent from the model.

Table 3: Calibrated Parameters[1]

Parameter		1998 Period pre-crisis	1998 Period crisis	2008 Period pre-crisis	2008 Period crisis
Vacancy creation cost	h	1.5	1.5	1.5	1.5
Matching efficiency parameter	m_0	0.435	0.435	0.435	0.435
Productivity shock arrival rate	μ	0.05	0.05	0.05	0.05
Self-employment startup cost	c	0.123	0.123	0.057	0.057
Max. productivity level	$\overline{\varepsilon}$	1.000	0.536	1.000	0.870
Min. productivity level	$\underline{\varepsilon}$	0.360	0.000	0.400	0.245

(1) Parameters rounded to three decimal places.

Table 4: Model results vs. data
(percentage rates)

Period	Data[1] **u**	Data[1] $1 - P(\rho)$	Model **u**	Model $1 - P(\rho)$
Pre-Asian crisis (1998Q2)	4.40	21.90	4.36	21.53
Asian crisis (1999Q3)	8.74	22.04	8.73	10.03
Pre-Financial crisis (2008Q2)	6.36	19.29	6.36	18.60
Financial crisis (2009Q3)	8.66	19.37	8.65	19.14

(1) Values correspond to the three-month average of the unemployment (**u**) and self-employment ($1 - P(\rho)$) rates for the 25-55 year-old population.

teractive effects of a larger proportion of temporary jobs, labor market rigidities, financial aspects, among others.

Initially, we analyze the effects of productivity shocks on employment. We simulate the financial crisis, incorporating the productivity shocks of the Asian crisis of the 1990s. This exercise allows us to identify how the economy would have reacted given a different economic downturn. *Ceteris* *paribus*, the unemployment rate would have increased by more than 13 percentage points, given the more severe nature of the crisis lived in the first episode. Additionally, the economy would have seen less temporary workers and a lower transition rate from temporary to permanent jobs would have occurred as shown in the second row of Table 5.

The second exercise leaves the productivity parameters as they were calibrated for the financial crisis, but restricting the labor market conditions to be as they were during the Asian crisis. This exercise allows us to understand what is the impact of the labor market reforms implemented after the Asian crisis on the performance of the economy. In particular, we analyze the impact of higher firing costs (given a longer average tenure of the labor force during the Asian crisis), non-existent unemployment insurance during the financial crisis and lower proportion of temporary job creation contracts on the economy. In this case, the unemployment rate would have increase to close to 7.6%, about 1 percentage point below the recorded figure for that period, as shown in the third row of Table 5. This comes along with a larger fraction of self-employed workers than actually recorded. In fact, this excess self-employment actually offsets the lower unemployment figures. We conclude then, that a more rigid labor market results in more workers leaving the formal sector altogether in favor of self-employment.

In the third exercise, we simulate the financial crisis with the access to financial markets parameter c equal to that calibrated for the Asian crisis (that is, with higher cost of engaging in self-employment activities). The fourth row of Table 5 shows selected parameters for this exercise. With higher cost to engage in self-employment, fewer workers would have opted for this option (compared to the effective number) and the crisis would have generated an increase in unemployment by almost 4 percentage points.

From the previous exercises we can draw a number of conclusions. Productivity shocks play a key role explaining the evolution of the labor market given the crisis, but they have to be understood in the context of the underlying institutional and legal conditions. Stringent labor market conditions favor self-employment, as workers benefit more from informal activities than unemployment (and the expectation of obtaining a new job). Finally, the improvements in the access to financial markets

Table 5: Counterfactual scenarios
(percentage rates)

Scenario	Unemp. rate	$1 - P(\rho)$	Perm. job destr. rate	Temp. emp. rate	Temp-to-perm trans. rate
Pre-financial crisis	6.36	18.60	2.42	16.10	3.80
Productivity shocks	19.46	14.28	3.52	26.33	2.18
Labor mkt. condts.	7.64	20.59	2.98	23.17	1.75
Access to fin. mkts	10.25	4.19	2.79	19.78	3.25
Financial crisis	8.65	19.14	2.79	19.78	3.25

(measured by the cost of engaging in self-employment c) have proven key to keep the unemployment rate low in the most recent crisis. In fact, this element's unemployment-hampering effect offsets the impact of "more flexible" labor market norms, according to our exercise.

6 Conclusions

This paper has analyzed how productivity shocks have affected employment in Chile in the context of changes in the financing conditions, structure of labor market institutions and labor market dynamics. Product of the Asian crisis of the 1990s, the unemployment rate remained high for a long period of time, while after the recent financial crisis the unemployment rate reached a slightly lower unemployment rate, which decreased fairly fast afterwards. Along with these events, the composition of the changes in employment was different between both crisis. While the recovery after the Asian crisis was fuelled by dependent (formal) job creation, the recovery at the onset the financial crisis occurred because of self-employment job recovery. While the differences in magnitude of the productivity shocks is partly responsible for these differences, our findings point at the fact that substantial changes to labor market regulations and access to financing are elements that cannot be disregarded as explanations for the different evolution of employment.

This paper contributes to the literature by proposing a theoretic, general equilibrium model that allows us to analyze the impact of these structural changes on the Chilean labor market. The model is an extension of the Mortensen-Pissarides model, based on Bentolila et al. (2009)

and it is calibrated using micro-data obtained from the National Employment Survey (ENE) y the Social Protection Surveys (EPS). By allowing for different types of labor contracts (temporary and permanent) and different forms of work (formal or wage-earning jobs, and self-employment), it is possible to match changes in labor market aggregates during the two crises. A combination of differences in productivity shocks, institutional arrangements, and financing access conditions are required to explain the differences between the Asian and financial crises.

A number of extensions can be considered for this paper. Most notably, self-employment is overly sensitive to the productivity drop of the Asian crisis, although it is fairly stable in the data. An alternative approach to deal with this problem is to analyze the behavior of a dynamic version of the model presented here, where shocks are introduced along a steady state. This approach exceeds the scope of this paper and is left to be pursued in future research.

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