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Master Thesis

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# The cyclical behaviour of separation and job finding rates in Colombia

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**Abstract**

During the recent years, debates about the relative contribution of separation and job finding rates to the fluctuations of unemployment have been frequent. However, all the analyses have focused on developed economies which have richer data sets to work with. The aim of this work is to shed light on this discussion for the Colombian case. Using accessible aggregate data about the stocks of unemployed workers and the duration of the spells, the job finding and separation rates for Colombia are constructed. It is found that contemporaneous fluctuations in both rates explain significantly and in the roughly the same proportion the movements in unemployment; results differ from previous findings by Lasso V (2011) where the separation rate is the most important in Colombia. Moreover, separation rate leads the behaviour of unemployment at one quarter. Results are contrasted with the obtained for France and United States to show that Colombian unemployment is of European nature but has United States' features. Finally, it is presented a model in the spirit of Diamond-Mortensen-Pissarides to account for the observed stylized facts.

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# 1 Introduction

## 1.1 Search and matching models in the labour market

Several types of frictions characterize most of the real world labour market transactions: When a firm wants to hire a new worker, she may not know clearly the productivity of the candidate; similarly, the worker must effort to signal his productivity. On the other hand, there could be mismatch between the skill requirements of jobs and the skill mix of workers; differences in locations of jobs and workers, slow mobility of labour force or poor transmission of information about job opportunities. All this frictions are reflected in the fact that it takes time for a worker to find a good job and for firms to fill vacancies; agents then must invest in a costly and time consuming process of searching to learn what the alternative opportunities are. As a result, the procedure might end with idle resources in equilibrium, that is: unemployment and vacancies.

Despite their importance, research about search frictions in the labour market started formally only in early 1970 with the influential contributions of McCall (1970), Mortensen (1970) and Phelps (1970). The aim of last two articles was to obtain the microfoundations of the Phillips curve assuming a wage distribution and a reservation wage strategy of workers; however, in all the three works, if a worker was unemployed, is because he had not found yet a high enough wage offer.

A different approach was taken by Pissarides (1979) where the *matching function* was first introduced, from this view, jobs and workers have different features that make them suitable or not to engage together in production through a labour contract, hence it is not only the worker who is concerned to find a wage high enough, but also the firm is interested in locating a good match before filling a vacancy; thus the process of assigning workers to jobs takes time, whatever the wage offered by each job. From this view, unemployment is neither voluntary nor involuntary, it is just the result of a decentralised equilibrium that moves towards a level where flows in and out of it are balanced.

A second alternative to the first one-sided search models, where the only role of workers was to accept or not the wage offers set by firms, was put forward by Diamond (1982), who incorporated in the search models the fact that wage setting was actually two sided: neither the firms nor the workers have the whole power to decide the remuneration of labour. He argues that a more suitable way of modelling wage setting is to assume that wages are negotiated in a bargaining process between the worker and the employer. Therefore, when this two sides meet or decide to engage in production, they have a stream of future benefits to share; and the wage decision establishes how the difference between what they can earn together relative to the alternative is going to be split.

The combination of previous three contributions started to be know as the Diamond-Mortensen-Pissarides (DMP henceforth) model, and soon it became a reference in the study of labour markets theory. Its main foundations can be summarized in three points:

1. Workers and firms engage in a costly and time consuming search process to find the adequate trade partner.

2. The rate at which a new hire appears is given by the matching function.

3. Wages are set in a Nash bargaining process.

One of the first appeals of DMP model was that it seemed more realistic than the traditional competitive market view; for example, the definition of unemployment used in search and matching theory is precisely the one used by International Labour Organization, that is, the number of workers which are not in a job, are looking for one, and available to take one.

Moreover, the DMP models were able to make predictions about the movement of workers between employment, unemployment, out of the labour force, and between employers; therefore they are useful to understand the stylized facts about job and worker flows that literature has documented. To mention just an example, Rogerson and Shimer (2010) show that in the United States recessions are typically characterized by a sharp increase in the inflow rate of workers from employment into unemployment and a large decline in the outflow rate of workers from unemployment into employment. Thus, employment could be low because employed workers are losing their jobs at a high rate; or, alternatively, it may be low because unemployed workers are not searching very intensively, or because firms are reluctant to hire. Neither of these possibilities is easily understood in a model without search frictions.

Search and matching models are also analytically tractable and they permit to consider the reactions to frictions and how the reactions to them by others change the economic environment, how we interpret labour market data and how we suggest policies. They can be useful for example, to analyse the wage dispersion across identical workers, the effects of unemployment benefits on search behaviour of unemployed workers, the effects in hiring and firing rates of Employment Protection Legislation, the behaviour at different stages of the business cycle of workers flows and the probabilities to find a job, to loose one or to move from out the labour force to employment or unemployment during the cycle.

Furthermore, search theory has opened several branches of literature that although related, have different primary concerns. First group of researchers aim to explain worker and job flow and levels of unemployment; the second one focus in how wage dispersion can be a result of labour markets with frictions; and a third one with the interests to incorporate the search frictions in the labour markets into the Dynamic Stochastic General Equilibrium Models to study business cycles.

Additionally, the analysis of the labour markets trough the lens of search frictions models has been prolific specially for the United States, for other OECD countries there have been also several studies; and new discussions have raised to complement and enrich original DMP models. However almost no progress has been done for developing countries, mostly because of the lack of appropriated data about the flows of workers, the level of vacancies and the durations of the spells of employment, unemployment and inactivity. The goal of this work is to use the search frictions framework to analyse the contributions of job finding and separation rates to fluctuations in unemployment for the Colombian case from 1984 to 2011 exploiting questions from household surveys to construct the required data. Moreover, results are compared with the corresponding from France and the United States to analyse to which of this two polar labour markets is closer the Colombian one. Besides, a model in the spirit of Mortensen and Pissarides (1994) is presented to account for the empirical findings

The remainder of this work is composed of five chapters. The second part of this introduction makes a brief presentation of Colombian labour market to put in context analysis done in this document. The methodologies used to compute the job finding and separation rates and to analyse their behaviour in the business cycle are presented in chapter 2. Chapter 3 presents the sources and describes the procedure to construct the data. Results obtained for Colombia and their comparison with France and the United States are presented in chapter 4. Chapter 5 proposes a simple model in the spirit of Mortensen and Pissarides (1994) including firing costs to explain the results obtained previously. Finally, in chapter 6 are presented the overall conclusions of this work.

## 1.2 The Colombian labour market

In December of 2012, Colombian Central Bank published a book to gather the most important facts, trends and institutions of the Colombian labour market. As part of the research, Arango and Hamman (2012) asked to a group of analysts of the domestic labour market which were, according to them, the main sources of unemployment. Interestingly, search frictions were signalled as the most important; analysts chose the mismatch between the skill requirements of firms and the skill mix of labour force as

the major cause for unemployment, in the fourth place, slightly below the high level of the minimum wage, it appeared the low mobility and poor information systems about both sides of the market. When analysts were asked about the best policies that could improve the performance of Colombian labour market, the strengthening of information system was chosen in second place.

As seen, search frictions in the Colombian labour market have a prominent role; still, few analyses of them have been done so far. However, before starting to study the job findings and separation rates in Colombia, it worth to make first a brief description about how is the labour market in the country.

Recently, Colombian economy has strengthen; since 2001 it has not had negative growth rates of real GDP, foreign investment has increased and the unemployment rate has shown a decreasing trend during the last 10 years. Now, Colombia is the fourth largest country in South America and the continent's second populous nation after Brazil, has substantial oil reserves and is an important producer of gold, silver, emeralds, platinum and coal. Some weaker progress has been achieved in terms of poverty, according to the World Bank, the country is now an upper middle income and the enrolment to primary school moved from 68% in 1988 to 90% in 2009. Yet, the country is still a commodities exporter and the industrial sector as a share of GDP has shrinked during the last years while mining sector has expanded.

The gradual process of modernization of Colombian economy has also translated to the labour market; however it presents very contrasted features. In some aspects, its behaviour is similar to more dynamic labour markets in developed countries. First, flows of workers moving from employment, unemployment and inactivity are considerable; according to Lasso V (2011) after 1998 the probability to move from employment to unemployment has duplicated, moving from about 9% in 1995 to 18% in 1999, the probability to find a job as self employed has also showed an increasing trend during the last 15 years and the likelihood of remaining in the self employment after a year has decreased over time, specially since 2002[1]. These numbers suggest that workers are less attached to their jobs, but they also find more easily a new one; then, on average they are rotating more in the labour market from one state to the other specially since 1998. Second, female labour participation has increased markedly during the last 25 years, starting at 40% in 1984 until be around 70% in 2011, this is presented in panel (a) of figure 1.1.

In addition, now Colombian labour force is more educated. The share of workers that have at most primary school has dropped, in panel (b) of figure 1.1 it is possible to see that in 1984 they represented 38% of total labour force; but by 2011 they were 19%. Similarly, the median schooling of labour force has increased from 7 years to 11 between 1984 and 2011.

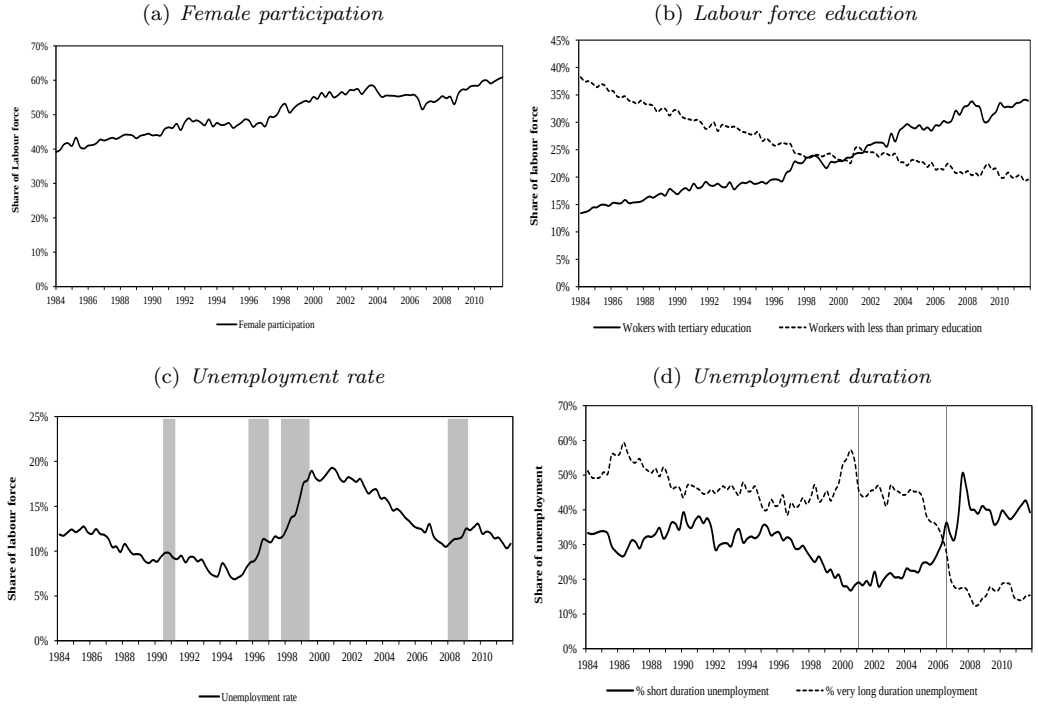
On the other hand, some features of the labour market would instead lead us to think that it is a rigid one. In 1995 Colombia had the lowest unemployment rate from its recent history, but in 1998 and 1999 the country experienced the most severe economic crisis which leaded to levels of unemployment up to 20%, even today it has not been possible to come back to the 1995's level, this is presented in the panel (c) of figure 1.1; the strong hysteresis of the unemployment rate suggests that the adjustments in the labour market are very slow, and that maybe, they occur mostly in the quantities (persons) instead of prices (wages).

The Colombian labour market presents also an interesting duality feature, most of the unemployed workers are in one of two extreme situations: they have being unemployed during 3 months or less or they have being unemployed for one year or more, this is displayed in the panel (d) of figure 1.1 and implies that there is an important share of workers that easily go in and out of employment while other non negligible group has low employability.

Besides, the country has had a huge growth of its informal sector up to levels of 25%; according to López Castaño (2008), the employment in modern sectors in Colombia has been biased in favour of the labour force with some degree of education and against the less educated. This poses a marked contrast with the fact that there is relative abundance of workers with at most secondary education, and consequently moves these latter to the informal sector that seems to have no limits to growth. From the firms point of view, Mejía and Posada (2007) argue that the high level of informality could emerge as an optimal choice of firms to the incentives that presents a rigid labour market where the minimum wage

[1]In 2002, 63% of employed workers with high education keep their jobs during a year; in 2010, this share had reduced to 56%. For low educated workers, the figures went from 60% to to 50% during the same time interval.

**Figure 1.1: Some Features of Colombian Labour market**




*Source*: Author's construction based on household surveys.

*Note*: Vertical lines in panel (c) signal the changes in household surveys. See chapter 3. Shaded areas in panel (d) represent the recession dates according to Alfonso et al. (2011)

is set above its equilibrium level. The level of sub employment is also very high in the country[2]; yet, according to Puyana et al. (2011) the employed workers who wish to work more hours per week perceive a higher wage per hour, suggesting that compensating differentials play an important role in this case.

Finally, the persistent differences in the results of labour markets from one city to the other suggest that there is low internal mobility of the labour force, calculations done by Arango (2011) show that the difference between the cities with the lowest and the highest participation rates is about 16 percentage points, the discrepancy can go up to 18 percentage points for the occupation rate whereas for the unemployment rate the range is close to 10 percentage points. Thus, even if flows of workers are high at the aggregated level as suggested by Lasso V (2011), the movements seems to occur within the same regions; high transportation costs and lack of information could be important determinants of this fact. Further research should either confirm or reject this hypothesis or set new ones.

[2]According to the current Colombian household survey, *sub employment* denotes all employed workers who wish to improve its revenues from work, to increase the number of hours worked, or, to have a job more suitable for their education/formation. If the person not only expresses her desire, but also has made some search in order to ameliorate its actual labour conditions, it is considered an *objective* sub employed.

# 2 Measuring job finding and separation rates

As mentioned in the introduction, DMP models are useful to analyse and to understand in more detail several empirical regularities; in this chapter I focus in one of them: the behaviour along the business cycle of the separations and job finding rates and how they contribute to the cyclical fluctuations in unemployment.

In a pioneer work Darby et al. (1986) assessed that for the United States economy changes in the inflow to unemployment were the main determinant of unemployment rate; similarly Davis and Haltiwanger (1990) highlighted that large job creation and job destruction flows can co-exist at all phases of the business cycle.

More recent analysis by Shimer (2005, 2012) drew new conclusions that are totally opposed to the previous ones; in particular, using publicly available data from the Current Population Survey (CPS henceforth) he argues that the prominent role attributed to separation rates in earlier studies is a consequence of a time aggregation bias, which basically results from the fact that transitions in the labour market occur continuously, but we only have information on whether the workers were in a state or not in discrete intervals (monthly in the best cases). He claims that once the bias is corrected, it is clear that separation rates are nearly acyclical whereas job finding rates are strongly procyclical and the main driving force of unemployment fluctuations.

As expected, these findings were controversial and subsequent studies developed alternative methodologies to either debate or confirm them. Elsby et al. (2009) proposed a slightly different method to evaluate the job finding and separation rates and found that even with Shimer's own data, inflows to unemployment have an important role in the increase of unemployment during recessions. Correspondingly, Fujita and Ramey (2009) used CPS gross flow data to quantify the contribution of each flow to overall unemployment variability and concluded that both are roughly important to explain movements in unemployment. Similarly, Yashiv (2006) compared several data sources and found that there is considerable cyclicality and volatility of both outflows and inflows to unemployment and hence, both are important for understanding the business cycle.

For other countries, Petrongolo and Pissarides (2008) used administrative and labour force survey (LFS) data to study the contribution of finding and separation rates to unemployment for Spain, France and the United Kingdom; their main finding is that even if both rates have an important role in fluctuations of unemployment rate, job finding is more relevant in high firing costs scenarios. On the other hand, Hairault et al. (2012) utilised also administrative and LFS data and showed a dominant role of the job finding rate in the French unemployment fluctuations during the last decade but still cyclical fluctuations of separation rates.

Finally, Elsby et al. (2008) made a comparative analysis of fourteen OECD countries using annual measures of the unemployment stock classified by its duration to conclude that fluctuations in both inflow and outflow rates make important contributions to unemployment variation within countries, that there is a geographical partitioning of the relevance of each rate[1] and that the timing of contributions is similar across countries.

As can be noticed, despite its relevance; the debate has been focused in advanced economies. The

[1]They found that Anglo-Saxon countries' unemployment rates are mostly determined by job finding rates whereas in Continental European countries' rates play an equal role

reason for this is mainly that there are not good or long enough datasets in developing countries, in particular regarding the labour market flows and the vacancies rates. However, Shimer (2005) and Elsby et al. (2009) methodologies permit to estimate the job finding and job separation rates based on the stock of unemployment and the duration of the spells, and these data are more likely to be available for several countries. Colombia for example counts with it quarterly since 1984 on.

As a first approach to the debate for the Colombian case, the works by Shimer (2005), Elsby et al. (2009), Fujita and Ramey (2009) and the modifications done to them to fit the Colombian case are presented next. In order to give a better analysis of the results, the outcomes obtained for Colombia are compared with the updated existent findings for the United States and French economies, therefore it is also presented the approach proposed by Elsby et al. (2008) to deal with French data given the low frequency at which it is available[2].

For the forthcoming analysis there will be considered only two states in which workers can be: employment and unemployment. Thus *separation rate* will refer to the transitions from employment to unemployment, and *job finding rate* to the transitions from unemployment to employment. With this approach movements in and out of the labour force are certainly ignored, and it is not possible to distinguish job loss from job leaving when separations occur; however for the United States case, Shimer (2012) established that the two transitions considered here explain more than two thirds of the variability of unemployment; similarly Hairault et al. (2012) assessed that the two-states approach can capture the main dynamics of French unemployment. For the Colombian case Lasso V (2011) argues that the changes between employment and unemployment within the labour force are the main drivers of unemployment fluctuations; and as will be shown after, the two-states is a fairly good approximation since the unemployment rate predicted from such case closely tracks the actual one.

## 2.1 Shimer (2005) methodology

Shimer (2005, 2012) proposes a methodology to compute the job finding and separation rates using publicly available data. He makes four main assumptions:

1. Workers neither enter nor exit the labour force, but just move between employment and unemployment; the latter defined as the period of active job search[3].

2. Since the methodology is based in macroeconomic aggregated data, workers are consider ex ante identical, meaning that in any period $t$ unemployed have the same job finding rate and employed workers have the same job separation rate; therefore it is ignored any heterogeneity or duration dependence that could make some unemployed workers more likely to find a job.

3. Given that the variations in the job finding or separation rates within the period are not observable, they are assumed to be constant.

4. Initially, Shimer (2005) considers that there is not on-the-job search, this last assumption is relaxed after to evaluate the possibility that workers change from job without experiencing unemployment spells and to match the stylized fact that these transitions are strongly procyclical. But given the features of the data used here, this work will stay in the basic model where there is not on-the-job search.

The environment proposed by Shimer (2005) is a continuous time which data is available only at discrete dates. This is the source of time aggregation bias: even if people loose and find jobs at very short

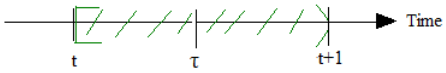
[2]The French Labour Survey is annual since 1950, from 2003 the survey passed to be a rotative quarterly panel where each household is surveyed during six quarters.

[3]As was pointed in the introduction, this criteria for defining unemployment is actually consistent with the official definition of the International Labour Organization (ILO), which considers as unemployed a person in age of working ( more than 15 years old for developed countries) who: *i)* has worked less than one hour during the reference week, *ii)* is *available* for working during the next two weeks and *iii)* has *actively looked for a job* during the last month.

intervals of time, say every day; the labour force surveys are conducted only on a monthly or quarterly basis, then they could not capture the inflows and outflows from unemployment over the period.

Under this setting, Shimer (2005) refers to the interval of time $[t, t+1)$ as the period $t$. Additionally $\tau \in [0, 1]$ is set to be the time elapse since the previous survey date. For illustrative purposes figure 2.1 is presented. In $t$ and $t+1$ individuals are surveyed, but between these dates, in a moment $\tau$, the unemployment count could have changed with respect to the reported by the survey in period $t$ since some workers could have loose their jobs and some unemployed workers might have found one.

**Figure 2.1: Source of time aggregation bias**




In the moment of time $\tau$ the number of employed and unemployed workers could differ from the reported in survey done in $t$. This problem is exacerbated when the surveys are conducted in a lower frequency.

Let $U_{t+\tau}$ denote the number of unemployed workers at time $t+\tau$ and $E_{t+\tau}$ the number of employed workers at the same moment of time; together they determine the labour force $L_{t+\tau} = E_{t+\tau} + U_{t+\tau}$.

Finally $U_t^s(\tau)$ represents the short term unemployment, that is, the number of workers that are unemployed in time $t+\tau$ but that were employed at some point between $t$ and $t+\tau$. This group of workers will not be captured as unemployed by the survey done in period $t$ even if they are unemployed most of the time interval elapsed between the two measurement dates; and then could bias any analysis about unemployment done only on the basis of stocks. To close notation, $U_t^s(0) = 0 \; \forall t$ and $U_t^s(1) = U_{t+1}^s$ is the total amount of short term unemployment at the end of period $t$[4].

Assuming that job offers arrive to unemployed workers following a Poisson process with rate $f_t$ and that all offers are accepted[5], $F_t = 1 - e^{-f_t} \in [0, 1]$ represents the probability that a worker who begins the period $t$ unemployed finds at least one job during the period of time (before the next survey date).

Likewise, if separations arrive to employed workers following a Possion process with rate $s_t$, the probability that a workers who begins period $t$ employed losses his job within the period is given by $S_t = 1 - e^{-s_t}$.

With this two Possion processes, it is possible to obtain the law of motion for unemployment:

$$\dot{U}_{t+\tau} = s_t E_{t+\tau} - f_t U_{t+\tau}$$

Similarly, for the short term unemployment we can set:

$$\dot{U}_t^s(\tau) = s_t E_{t+\tau} - f_t U_t(\tau)$$

Combining both equations to eliminate $E_{t+\tau}$:

$$\dot{U}_{t+\tau} = \dot{U}_t^s(\tau) - f_t[U_{t+\tau} - U_t^s(\tau)]$$

Recognizing that data is only available for $\tau = 0$ and $\tau = 1$, this yields:

$$\boxed{F_t = 1 - \frac{U_{t+1} - U_{t+1}^s}{U_t}} \tag{2.1}$$

[4]This means that $U_{t+1}^s$ is the number of workers that are unemployed at the moment of the next survey but that were registered as employed in the previous interrogation.

[5]Here, it is assumed that workers do not use a reservation wage strategy to search for a job, this differs from initial search models as in Mortensen (1970) or Burdett and Mortensen (1998).

From the previous equation, it is possible to obtain the probability that a typical unemployed worker finds a job during the time elapsed between two consecutive surveys: $F_t$. This result can be then used to get the job finding rate:

$$\boxed{f_t = -\ln(1 - F_t)} \tag{2.2}$$

So, it is straightforward to notice that, having measures of unemployment and short term unemployment[6] it is possible to obtain the job finding probability and with it, the job finding rate.

Combining the information about the labour force and the job separation rate; it is possible to use the law of motion of unemployment to obtain the job separation rate:

$$U_{t+1} - U_t = s_t(L_t - U_t) - f_t U_t$$

After some algebraic manipulations we can finally have a non linear equation for $s_t$ that can be solved to obtain the separation rate:

$$\boxed{U_{t+1} = \frac{s_t L_t \left[1 - e^{-(f_t + s_t)}\right]}{f_t + s_t} + e^{-(f_t + s_t)} U_t} \tag{2.3}$$

In the steady state, this equation reduces to:

$$\boxed{u_t^{ss} = \frac{s_t}{s_t + f_t}} \tag{2.4}$$

Where $u_t$ is the unemployment rate and the index $ss$ indicates that we are considering the steady sate. Shimer (2005), Elsby et al. (2009) and Fujita and Ramey (2009) argue that the evolution of actual unemployment rate is closely approximated by this steady state relationship, that is, that $u_t \approx u_t^{ss}$. For the United States, Shimer (2005) founds a correlation between this two values of 0.99; for the French case Hairault et al. (2012) obtained a value of 0.91 when administrative data is used and of 0.83 when LFS is the source of information; for Colombia Lasso V (2011) found a correlation between the cycles of these two series of 0.99.

Hence, to measure the job finding and separation rates in practice we need data about:

1. The number of employed workers: $E_t$
2. The number of unemployed workers: $U_t$
3. The unemployment duration, in particular the number of unemployed of short term[7]: $U_t^s$

This data is usually available publicly and for a non negligible number of countries beyond the developed economies; as was mentioned before, for the Colombian case we can count with them since 1984.

Finally, Shimer (2005) computes the hypothetical steady state unemployment rate that would prevail if the job finding rate would remain at its historical average in order to obtain the relative contribution of

[6] Thus, in this context, short term unemployment is defined as the number of unemployed workers whose duration of the unemployment spell is lower or equal than the time interval between two consecutive surveys: If surveys are done monthly, short term unemployment corresponds to unemployed workers who have been in such state during 4 weeks or less; in the case of quarterly surveys, the ones that have been during 12 or less weeks.

[7] For the United States case, Shimer (2005) must adjust this series from 1994 on due to a redesign of the survey that changed how the unemployment duration question was asked; prior to 1994, the official measure of short-term unemployment captured the total number of unemployed workers who were employed at any point during the preceding month but not at the moment of the survey; whereas after the redesign, short term unemployment counted only workers who moved from employment at one survey date to unemployment at the next survey date, ignoring movements within the period. To fit the true value, his proposal is to multiply the official series by a correction factor of 1.1

this rate to overall unemployment fluctuations; an equivalent procedure is done for the separation rate. In this way, in Shimer (2005) and Shimer (2012) each transition rate's contribution is given by:

**Table 2.1: Contribution of job finding and separation rate to overall unemployment fluctations. Shimer (2005) approach**

| *Contribution of job finding rate* | *Contribution of job separation rate* |
|---|---|
| $c_t^f = \frac{\bar{s}}{\bar{s} + f_t}$ | $c_t^s = \frac{s_t}{s_t + \bar{f}}$ |

Where $\bar{s}$ and $\bar{f}$ represent the average sample values of separation and finding rates respectively.

## 2.2 Elsby et al. (2009) methodology

The counter-intuitive results from Shimer (2005) and Shimer (2012) regarding the cyclical behaviour of separation rates have motivated a new wave of works that proposed alternative approaches to evaluate these findings. One of them, based also in Labour Force Survey data that is available for the public is the study by Elsby et al. (2009) [8].

Their methodology is based on the same assumptions from Shimer (2005), but it incorporates into the analysis the fact that most of the LFS that follow the International Labour Organization (ILO hereafter) guidelines consider the week previous to the survey as the relevant reference period to compute aggregated employment and unemployment figures; their aim is therefore to be consistent with the official labour force definitions that underlie the construction of the series that are used to obtain job finding and separation rates.

Hence, Elsby et al. (2009) propose a discrete weekly equivalent to Shimer's time aggregation correction method. They use the same definition as equation (2.1) in order to compute the job finding probability, but make a difference computation to obtain the separation rate. Bearing in mind that the reference period is a week, for monthly data the time elapsed since the last survey ($\tau$) can only take four values:

$$\tau \in \left\{0, \frac{1}{4}, \frac{1}{2}, \frac{3}{4}\right\}$$

The stock of unemployment under this conditions evolves following a difference equation:

$$U_{t+\tau+\frac{1}{4}} = U_{t+\tau} + s_t E_{t+\tau} - f_t U_{t+\tau}$$

Given that they assume initially a constant labour force, if the previous expression is solved forward four weeks it is obtained:

$$\boxed{U_{t+1} = s_t L_t \sum_{n=0}^{3} (1 - s_t - f_t)^n + (1 - s_t - f_t)^4 U_t} \tag{2.5}$$

From this new non-linear expression we can get the separation rate once the job finding rate has been obtained in equation (2.2). I extended equation (2.5) to fit quarterly data as in the Colombian case, details are presented in the appendix A, the resulting formula is basically the same, except from the exponents and limits of the sum:

[8] In their paper, Elsby et al. (2009) express their preference for this kind of data over the gross flow despite its usefulness as they claim that this latter are subject to numerous deficiencies, for example they exclude the individuals who change residence (and actually changes in domicile could be endogenous to a labour market transitions) and generate spurious transitions because of missclassification that could have occurred in either of the months used in the longitudinal match.

$$\boxed{U_{t+1} = s_t L_t \sum_{n=0}^{11} (1 - s_t - f_t)^n + (1 - s_t - f_t)^{12} U_t} \tag{2.6}$$

According to the authors, this new methodology solves the over correction of time aggregation bias that results from Shimer (2005) procedure and avoids the problem of raising the level of estimated inflow rates to unemployment and reducing the variations of the rate over the economic cycle that Shimer (2005) has.

The assumption of a constant labour force leads to a steady state relationship just as in equation (2.4), and since it is approximately equal to the actual unemployment rate, Elsby et al. (2009) propose a distinct manner to evaluate the impact that changes in either the job finding or separation rates have in the variation of unemployment. Log differentiation of the steady state unemployment rate expression in equation (2.4) yields:

$$\boxed{du_t \approx u_t(1 - u_t)[d\ln(s_t) - d\ln(f_t)]} \tag{2.7}$$

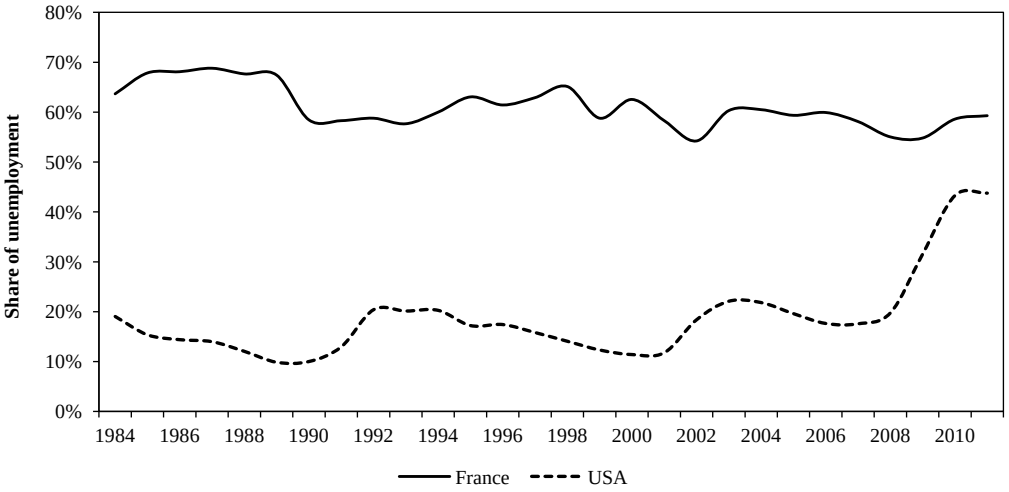
Where $u_t$ is again the actual unemployment rate. If it is small, that is, if $(1 - u_t) \approx 1$, the logarithmic changes in $s_t$ and $f_t$ will translate into fairly proportional changes in the unemployment rate. With this decomposition of the unemployment rate variations, Elsby et al. (2009) introduce a technique to quantify the contributions of each transition rate to the fluctuations in $u_t$; all that is needed, is to compare the log variations in the two flows with the corresponding in the unemployment rate to check which is more important.

## 2.3 Elsby et al. (2008) methodology for low frequency data

Elsby et al. (2008) argue that short duration unemployment can be very noisy for countries in which it accounts for a small proportion of overall unemployment, posing a natural limitation to Shimer (2005) procedure when it is going to be applied for countries other than the United States. For the French economy for example, the share of workers with more than a year of unemployment has fluctuated for more than 30 years around 40% whereas in the United States the workers just experience nine weeks of unemployment on average. To illustrate the magnitude of the difference, figure 2.2 compares the share of unemployed workers with more than 27 weeks of unemployment in France and the United States[9], it appears that indeed most of French unemployment corresponds to people that has been in such state during a long period of time, therefore, using Shimer (2005) method could bring misleading results.

[9]The BLS does not publish the number of unemployed workers with more than 12 months of unemployment, the highest interval covers the people with more than 27 weeks of unemployment, that is why it is used here as the reference to compare with French unemployment.

**Figure 2.2: Unemployed workers with more than 27 weeks of unemployment**




*Source*: Author's construction using data from French LFS and official BLS publications.

To address this difficulty Elsby et al. (2008) develop a method that exploits data on unemployment at lower frequencies to construct comparable time series of the job finding and separation rates for the cases where the actual unemployment rate can not be closely approximated by its flow steady state value (equation (2.4)) and derive a decomposition of unemployment variation that allows it to deviate from the equilibrium relationship. Their method has into account that Shimer (2005) procedure can not be applied directly to other OECD countries because the data needed for it is not available, the frequency of the surveys for most of the cases is low, for France for example it is annual until 2002.

Considering again only two states in which workers can be (employed and unemployed) the evolution of the unemployment rate can be written as:

$$\frac{du_t}{dt} = s_t(1 - u_t) - f_t u_t$$

Assuming that the flow hazard rates $s_t$ and $f_t$ are constant within years, and solving the equation one year forward it is found:

$$\boxed{u_t = \lambda_t u_t^* + (1 - \lambda_t) u_{t-12}} \tag{2.8}$$

Where $u_t^*$ is the steady state unemployment rate presented in equation (2.4) and $\lambda_t = 1 - e^{-12(s_t + f_t)}$ denotes the annual rate of convergence to the steady state.

As an extension of the Shimer (2005) method, it is possible to write the probability that an unemployed workers exits unemployment within $d$ months as:

$$F^{<d} = 1 - \frac{U_{t+d} - U_{t+d}^{<d}}{U_t} \tag{2.9}$$

Where $U_{t+d}$ denotes the stock of unemployed workers in period $t+d$ and $U_{t+d}^{<d}$ the stock of unemployed workers with duration less than $d$ months.

As in Shimer (2005) this can be mapped into a job finding rate given by:

$$\boxed{f_t^{<d} = \frac{-\ln(1 - F_t^{<d})}{d}} \tag{2.10}$$

With this estimation of job finding rate, it is possible to compute the separation rate using equation (2.8).

Finally, in order to evaluate the contribution of each rate to overall fluctuations in unemployment a big contrast appears with respect to Elsby et al. (2009) since the unemployment rate in countries where the share of short duration unemployment is low can substantially differ from its flow steady state value. Using equation (2.8) and doing a log-linear approximation of it, it is possible to express the logarithmic change in unemployment rate as:

$$\Delta \ln u_t \approx \lambda_{t-1} \left\{ (1 - u_t^*)[\Delta \ln s_t - \Delta \ln f_t] + \frac{1 - \lambda_{t-2}}{\lambda_{t-2}} \Delta \ln u_{t-1} \right\} \tag{2.11}$$

From here it is possible to notice that if unemployment dynamics are very fast, $\lambda_t$ is close to one for all $t$, then the equation reduces to the decomposition proposed by Elsby et al. (2009), as in equation (2.7); however, out of steady state contemporaneous changes in unemployment rate are driven not only by contemporaneous but also by lagged variation in the job finding and separation rates. In order to summarize the contributions of each rate Elsby et al. (2009) compute:

$$\beta_f = \frac{cov(\Delta \ln u_t, C_{ft})}{var(\Delta \ln u_t)} \quad \beta_s = \frac{cov(\Delta \ln u_t, C_{st})}{var(\Delta \ln u_t)} \quad \beta_0 = \frac{cov(\Delta \ln u_t, C_0)}{var(\Delta \ln u_t)}$$

(2.12)

Where $\beta_f$, $\beta_s$ and $\beta_0$ represent respectively the total contribution of job finding rate, job separation rate and the initial deviation form steady state on the fluctuations of unemployment rate. Similarly, $C_{ft}$, $C_{st}$ and $C_0$ are the *cumulative* contributions of contemporaneous and past variations in the job finding rate, job separation rate and the initial deviation from steady state at time $t = 0$ and are defined as:

$$C_{ft} = \lambda_{t-1} \left[ -(1 - u_{t-1}^*) \Delta \ln f_t + \frac{1 - \lambda_{t-2}}{\lambda_{t-2}} C_{ft-1} \right], \quad \text{with } C_{f0} = 0$$

$$C_{st} = \lambda_{t-1} \left[ (1 - u_{t-1}^*) \Delta \ln s_t + \frac{1 - \lambda_{t-2}}{\lambda_{t-2}} C_{st-1} \right], \quad \text{with } C_{s0} = 0$$

And,

$$C_{0t} = \frac{\lambda_{t-1}(1 - \lambda_{t-2})}{\lambda_{t-2}} C_{0t-1}, \quad \text{with } C_{00} = \Delta \ln u_0$$

## 2.4 Fujita and Ramey (2009) measure of cyclicality and contribution of separation and job finding rate.

Fujita and Ramey (2009) also made a contribution to the debate about the movements of job finding and separation rates along the cycle; instead of using the stock of unemployed and employed workers, they use the CPS gross flow data to analyse business cycle dynamics of separation and job finding rates and to quantify the contributions of these rates to overall unemployment variability. Moreover, using traditional Hodrick Prescott filtering and first differencing to remove the trend of the data, they evaluate the comovements of the cyclical components of job finding and separation rate with the corresponding of the productivity and unemployment rate at various leads and lags to evaluate their degree of cyclicality.

If $eu_t$ and $ue_t$ denote the gross-flows between $t-1$ and $t$ form employment to unemployment and from unemployment to employment respectively and letting $E_{t-1}$ and $U_{t-1}$ indicate the stocks of employed and unemployed workers in month $t-1$, the average monthly separation and job finding rates are given by:

$$\hat{s}_t = \frac{eu_t}{E_{t+1}}, \qquad \hat{f}_t = \frac{ue_t}{U_{t+1}}$$

If the underlying process of finding and loosing a job arrives following a Poisson rate, the continuous-time equivalents of the previous expressions ($s_t$ and $f_t$) must satisfy:

$$\hat{s}_t = \frac{s_t(1-e^{(s_t+f_t)})}{s_t+f_t}, \qquad \hat{f}_t = \frac{f_t(1-e^{(s_t+f_t)})}{s_t+f_t}$$

Once the hazard rates $s_t$ and $f_t$ have been computed, they are converted to quarterly frequency by simple averaging.

To quantify the contributions of separation and job finding rates to overall unemployment variability, Fujita and Ramey (2009) made use of the steady state approximation of the actual unemployment presented in equation (2.4); this expression could also be applied to the trends obtained with the HP filter[10]

$$\bar{u}_t \approx \frac{\bar{s}_t}{\bar{s}_t + \bar{f}_t} \approx \bar{u}_t^{ss}$$

Doing a log linear approximation of $u_t^{ss}$ around its trend $\bar{u}_t^{ss}$ leads to the following decomposition:

$$\ln\left(\frac{u_t^{ss}}{\bar{u}_t^{ss}}\right) = (1-\bar{u}_t^{ss})\ln\left(\frac{s_t}{\bar{s}_t}\right) - (1-\bar{u}_t^{ss})\ln\left(\frac{f_t}{\bar{f}_t}\right) + \epsilon_t$$

This can be expressed in a more general form as:

$$du_t^{ss} = du_t^{sr} + du_t^{jfr} + \epsilon_t \tag{2.13}$$

Where $du_t^{sr}$ and $du_t^{jfr}$ represent respectively the deviations of separation rate and job finding rate from their trends. The expression in equation (2.13) makes it possible to decompose unemployment variability in terms of changes in job finding and job separation rates, that is, $Var(du_t^{ss})$ can be written as:

$$Var(du_t^{ss}) = Cov(du_t^{ss}, du_t^{sr}) + Cov(du_t^{ss}, du_t^{jfr}) + Cov(du_t^{ss}, \epsilon_t)$$

Expressed as a fraction of total variation of steady state unemployment, the expression reduces to:

$$1 = \frac{Cov(du_t^{ss}, du_t^{sr})}{Var(du_t^{ss})} + \frac{Cov(du_t^{ss}, du_t^{jfr})}{Var(du_t^{ss})} + \frac{Cov(du_t^{ss}, du_t^{\epsilon})}{Var(du_t^{ss})}$$

Which is equivalent to:

$$1 \approx \beta^{sr} + \beta^{jfr} + \beta^{\epsilon}$$

[10] Originally, the trends could also be set to be the value of unemployment steady state lagged one period, that is, $\bar{u}_t^{ss} = u_{t-1}^{ss}$

Therefore, the variation in $du_t^{ss}$ that derives from variations in $du_t^{sr}$, $du_t^{jfr}$ or $du_t^{\epsilon}$ is given by:

$$\boxed{\beta^i = \frac{Cov(du_t^{ss}, du_t^i)}{Var(du_t^{ss})}} \tag{2.14}$$

Where $i$ can take the values $sr$, $jfr$ or $\epsilon$. Thus, the betas measure how much of unemployment variation is explained by fluctuations in the separation, job finding rates and a residual component.

Results of the detrending procedure show that for the United States the separation rate and productivity have a peak correlation of -0.58 when the HP filter is used, with the first differencing the magnitudes are reduced. For the job finding rate, the obtained correlation has its peak at a lead of two or three quarters in the HP filtering data. Using as cycle indicator the unemployment rate, they are also found different degrees of comovement between the labour market hazard rates and the business cycle. These results once more contradict Shimer (2005) finding about aciclycality of separation rate.

Since for the Colombian case the gross flows of workers between one state and the other are not available, the Fujita and Ramey (2009) method for computing the job finding and separation rates will not be used; I rather will make use of the measures of contributions to unemployment variability ($\beta^{sr}$ and $\beta^{sr}$) proposed by them.

# 3 Data and data treatment

## 3.1 Colombian Household surveys

This work relies on Households Survey data provided by the National Statistical Department of Colombia (DANE); using this source of information it is possible to obtain relatively long time series for the Colombian case.

In Colombia, household surveys started to be implemented during the decade of 1970, the first of them was *Encuesta Nacional de Hogares*[1] (ENH henceforth) and had as main goal to produce basic statistics related to the demographic, social and economic features of Colombian population, changes in the level of employment were also captured by this initial survey. From 1970 to 1983, only nine surveys were conducted, with different frequency and sample designs; in 1978 for example was done the first measurement of rural areas; some cities were surveyed only twice a year whereas other every quarter.

More homogeneous series are available since 1984, when ENH started to be applied quarterly to the seven main cities in the country[2] and the municipalities close to them using the same methodology, sample design and basically the same questions. However, according to Lasso V (2002), this survey was subject to some limitations; for example, the high rotation of the staff in charge of collecting the data made harder the development of the survey and monitoring of the households.

In order to correct these failures, to modernise the surveys system and to obtain results that were consistent with the ILO guidelines, in 1996 the DANE began a project to improve the quality of the households survey, updating the methodologies, the samples and changing the frequency at which data was collected.

In 2001, a new survey took place, the *Encuesta Continua de Hogares* (ECH in what follows) replaced the ENH and introduced the designed changes: the survey became continuous, meaning that data collection was conducted each of the 52 weeks of the year; more cities were included (13 instead of seven) and aggregated data was published every month instead of every quarter.

Nevertheless the most considerable modification from one survey to the other was the classification of individuals between employed, unemployed or inactive: First, the contributing family workers (previously referred to as unpaid family workers) working in a family business during one hour or more per week are considered as employed workers according to the ILO definitions adopted by the ECH; conversely in ENH, this category covered the family workers who worked 15 weeks or more per week. Thus, people who devoted one to 14 hours per week to work in a family business without any compensation or wage, move from being considered unemployed or inactive in the ENH to be employed in the ECH. The second main change was done to the definition of unemployed worked; the ECH concept includes the *availability* to work of people that express the desire to do it; therefore, in comparison with the ENH, in the ECH people who is not available to work or does not have a valid reason for unemployment[3] is not considered

[1] National Households Survey

[2] Bogotá, Cali, Medellín, Barranquilla, Pasto, Bucaramanga and Manizales

[3] Valid reasons for unemployment include: *i)* Already found a job, *ii*) being waiting for callback, *iii)* do not find job in the city, *iv*) do not know how to look for a job, *v*) do not find job in her the profession or occupation, *vi)* do not have the experience needed for the job, *vii*) being discouraged of searching, *viii)* being waiting for the high season, *ix)* do not have enough resources to start her own business, or, *x)* being considered too young or too old by the employers. Reasons from *iii)* to *vi)* could be considered as search frictions.

as unemployed.

As a result of these two changes, the unemployment rate was reduced in about 3 percentage points while the employment rate increased about one percentage point; this break in the series posed a challenge to the researchers and politicians willing to do long term analysis about Colombian labour market. Lasso V (2002) and Arango et al. (2006) suggested different methods to splice the two labour market time series resulting from each survey. For this work, the aggregated series obtained from the latter work will be used to analyse the job finding and separation rates during a longer period of time.

In the third quarter of 2006, further adjustments were done to the households survey. The sample was updated according to the population census done in 2005 and two more surveys related to the households conditions in the country were included: The National Survey of Revenues and Expenditures and the Life Conditions Survey. Besides, a mobile device to collect the data was introduced and the answers of each person started to be answered directly by the individual instead of being responded by the chief of the household. According to the DANE, changes done in 2006 did not have important effects on the main figures from the labour markets in the urban areas with respect to the ECH, therefore any procedure to splice the time series from ECH and the new survey will be used. Gran Encuesta Integrada de Hogares, *GEIH*, was the name given to the survey that resulted from the 2006 modifications to the ECH, until now it is the main source of information about the Colombian labour market.

## 3.2 Construction of the series: The Colombian case.

This work relies on the microeconomic public use data from the Household Surveys from the first quarter of 1984 to the last quarter of 2011. In order to obtain time series for this period, several steps are followed:

First, to obtain the data from 1984 to 2000:IV I use the aggregated spliced series of unemployment rate ($UR_t^s$), employment rate ($ER_t^s$) and participation rate ($PR_t^s$) from Arango et al. (2006). Since the data needed to apply the methodologies presented in chapter 2 refers to the *number* of employed and unemployed people instead of the rates, the required series are computed using the fact that the definition of the working age population did not changed from one survey to the other[4]:

$$LF_t^s = WAP_t * PR_t^s$$

$$U_t^s = UR_t^s * LF_t^s$$

$$E_t^s = WAP_t * ER_t^s$$

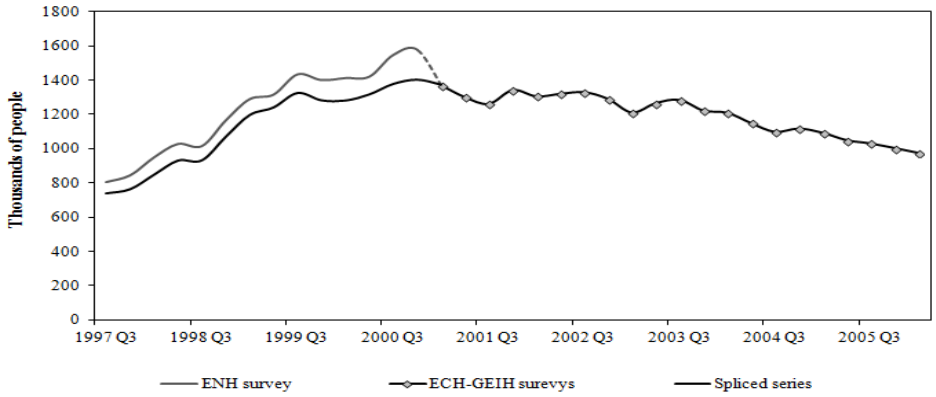
Where $LF_t$ corresponds to the labour force, $WAP_t$ to the working age population, $U_t$ to the number of unemployed workers and $E_t$ to the number of employed workers. The index $s$ indicates that the series are spliced; note that the working age population does not have the index since it did not changed from the ENH to the ECH.

Second, to get the data from the first quarter of 2001 on, I compute the quarterly average of the number of people belonging to the labour force and classify them in unemployed and employed only for the seven cities that were originally surveyed in the ENH.

Finally, I seasonally adjust the full time series using the procedure census X-12. Results from the splicing procedure and seasonal adjustment for the number of unemployed workers are presented in figure 3.1. It is evident the break in the series derived from the change of the survey; however, the splicing procedure seems to correct it fairly well.

[4]In Colombia, the working age population includes all persons with 12 years or more in urban areas or 10 years or more in rural areas.

**Figure 3.1: Spliced series for unemployment**




*Source*: Author's construction based on household surveys and Arango et al. (2006).
*Note:* Constructed for the seven cities that were surveyed in ENH.

The classification of unemployed workers according to their unemployment duration is not published officially by the DANE; nevertheless, since 1984 all the surveys have asked to the individuals two different questions related to their unemployment spells: *i)* How many weeks have you looked for a job? *ii)* How many weeks have you been unemployed? Given that the methodologies presented in previous chapter refer to search and matching models, and because to be consider as unemployed worker it is necessary, according to the official ILO definition, to be actively looking for a job; the first question is used to construct the short term unemployment series[5].

The change in the frequency of the household survey from quarterly to monthly since 2001 poses a challenge for the construction of the short term unemployment series; if the whole sample period were quarterly, it can be easily defined as the number of unemployed workers that have been in such state during 12 weeks or less; similarly, if the whole data came from monthly surveys, short term unemployed workers would be those with less than 5 weeks of search. But with two different frequencies it is not so straightforward which should be the period considered to construct the series.

However, given that the Shimer (2005) method defines the relevant time interval to compute the short term unemployment as the time elapsed between two measurement dates and that this work is based mostly on quarterly data, I will consider as short term unemployed to the unemployed workers that have been looking for a job during 12 weeks or less. Figure 3.2 presents the resulting series. The first vertical line signals the date when the survey moved from been quarterly to monthly, and the second one when the mobile capture device was introduced to collect the data[6]. It can be noticed that the change of the survey the second time brought an increase of the series, but looking at the whole series it is perceived that since 1996 it started to show an growing trend, moreover the marked increase in the short term unemployment coincides with the notable reduction of the unemployment that arrived in the last two quarters of 2006, when the economy was booming.

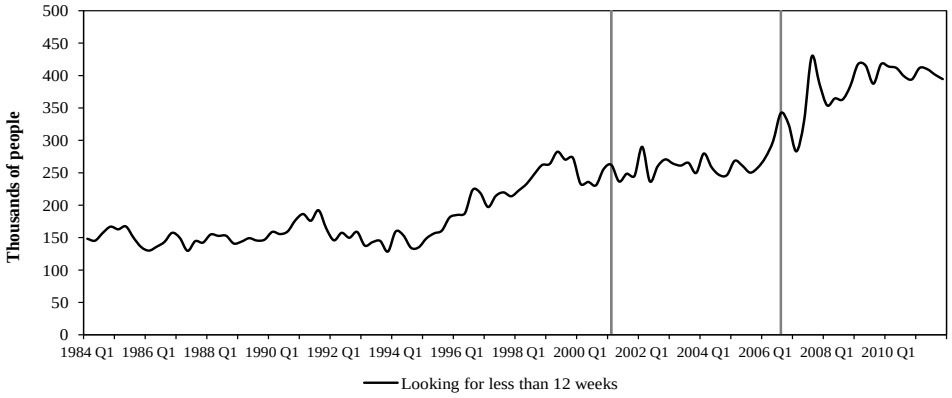
Finally, Colombia does not have and official Business Cycle Dating Committee as it is the case in the United States or in Europe; however, a chronology of the business cycle is needed in order to have a reference to evaluate the performance of the unemployment, job finding and separation rates along the cycle. To overcome this lack of official data, the dates of recession and expansion for the Colombian economy are based on the monthly chronology proposed by Alfonso et al. (2011)[7]; since the frequency of

[5]Besides, according to the information presented by the Bureau of Labour Statistics of the United States, the duration of unemployment is computed on the base of how much time persons had been looking for work. Thus for comparative purposes the first question is more suitable to construct the series

[6]This means, the first vertical line signals the movement from ENH to ECH and the second one from ECH to GEIH.

[7]This dating of business cycle is based on 41 monthly series that cover the whole Colombian economy, the proposed chronology results from analysing the levels of the series without using any detrending procedure as the Hodrick and Prescott (1980) (HP) filter, and its performance seems satisfactory when it is contrasted with other variables not used in its construction as the urban GDP.

**Figure 3.2: Colombian short term unemployment for quarterly data**




*Source*: Author's construction based on household surveys. Seasonally adjusted series

this study is quarterly, in order to make the chronology equivalent, the quarters of recession are set to be the ones for which the monthly chronology marked at least one month of economic downturn.

## 3.3 Series for France and the United States.

In this work Shimer (2005), Elsby et al. (2009) and Elsby et al. (2008) works are also updated until the last quarter of 2011 in order to compare Colombian labour market with two countries, the United States and France. These two economies are interesting because they illustrate two polar cases, the former is usually consider as a very flexible labour market whereas the latter is consider a very rigid one with strong employment protection and low labour reallocation. According to Allard (2005) index[8], the United States have an average score of 0.6 in its employment protection, the lowest from the OECD countries, whereas France reached a value of 3, only below Greece and Italy.

For the United States, I made use of the public CPS monthly data published by the Bureau of Labour Statistics[9]; series about the employment, unemployment and short term unemployment are available since 1948; however, I just consider the period from 1984 to 2011 in order to make it homogeneous to the Colombian period of analysis. To work in the same frequency I take the quarterly average of the data. Finally, to describe the business cycle in the United States, I use of the official quarterly chronology published by the Business Cycle Dating Committee of the National Bureau of Economic Research.

The French case requires more attention; household surveys started in 1950 but at annual frequency, only since 2003 it is possible to obtain data every quarter. The French Statistical Department (INSEE) has published some spliced series at the quarterly frequency for the unemployment level, but the series for the employment level and the unemployment classified by its duration are only available at the annual frequency. This is the reason for using the procedure suggested by Elsby et al. (2008) for low frequency data presented previously.

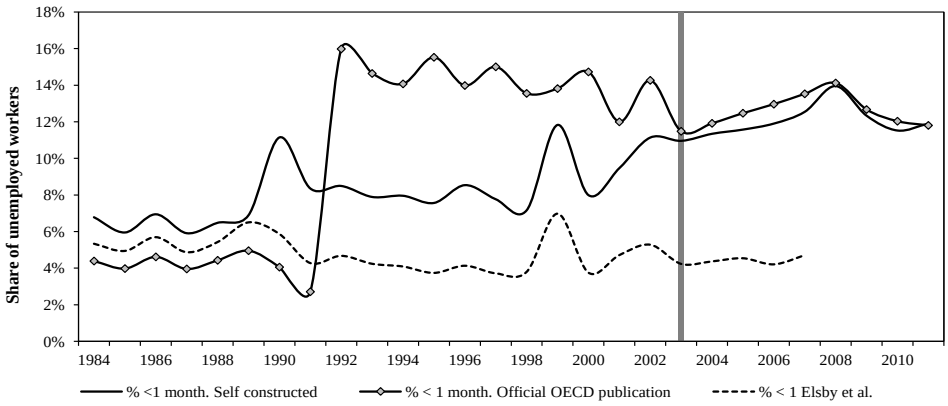
The classification of unemployed workers according to the duration of their spells is published annually by the OECD[10], this is the source of information used by Elsby et al. (2008); however, the official data presents two strong breaks: one very strong in 1992 and the other less dramatic in 2003, the latter due to the change in the survey. These breaks are not presented in Elsby et al. (2008) data, which could suggest that in the official OECD publication jumps appeared latter. Given this strange jump of the series I

[8]The index is the weighted sum of the score that each country obtains according to several indicators of how easy or difficult is for a firm to dismiss a worker, it includes how many salaries does a firm has to pay when fires a worker, the notice period required to inform the worker about the decision, the definition of unfair dismissal and the maximum number of successive temporary contracts. The score goes from 0 (very easy) to 6 (very hard) and it is computed for three types of situations: Regular contracts, Temporary contracts and Collective dismissal.

[9]The data can be obtained from: http://bls.gov/cps/tables.htmcharunem_m

[10]It can be consulted in: http://stats.oecd.org/

**Figure 3.3: Unemployed workers with less than 5 weeks of unemployment in France**




*Source*: Author's construction based on household surveys, OECD data and Elsby et al. (2008)

compute by my self the share of workers with less than 5 weeks of unemployment[11] using the micro data of French LFS (Enquête emploi). Results are presented in figure 3.3; it appears that Elsby et al. (2008) series basically coincides with the official published by the OECD until 1992. Conversely, the series I obtain follow the same dynamics as the Elsby et al. (2008) but with a higher level, the increase in 1990 also seems to be stronger in my series; nevertheless my series coincide with official published data since 2003 (the period after the change of survey, represented by the vertical line) and does not present such dramatic break that suffers the official OECD data, so it will be used as my reference. Further details about the differences between each series are presented in annex B.

Regarding the dating of the business cycle, I follow the definition proposed by the Centre for Economic Policy Research (CEPR) for the European case, that is, France will be in recession whenever the growth rate of the real GDP is negative during two consecutive quarters. For the annual data, I will consider years of crisis the ones when at least one quarter was marked as recession.

[11] I actually do the same for the durations from 1 to 3 months, from 3 to 6 months and from 6 months to one year

# 4 Separation and job finding rates in Colombia

Figure 4.1 shows the smoothed job finding and separation rates obtained for Colombia using both Shimer (2005) and Elsby et al. (2009) methods. From the figure two main facts are evident: First, the separation rates obtained from both methods closely track each other and follow parallel trends, but just as Elsby et al. (2009) mentioned for the United States case, Shimer (2005) method (solid line in panel (b)) produces greater estimated rates of inflow to unemployment. Second, both job finding and separation rates move along the cycle following the expected direction, that is, during recessions separation rate increases and job finding rate falls, with the exception of the 2008 downturn when the decrease in finding rate occurred only towards the end of the business cycle phase. Moreover, it can be noticed that separation rate seems to have a turning point before than the cycle does, that is, separation seems to lead the cycle whereas job finding rate appears to move contemporaneously with the business cycle. From a visual approach, separation rate is not acyclical and is a leader indicator of the business cycle; this affirmation will be confirmed latter with a more formal criteria.

Separation rate reaches an average value of 4,6% when measured according to Elsby et al. (2009) method or 4,8% following Shimer (2005), besides during the last 10 years it has increased; in particular, separation rate has not come back to the levels it had before 1998 crisis, this finding is consistent with Lasso V (2011) results who argues that separation rate duplicated after 1999 and has not showed any signal of significant reduction since then. Given that separation rates are usually small, separation rates and separation probability are very close, that means that on average a Colombian worker will loose her job in a given quarter with a probability of 4,5%, value that is more than 1 percentage point higher than in the United States, an more than 3 percentage points greater than French labour market.

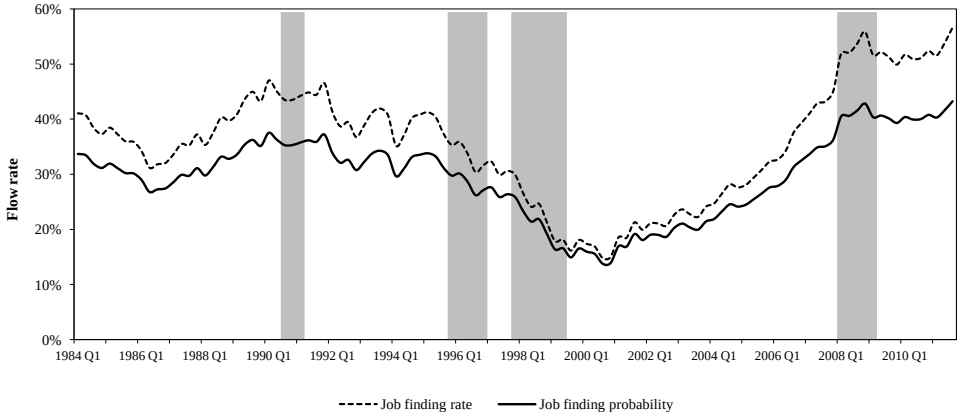
Job finding rate has an average value of 35,6% and it has also increased markedly during recent years, but conversely to Lasso V (2011) affirmation, my results indicate that it has reached higher levels than it had before the 1998 crisis, attaining a maximum value of 56% in 2010 after being in a minimum value of 15% in 2000. The same is behaviour is true for the job finding probability, $F_t = 1 - e^{-f_t}$, (solid line in panel (a)) although the level of this latter series is smaller. On average, in the Colombian labour market an unemployed worker will find a job in a particular quarter with 35% of probability, such value is lower than the estimated for the United States that reaches a mean value of 46% during the post war period, but still significantly higher than the French figures that reach 7,5% in Hairault et al. (2012); 7,8% in Elsby et al. (2009) or 9,7% in own calculations. Further comparisons will be given in next section.

On the other hand, the steady state obtained from the resulting job finding and separation rates is a good approximation of actual unemployment rate. The correlation between the the two series is 96% irrespectively of computing the series with Shimer (2005) or Elsby et al. (2009) methodologies. Even if the value is lower than for the United States where it reaches 99%, it is still high and confirms that the assumption of two states (employment and unemployment) done in chapter 2 is a fairly good one for the Colombian labour market at the aggregated level; this is displayed in figure 4.2.

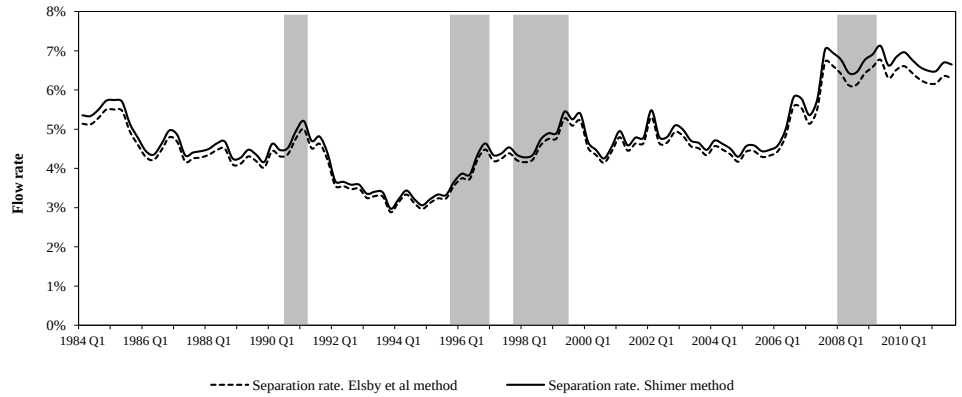
However, during the 1998 crisis the predicted steady state unemployment rate was notably higher than the actual one, and only until the second quarter of 2001 the two values become closer again. The omission of inactivity state could be a plausible explanation of the deviation during this period; in fact, during this period the annual growth of the participation rate was almost 4 percentage points, such value

**Figure 4.1: Job finding and separation rates for the Colombian Labour market**

(a) ***Job finding rate***




(b) ***Separation rate***




*Source*: Author's construction based on household surveys.
*Note*: Shaded areas represent recession dates according to Alfonso et al. (2011).

is higher than the observed in previous recessions, meaning that secondary members of the household such as housewives and older children become active job seekers at a stronger rate than before, imposing additional pressure to the labour market that was in part eased by the big flow of international emigration of working age population that experienced the country during in the aftermath of the crisis.

Overall, the estimations of separation and job finding rates are coherent with the features of Colombian labour market and indicate that flows on it are relatively high, specially during the last years. They also seem to have an prominent role in the evolution of unemployment rate since they fluctuate along the business cycle, this allows to make interesting contributions to the analysis of the labour market of the country. In what follows their cyclical properties are presented and it is studied how important they are to explain changes in unemployment; finally, the results obtained from this analysis are compared with the corresponding for the French and the United States economy.

## 4.1 Cyclical behaviour of job finding and separation rates.

The results displayed in figure 4.1 suggest that separation and job finding rates do move along the business cycle. In this section it is presented a more standard analysis of the cyclicality of both rates.

It is computed the correlation coefficient between the cyclical components of the logarithm of transition rates and an indicator of the business cycle for various leads and lags using two filtering procedures: Hodrick Prescott with parameter 1600 and the Band Pass proposed by Baxter and King (1995). For

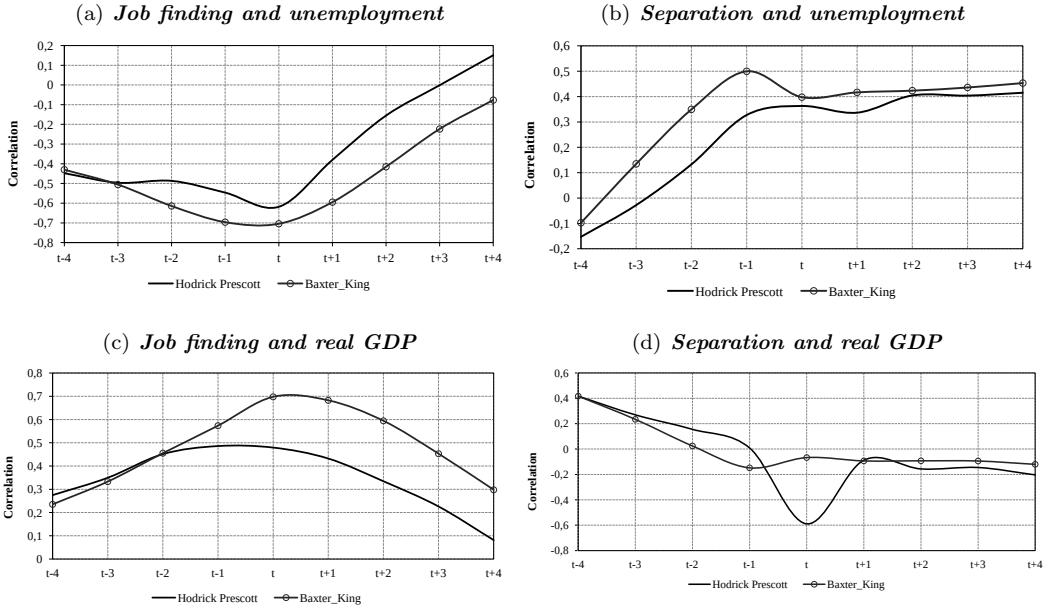
**Figure 4.2: Colombian steady state unemployment**


*Source*: Author's construction based on household surveys.
*Note*: Shaded areas represent recession dates according to Alfonso et al. (2011).

business cycle indicators I consider the unemployment rate and the real GDP. Results obtained for each detrending method and each business cycle indicator are displayed in figure 4.3.

From the band pass filtering it is possible to conclude that separation rate does fluctuates in the business cycle, it reaches a peak correlation of 0.5 with the unemployment rate with one quarter of lead; moreover for the remaining leads and lags correlation is always different from zero. Conversely, when the cycle indicator is the real GDP, the correlation has a maximum at value -0.2 at lead 1. The HP filtering yields less clear results, but it does show a positive correlation between separation and unemployment rate and a negative one when the transition rate is compared with the real GDP reaching a correlation of -0.6 at zero lags. In sum, this means that separation rate is countercyclical, tends to lead the behaviour of unemployment rate and adjusts contemporaneously with the cycle; this timing of the comovement was also found by Fujita and Ramey (2009) for the United States case.

**Figure 4.3: Correlations between transition rates and business cycle indicators**




*Source*: Author's construction.

The correlation between unemployment and job finding rates peaks with zero lags at -0.7 when the band pass filter is used; for the HP filtered data this value reaches -0.6. When the cyclical indicator is

the real GDP, correlation reaches 0.7 at lag zero if band pass is used or 0.5 somewhere between leads 1 or zero when the HP filter is employed. Thus, the job finding rate is highly procyclical and moves contemporaneously with the unemployment rate and the real GDP.

This findings are more in favour of Elsby et al. (2009), Petrongolo and Pissarides (2008) and Fujita and Ramey (2009) than of Shimer (2005) and indicate that both job finding and separation rates do fluctuate along the business cycle in the Colombian case.

## 4.2 Contribution to unemployment fluctuations.

Resulting job finding and separation rates have been proved to move along the cycle, and then to contribute to unemployment fluctuations. However, it is still necessary to disentangle which of the two rates has a higher impact on movements of unemployment. This has very important policy implications, since governments could promote more accurate mechanisms to reduce high unemployment rates. For instance, if job finding rate's movements are the main drivers of unemployment fluctuations, policies aimed to improve the information systems and the mobility of the labour force will be more effective, by contrast, if the separation rate has the most prominent role, better employment protection legislation could do a better job.

In order to revise which rate dominates unemployment fluctuations, it is presented first the Shimer (2005) approach to evaluate the contribution of each rate by fixing the value of one of them at its sample mean, that is, the contribution of separation rate must be computed as follows:

$$c_t^s = \frac{s_t}{s_t + \bar{f}} \tag{4.1}$$

Where $\bar{f}$ is the sample mean of the job finding rate. The obtained series will be the hypothetical unemployment rate that would prevail if only the separation rate would had moved during the cycle. An identical computation is done for the job finding rate fixing the separation at its mean. The hypothetical series that tracks more closely the actual value of unemployment rate would indicate which rate contributes more to unemployment fluctuations. This procedure is done for the hazard rates obtained from both Shimer (2005) and Elsby et al. (2009) methods and results are presented in figure 4.4

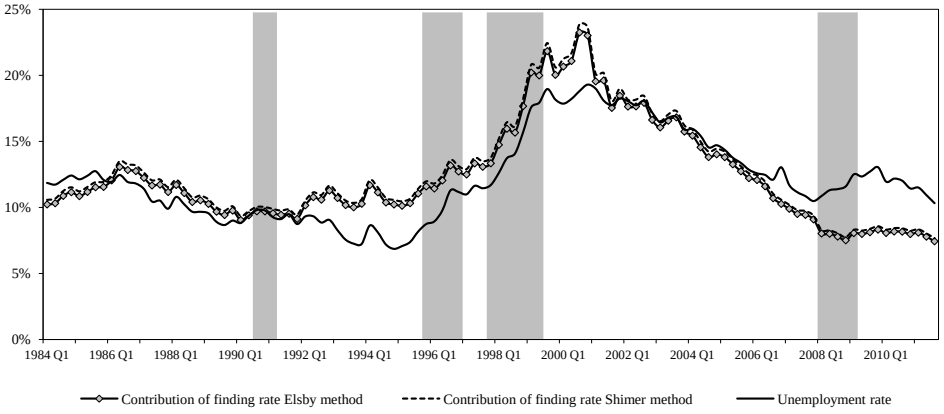
From the visual analysis of the results obtained, it could be said that both rates explain equally unemployment fluctuations until 1998, but after that year, job finding rate seems to have the most prominent role. Such break would suggest, according to Petrongolo and Pissarides (2008), that in 1998 Colombian labour market adopted more restrictive employment protection legislation (EPL) since job finding rate basically drives unemployment dynamics in regimes of strict EPL. However basic labour institutions did not change as soon as the crisis appeared, only until 2002 a labour reform was introduced in the country and it was actually in the opposite direction, in order to make more flexible the Colombian labour market. Therefore, such break seems to respond to economic reasons and not to changes in institutions and is opposite to this wisdom.

Shimer (2005) proposal to evaluate the contributions of job finding and separation rates to the overall unemployment fluctuations is illustrative but it does not lack problems. Fujita and Ramey (2007) argue that this measures do not actually decompose total unemployment variability and Elsby et al. (2009) claim that it is very sensitive to the value at which separation and job finding rate are held constant. Indeed, choosing the sample mean as the reference value is not explained in Shimer (2005) and could be consider as arbitrary, if the same hypothetical series would be constructed using the value of the trends in each quarter instead of the means, separation rate would not reduce its importance in explaining the unemployment movements, and in fact, would move closer to actual unemployment rate during the whole sample period.

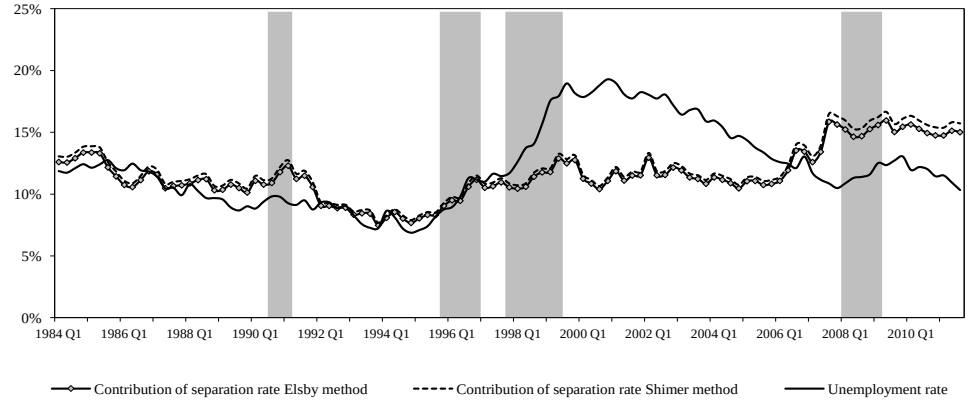
Given the drawbacks of Shimer (2005) method, it is computed the contribution of job finding and separation rate to unemployment fluctuations using a single measure as was proposed by Fujita and Ramey (2009) for the United States. Such calculations have been also done for France, Spain and Great

**Figure 4.4: Contribution of job finding and separation rates for the Colombian Labour market**

(a) ***Contribution of job finding rate***




(b) ***Contribution of separation rate***




*Source*: Author's construction based on household surveys.

*Note*: Shaded areas represent recession dates according to Alfonso et al. (2011).

Britain thanks to studies by Petrongolo and Pissarides (2008) for France by Hairault et al. (2012) and for Colombia by Lasso V (2011); this last work however differs from the assumptions done in this paper and calculations worth to be re-done under the framework proposed here.

In table 4.1 they are presented the values for $\beta^{jfr}$ and $\beta^{sr}$ using a Hodrick Prescott filter with parameter 1600 and the first difference of steady state unemployment to extract the trend of the series. From here it can be noticed that for the whole period of analysis, job finding rate contributes slightly less to unemployment fluctuations when HP filter is used, but rates are equally important when first difference is used. Thus it could be said that both rates contribute equivalently to unemployment movements. These findings differ from Lasso V (2011) who found a higher role for inflow to unemployment.

Differences in the results of this paper with respect to the ones in Lasso V (2011) may come from two main sources: First, he considers a four states setting, that is, labour force is not constant and workers can move to unemployment, wage earning employment, non wage earning employment and inactivity; however this does not seem to be a major source of discrepancy as in Lasso V (2011) analysis movements between employment and unemployment are the main drivers of unemployment fluctuations. Second, even if the data we use comes from the same survey, he constructs the gross flows of workers moving from one state to the other at a annual period, whereas here it is used the stock of employed and unemployed workers at quarterly frequency; the data of this paper has the advantage of consider shorter periods of time and thus capture more detailed transitions that workers may have experienced within a year.

**Table 4.1: Contribution of job finding and separation rate to unemployment fluctuations in Colombia**

| | HP filter $\lambda = 1600$ | | First difference | |
|---|---|---|---|---|
| | *Elsby et al. (2009)* | *Shimer (2005)* | *Elsby et al. (2009)* | *Shimer (2005)* |
| **Full sample** | | | | |
| $\beta^{jfr}$ | 0.443 | 0.427 | 0.497 | 0.481 |
| $\beta^{sr}$ | 0.464 | 0.464 | 0.496 | 0.485 |
| $\beta^{\epsilon}$ | 0.082 | 0.082 | -0.002 | 0.010 |
| **Pre 1998** | | | | |
| $\beta^{jfr}$ | 0.354 | 0.341 | 0.412 | 0.399 |
| $\beta^{sr}$ | 0.488 | 0.486 | 0.569 | 0.558 |
| $\beta^{\epsilon}$ | 0.139 | 0.139 | -0.000 | 0.012 |
| **Post 1998** | | | | |
| $\beta^{jfr}$ | 0.524 | 0.502 | 0.578 | 0.559 |
| $\beta^{sr}$ | 0.437 | 0.440 | 0.407 | 0.398 |
| $\beta^{\epsilon}$ | 0.019 | 0.019 | -0.003 | 0.008 |
| **Pre 1990** | | | | |
| $\beta^{jfr}$ | 0.559 | 0.554 | 0.380 | 0.355 |
| $\beta^{sr}$ | 0.406 | 0.400 | 0.558 | 0.581 |
| $\beta^{\epsilon}$ | -0.001 | 0.006 | -0.005 | 0.002 |
| **1990-1993** | | | | |
| $\beta^{jfr}$ | 0.026 | 0.009 | 0.319 | 0.298 |
| $\beta^{sr}$ | 0.885 | 0.892 | 0.602 | 0.588 |
| $\beta^{\epsilon}$ | 0.004 | -0.003 | -0.004 | 0.010 |
| **1993-2002** | | | | |
| $\beta^{jfr}$ | 0.580 | 0.569 | 0.619 | 0.612 |
| $\beta^{sr}$ | 0.328 | 0.327 | 0.352 | 0.338 |
| $\beta^{\epsilon}$ | 0.006 | 0.064 | 0.000 | 0.017 |
| **Post 2002** | | | | |
| $\beta^{jfr}$ | 0.127 | 0.088 | 0.334 | 0.315 |
| $\beta^{sr}$ | 0.708 | 0.714 | 0.642 | 0.636 |
| $\beta^{\epsilon}$ | 0.140 | 0.133 | -0.005 | 0.002 |

*Source:* Author's construction.

As was referred earlier, figure 4.4 suggests that job finding rate became the main driver of unemployment fluctuations from 1998 on, this is evaluated in more detail next, where I divide the sample in two periods: before and after 1998. However, this partition is not consistent with any labour reform, therefore I present also a more interesting analysis splitting the sample according to the political and institutional changes introduced to the Colombian labour market: Before 1990, from 1990 to 1993, from 1993 to 2002 and from 2002 on; this sectioning will lead to a better analysis of Petrongolo and Pissarides (2008) affirmation about the relevance of each rate according to the level of employment protection legislation prevailing in the country.

Let be considered the results presented in table 4.1 in more detail. The first split of the sample period confirms the graphical conclusion from figure 4.4. After 1998 the job finding rate contributed the most to changes in unemployment whereas before that year separation rate was slightly more important. According to Avella (2012), analysts from that time attributed to demographic factors, the decreased economic activity and the growth of the participation rate the behaviour of the labour market after 1998, at the same time labour market institutions started to be questioned but changes on them occurred only until December 2002.

Nevertheless, the additional intervals in which I divide the sample do correspond to changes in labour market institutions. Firstly, the reform implemented in 1990 (through the Law 50 of 1990), was a result of long debates that had been held in the country since previous decades. In 1970 a special mission from the ILO was invited to the country to propose an integral employment policy and to discuss which factors might had been generating the high levels of unemployment by that times compared with past years. The visit concluded with several suggestions and warnings about the degree of rigidity that the labour market had; to cite some examples it paid special attention over the following facts: *i)* fixed term contracts could

not be established for less than one year, must last 3 years at most and could be renewable indefinitely, *ii)* massive dismissals should be authorized by the Labour Ministry, *iii)* working day could not exceed 8 hours per day without implying extra and nocturnal payments, *iv)* unfair firings implied compensations according to the tenure of the employee and if it was more than 10 years, it would imply rehiring the worker.

In 1985 a new expertise group was convened under the name of *Employment Mission* (also know as Chenery Mission) to make further inquiries about the situation of Colombian labour market; the suggestions done by previous ILO mission were confirmed by this new group, which also found that social contributions that employers had to do were near to 78% of wages paid in 1982, although they were given to a small share of all employees (about 29%). The Mission also made special warnings about the way in which severance payments have been paid off [1].

Under this context, it could be said that before 1990 Colombia had a stricter Employment Protection Legislation and as a consequence unemployment fluctuations should have been driven mainly by changes in job finding rate, table 4.1 does not give sharp evidence on this when the HP filter is used given that the divergence between the contribution of each rate is not large; besides that conclusion does not hold if first differences are used.

In December of 1990 was promulgated the Law 50 of 1990, which was thought to increase flexibility and make structural adjustments to the Colombian labour market. Five principal changes were introduced: First, it established that fixed term contracts could be inferior to one year, but not than 6 months. Second, it eliminated the obligation to rehire the worker when it was proved that the dismissal was unfair and she had a 10 years or more tenure. Third, it made it possible to have working days longer than 8 hours. Fourth, it excluded the possibility of trade unions to participate in politics. Fifth, it modified the formula for paying off severance payments, now the dismissed worker would receive the equivalent to three months of wage if he had been in the job for more than one year, less than five months if had been from five to ten years in the position and nine in case of have been working during more than 10 years, besides it eliminated the double retroactive effect that was seen as a heavy impediment to create new jobs.

Following Petrongolo and Pissarides (2008), this reforms aimed to increase the flexibility of the labour market should be reflected in the contribution of job finding and separation rates to overall unemployment fluctuations; indeed the period of time just after the 1990 reform and previous to the publication of Law 100 of 1993 was characterised by a weaker role of job finding rate to explain movements in unemployment.

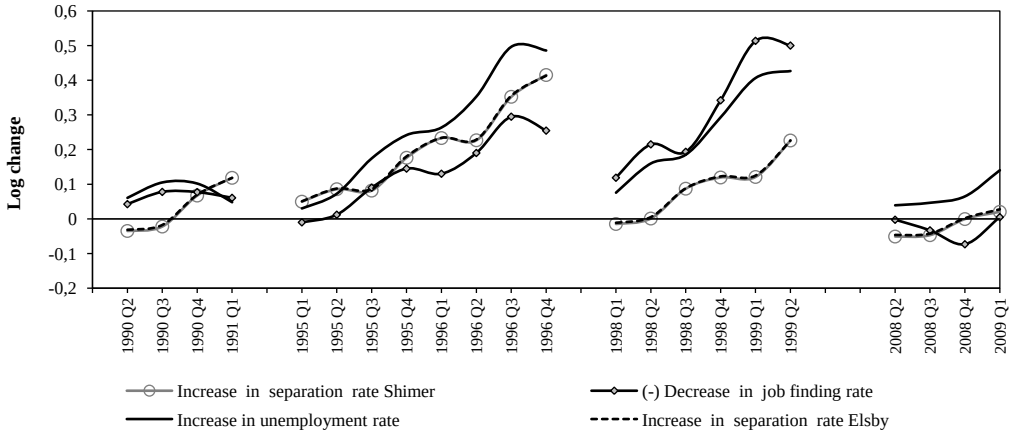
In 1993 a new law was published to address social security aspects that were not discussed in the reform of 1990, its main goal was to integrate the assurance against professional risks, pensions and social security in a single Integral Social Security System. But to that end it also changed the social contributions that employers should to per each worker from 13,5% to 25,5% stepping back some of the flexibility that has been obtained from previous labour reform. Consequently, job finding rate reached once more an important role to explain unemployment fluctuations after 1993.

Finally in December of 2002 a new labour reform was approved, this time the working day was increasing again and nocturnal recharges to the wage were paid only if the worker stayed at his job beyond 10:00 pm, the payment for extra hours of work was also reduced as well as the compensation that a worker should receive after an unfair dismissal. This new wave of reformation to labour institutions reduced once more the predominant role of job finding rate and reduced labour stability, specially for low skill workers; this last effect has increased the labour precariousness of the most vulnerable part of the labour force and has also jeopardized the sustainability of pension and social security systems since only a fraction of workers has enough income to make contributions to them.

Altogether, it is found that there are some periods where each rate has been the most important to explain unemployment fluctuations, then, on average both rates play roughly equal roles. However the

[1] Before 1990 severance payments were settled in the following way: For each year of work the dismissed employee would receive one month of payment valued according to the last wage earned, the employee could use part of these payments when she was still employed, and the withdrawals done during the working time were deducted from the final amount (received when the contract ended) only for its nominal value. This formula of paying off was known in Colombia as the *double retroactive effect*.

**Figure 4.5: Job finding and separation rates during recessions**




*Source*: Author's construction based on household surveys.

*Note*: Recession dates are taken from Alfonso et al. (2011)

division in sub-periods that I propose here is not exhaustive and several alternatives can be addressed; for example, it could be excluded from the analysis the period 1998-2001 when there was a big discrepancy between the the actual unemployment rate and the unemployment implied by the steady state flow equilibrium, as is done by Petrongolo and Pissarides (2008) for the United Kingdom case; I do not consider that possibility here since the deviation period contains the most severe economic crisis that the country has experienced and omit it could lead to misleading results.

Similarly, the division of the sample could be done considering the global context, for example to check the impact that the Latin American crisis of the 1980 decade or the Asian crisis of 1997 had in Colombian labour market. Other interesting division could be done by splitting the sample according to the political situation of the country, after 2002 for example violence indicators dropped in the country, this definitely might have impact the labour market. However, for the scope of the work there are just considered direct modifications in labour market institutions.

On the other hand, the information about the contributions of job finding and separation rate to unemployment fluctuations is of particular interest during a recession, since it becomes a tool to understand its dynamics and therefore to design more suitable policies to face its increase. Figure 4.5 displays the logarithmic growth of these three variables during the recessions[2]. It can be seen that for the 1990 recession the unemployment and job finding rates basically followed the same behaviour while separation rate did not. Conversely, in 1995 and 1998 crisis all the series followed almost parallel directions, although for the latter downturn the decrease (with opposite sign) of job finding rate was closer to the growth of unemployment rate. Finally, during the last recession it was the separation rate which was nearer to unemployment movements.

In order to offer a more formal criteria to determine the contribution of hazard rates to unemployment fluctuations during recessions, I present next in table 4.2 the values of $\beta^{jfr}$, $\beta^{sr}$ and $\beta^{\epsilon}$ considering only the contraction episodes of Colombian economy; conclusions depend on the detrending method that is used, using HP filter, both job finding and separation rate contribute equally to unemployment fluctuations; but using first differences job finding does it more.

[2]For the job finding rate it is displayed the logarithmic growth with the opposite sign, this because as was presented in section 4.1 job finding rate is procyclical whereas unemployment rate is countercyclical.

**Table 4.2: Contribution of job finding and separation rate to unemployment fluctuations during recessions**

| | HP filter $\lambda = 1600$ | | First difference | |
|---|---|---|---|---|
| | *Elsby et al. (2009)* | *Shimer (2005)* | *Elsby et al. (2009)* | *Shimer (2005)* |
| **Recessions** | | | | |
| $\beta^{jfr}$ | 0.442 | 0.422 | 0.653 | 0.646 |
| $\beta^{sr}$ | 0.423 | 0.428 | 0.294 | 0.298 |
| $\beta^{\epsilon}$ | 0.093 | 0.099 | 0.002 | 0.018 |

*Source:* Author's construction.

## 4.3 Comparison with the United States and France

In this section I update the computations done by Shimer (2005) and Elsby et al. (2009) for the United States and by Elsby et al. (2008) for France in order to have the same period of time to compare them with the results presented previously for Colombia. The choice of this two countries for making the comparison is not casual; traditionally they have been considered as two totally opposite labour markets, a very rigid one with strict employment protection legislation (EPL) and low turnover as is the French one, and a very flexible one with high rates of rotation as is the one of the United States. According to the Allard (2005) index, the United States has the lower EPL value of the OECD countries with a value of 0.6 whereas such value reaches 3 for France (almost the maximum of this group of countries). The comparison will allow to examine if Colombian labour market is closer to the French or the United States' one in terms of the transition probabilities that a typical worker faces.

Even if the data for France and the United States are available since the decade of 1950, I will just consider the period 1984-2011 to make it compatible with the Colombian one; likewise, the monthly USA data will be averaged to obtain it quarterly; for France it is possible to work only at the annual frequency, so quarterly data from 2003 on will be averaged to obtain it annually.

The first fact that emerges from comparison is the traditionally high level of the Colombian unemployment rate with respect to the other countries, presented in panel (a) of figure 4.6. Higher unemployment in Colombia is an empirical observation that persists irrespectively of doing the comparison with developed economies or Latin American countries; therefore several explanations to this reality have been proposed without having one totally satisfactory; some suggest that differences arise from discrepancies in institutions, others that they come from cultural aspects, and others that they appear as a result of having distinct definitions of the working age population, the employed and the unemployed workers and the varying methodologies that each LFS applies.

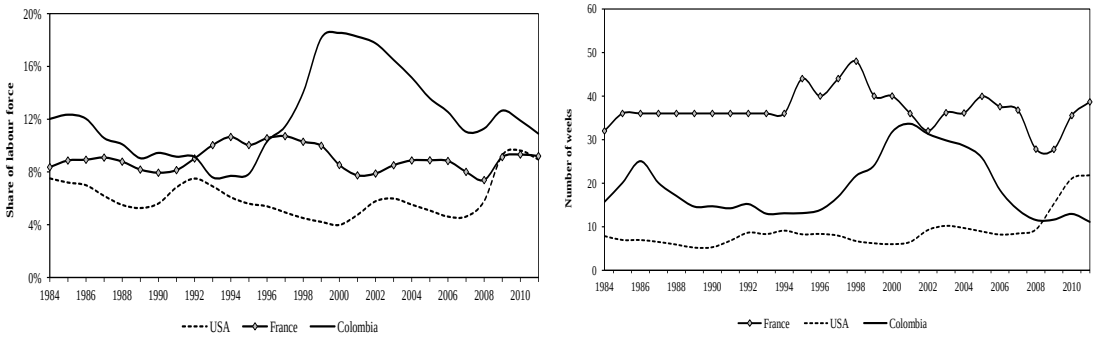
However, during the 1992-1995 boom in Colombia, the unemployment rate was lower than the French one and closer to the one of the United States. Besides, during the last years the number of unemployed workers as a share of labour force has converged between Colombia, France and the United States as a consequence of financial crisis of the last years that hit sharply the two last countries but did not affect severely to Colombian economy. Therefore, considering only the unemployment rate as the indicator of labour market conditions, we could talk about convergence in the three labour markets when the developed ones are in crisis and the Colombian is not.

On the other hand, differences in the unemployment between these countries go beyond their levels; the median duration of the spells is notably high in France and normally overcomes the three quarters (36 weeks); conversely in the United States it is low and has been around (with the exception of 2008 crisis) 9 weeks for the period of analysis. Colombia is an intermediate case between the two, with the exception of the last 3 years, the median duration of unemployment has been always higher than in the United States, but for the whole period, all the time smaller than in France. Moreover Colombian case presents a richer dynamic, median unemployment duration started at 15 weeks, it fluctuated around that value until 1997 to begin a fast increase until 2001 when it reached its maximum (34 weeks) and since then it has slowly decreased up to lower levels than the pre 1998 crisis.

The stylized fact presented earlier will be key to understand the job finding and separation rates

**Figure 4.6: Unemployment rates in Colombia, France and USA**

(a) ***Unemployment rates*** (b) ***Median duration of unemployment***



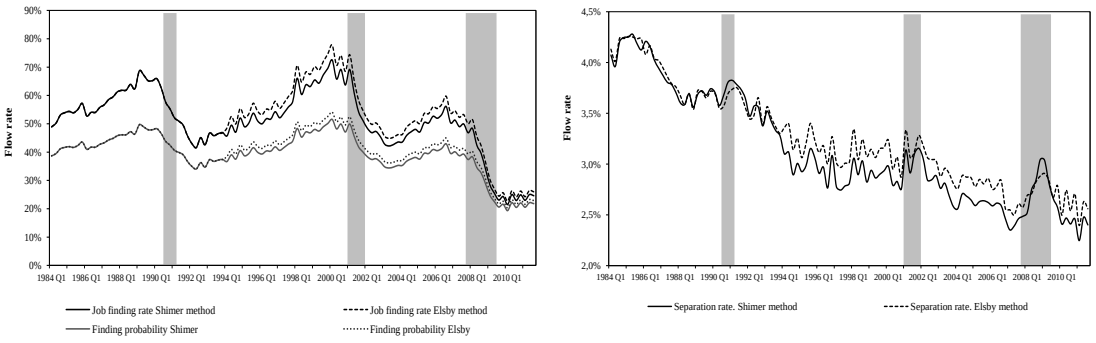

*Source*: Author's construction based on official BLS publication and LFS from Colombia and France

obtained from each country and means that even if Colombian unemployment rate is higher than in France, workers move faster out of this state, following the assumptions done in this work, this would mean that they found a job more easily than in France. This hypothesis is corroborated next, when results of the updating of Shimer (2005) and Elsby et al. (2008) are exposed.

First, the findings of Shimer (2005) and Elsby et al. (2009) for the United States are brought up to 2011 having into account the correction done by each authors to the short term unemployment series from 1994 on[3]. Results are presented in figure 4.7 and show that job finding probability falls significantly during recessions and has decreased to be half of what it used to be. Conversely, separation rate grows during economic downturns and the increase has been particularly fast during the last crisis episode; once more, since separation rates are low, they are really close to the separation rate value and thus are not displayed in the graph.

**Figure 4.7: Job finding and separation rates in the United States**

(a) ***Job finding rate*** (b) ***Separation rate***




*Source*: Author's construction.

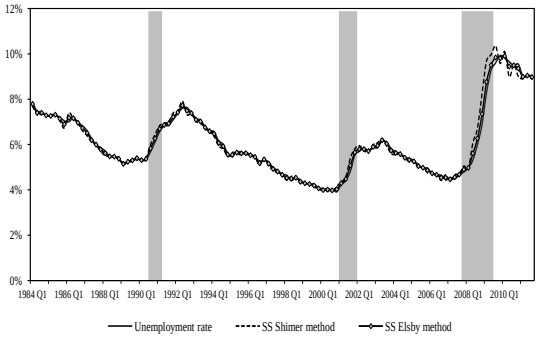
*Note:* Shaded areas correspond to recession dates according to the Business Cycle Dating Committee of NBER

On average, an unemployed worker in the United States will find a job with 39% of probability, which is 4 percentage points higher than the obtained in Colombia; on the other hand, separation probability has a mean value of 2.5% which is smaller than in Colombia. This means that in Colombia people looses his job easier and finds a new one with more difficulty when compared with the United States; as a result duration of unemployment in the first country should be at higher levels than in the latter; which is actually observed in the empirical data presented previously.

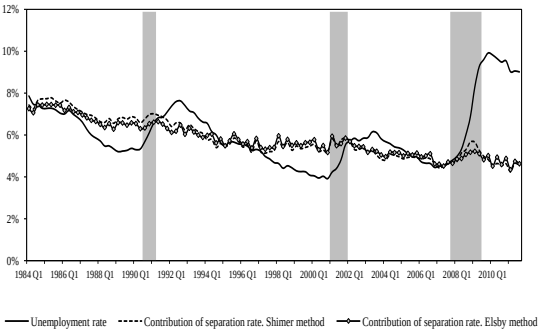
[3]recall that from 1994 on the way that unemployment duration was asked changed and induced an sub report of it. To correct it is enough to multiply by 1.1 the official BLS series in the case of Shimer (2005) and by 1,1549 in the case of Elsby et al. (2009).

**Figure 4.8: Transition rates in the United States: Steady state and contributions**

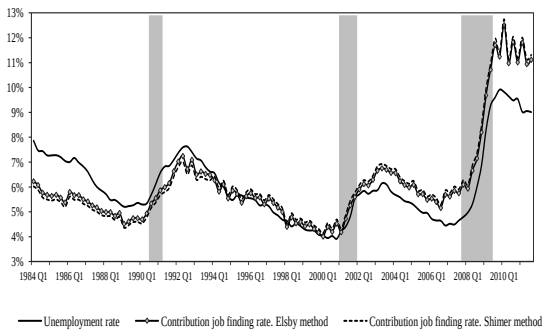
(a) ***Steady state unemployment***



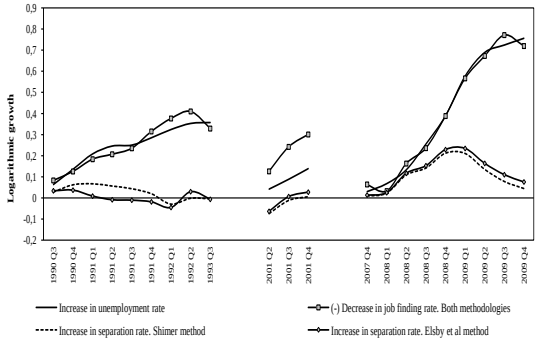

(b) ***Contribution separation rate***




(c) ***Contribution job finding rate***




(d) ***Contribution in recessions***




*Source*: Author's construction.

*Note:* Shaded areas correspond to recession dates according to the Business Cycle Dating Committee of NBER

The steady state unemployment rate derived from the transition rates in the US closely tracks the actual one, these two series have a correlation coefficient of 99% when Elsby et al. (2009) methodology is adopted or 98% when Shimer (2005) method is used, this is displayed in panel (a) of figure 4.8 and suggests that the two states (employment and unemployment) case is a fairly good approximation to the aggregated labour market of the United States.

Finally, to examine the contribution of each rate to unemployment fluctuations, the procedure followed for the Colombian case is applied here once more; first, in panels (b) and (c) of figure 4.8 they are presented the hypothetical unemployment rates that would prevail if each of the rates would be constant at its mean value, that is, to obtain the contribution of job finding rate, separation rate is set at its average value and to get the participation of inflows to unemployment, job finding rate is set to its mean.

Resulting series suggest that job finding rate governs the movements of unemployment, whereas separation rate predicts a roughly constant unemployment rate; this observation was exactly the one reached by Shimer (2005) who argues that in the past three decades the separation rate has varied little over the business cycle. Nevertheless, this visual conclusion is examined more formally through the Fujita and Ramey (2009) analysis; a special remark must be done, here it is just considered the period 1984-2011 which has been characterised by a low separation rate with small volatility; therefore, when the results of this section are compared with previous findings by Shimer (2005), Elsby et al. (2009) or Fujita and Ramey (2009), this observation should not be forgotten.

Table 4.3 displays the values of $\beta^{jfr}$, $\beta^{sr}$ and $\beta\epsilon$ obtained for the whole sample and for recession episodes in the United States, numbers in the first case are quite similar to the obtained by Fujita and Ramey (2009) for the Shimer data during the post 1985 period (Table 1 in their work) and reflect that for the last three decades fluctuations in unemployment rate have been driven mainly by movements in job finding rate; however, separations still explain up to 21% of changes in unemployment according to the first differences approach. Recessions exhibit an identical behaviour, and according to the panel (d)

**Table 4.3: Contribution of job finding and separation rate to unemployment fluctuations in USA**

| | HP filter $\lambda = 1600$ | | First difference | |
|---|---|---|---|---|
| | *Elsby et al. (2009)* | *Shimer (2005)* | *Elsby et al. (2009)* | *Shimer (2005)* |
| **Full sample** | | | | |
| $\beta^{jfr}$ | 0.805 | 0.796 | 0.854 | 0.781 |
| $\beta^{sr}$ | 0.158 | 0.186 | 0.139 | 0.211 |
| $\beta^{\epsilon}$ | 0.048 | 0.007 | 0.134 | -0.002 |
| **Recessions** | | | | |
| $\beta^{jfr}$ | 0.789 | 0.714 | 0.748 | 0.642 |
| $\beta^{sr}$ | 0.139 | 0.224 | 0.227 | 0.333 |
| $\beta^{\epsilon}$ | 0.110 | 0.032 | 0.125 | -0.005 |

*Source:* Author's construction.

of figure 4.8, increase in unemployment was closer to the growth of separation rate only in 2001 recession, for the other two cases, it was job finding rate which mainly determined movements in unemployment.

The previous finding is interesting since it differs from the conclusion for the Colombian case where both transition rates are equally important, and seems to be against the wisdom that the role of separation rate in unemployment fluctuations is limited in countries with strict employment protection and low labour turnover. It was pointed out in the introduction and section 4.2 that Colombian labour market is consider to be very rigid due to the elevated contributions that employers must do over the wages paid; conversely, the United States has been considered as the main reference of a flexible labour market[4] and previously to the 2008 crisis its model was commonly regarded as only way to have low unemployment by allowing to the workers to move continuously. Therefore, as it was the case in Hairault et al. (2012), my results suggest that models of search and matching do not necessary imply that firing costs reduce the contribution of inflows to changes in unemployment.

I next update Elsby et al. (2008) analysis for low frequency data for the French case, results are displayed in figure 4.9 and show that separation rate has increased every year where there has been at least one quarter in recession whereas job finding rate has decreased in the same years with the only exception of 1993. On average, a French worker looses his job with 1% of probability, the lower value for the studied countries. Similarly, the likelihood for an unemployed to find a job is 9,7%, once more, the lowest value for the analysed countries.

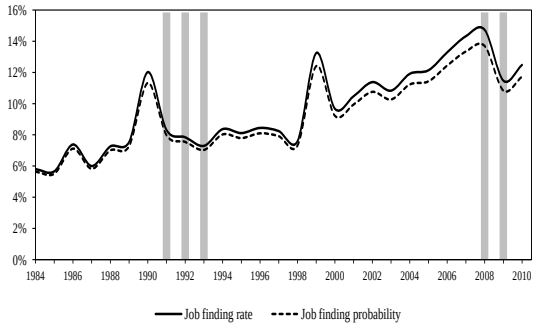
Job finding rate obtained here is higher than the obtained by Elsby et al. (2008) (who found 7,8%) and by Hairault et al. (2012) (how found 7,5%); differences from the second group of authors could be due to the use of different data: here it is used the stock of unemployment classified according to the duration of the spell and they use the gross flow of workers moving from one state to the other. Even if the methodology followed in this section is the one proposed by Elsby et al. (2008), findings differ as a consequence of the issue with the short term unemployment presented in chapter 3.

On the other hand, figures obtained for France indicate a very low labour turnover, and demonstrate that even if unemployment rate is lower in France than in Colombia, in the former country people willing to work but unable to find a job will find very hardly a job; therefore they would be in unemployment for extremely long periods, as was presented in figure 4.6. This poses a harder challenge for the country as would require in first place to know the main reason of the low employability of this workers to then design the more suitable policy to increase it; normally, long periods in unemployment generate a depreciation of human capital of workers, which increases the mismatch between the skill requirements of the firms and the skill mix of labour force. However, this work is based on the assumption of homogeneous workers, thus the features of long duration unemployed are left for further research.

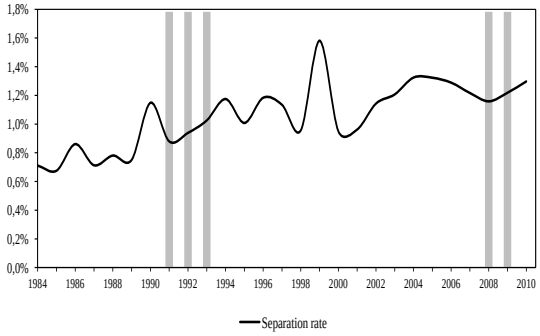
[4]For example, union density and coverage have been traditionally low and these figures have notably decreased since 1980, Allard (2005) describes the US as a country with no legal restrictions on firing and OECD data indicates that tax wedge in the United States is 29% whereas in countries like Belgium it goes beyond 50%.

**Figure 4.9: Job finding and separation rates in France**

(a) ***Job finding rate***




(b) ***Separation rate***




(c) ***Actual, steady state and predicted unemployment rates***


*Source*: Author's construction.

*Note:* Shaded areas correspond to the years with at least one quarter of recession according to the CEPR criteria.

Elsby et al. (2008) argue that for countries where the share of short term unemployment is low, as is the case in France, the steady state approximation is inaccurate, and that a better estimation is reached through equation (2.8). Both series are presented in panel (c) of figure 4.9, where it can be noticed that the predicted unemployment rate from equation 2.8 does a better job in tracking actual unemployment, the correlation coefficient between the two reaches 95%, while with the traditional flow steady state only gets 86%.

Finally, to analyse which transition rate contributes the most to unemployment fluctuations, computations of equation 2.12 are presented next in table 4.4, where it is shown that job finding rate is the main driver of unemployment fluctuations as is the case in the US; hence concerning the contributions of job finding and separation rates, French and United States' labour markets are not so different, such remark had been already done by Hairault et al. (2012). On the contrary, Colombian case does not seems to be close to any country in this particular feature.

**Table 4.4: Contribution of job finding and separation rate to unemployment fluctuations in France**

| | *Elsby et al. (2008)* |
|---|---|
| **Full sample** | |
| $\beta_f$ | 0.511 |
| $\beta$ | 0.458 |
| $\beta_0$ | 0.036 |

*Source:* Author's construction.

## 4.4 Conclusions

After the analysis done during the sections of this chapter, several conclusion emerge. First, through several methodologies it was showed that separation rate in Colombia not only moves along the business cycle, but also tends to lead the behaviour of unemployment rate, besides it contributes significantly and basically in the same magnitude as the job finding rate to the fluctuations of unemployment rate. Second, job finding rate is procyclical and moves contemporaneously with the business cycle, moreover its movements have a considerable impact on unemployment fluctuations.

Besides, labour reforms in the country have not had a true impact on the levels of transition rates and thus in the flows of workers in the labour market. Job finding and separation rates have moved during the whole period of analysis following the economic conditions, and significant increases in job finding and separation rates have occurred only since 2006; moreover, the separation rate, has fluctuated around a roughly constant mean. Nevertheless, the reforms introduced to the institutions of Colombian labour market have affected the contribution that the movements of job finding and separation rates have on overall unemployment fluctuations; during the years following the reform of 2002, separation rates become the principal determinant of the changes in unemployment rate.

In addition, transition rates in the Colombian labour market indicate that there is high turnover and such rates are large when compared with their French counterparts; a typical Colombian employee is four times more likely to loose its job than a French one; but in Colombia a worker finds a job with three times more probability than she would do it in France. Contrariwise, when comparison is done between Colombia and the United States, it comes out that in the latter country job finding rate is higher whereas separation is lower. Hence, given that people loose his jobs more easily in Colombia and find a new one with more difficulty than in the United Sates, unemployment duration in Colombia must be higher than in the United States, this line of argumentation is consistent with the empirical data as was exposed previously.

Regarding the levels, Colombia has an unemployment rate closer to the French case, but from the point of view of the transition rates, Colombian labour market seems to be closer to the United States. It could be said then that Colombia's unemployment is of European nature but it has American features in terms of the flows moving from one state to the other.

Furthermore, the two states assumption from which derive all previous results performs pretty well; however it is not irrelevant, Elsby et al. (2009) showed that for the United States the share of unemployment coming from non participation is big enough to represent almost half of it; and for Colombia López Castaño (1996) found that even if movements from inactivity to employment are mostly acyclical, workers with low education move to inactivity in booms and come back to the labour market in crisis; therefore this study is just a first step to develop further analysis where several states, on the job search and demographic groups should be considered.

# 5 Modelling empirical findings.

The empirical results from previous chapters leaded to conclude that Colombian unemployment is of European nature with American features when the levels of job finding and separation rates are considered. The aim of this chapter is to present a simple model in the spirit of Mortensen and Pissarides (1994) including firing costs to explain the empirical regularities obtained earlier.

## 5.1 The model

Following Hagedorn and Manovskii (2008), which will be the basic framework used here[1], the Mortensen and Pissarides (1994) (MP henceforth) type of models can be considered as an approximation to a richer one where there is curvature in utility and production. Just as in basic MP model, the main idea is that there exist frictions on each side of the labour market, which cause that workers and firms have to invest in a costly and time consuming process of searching to learn what the alternative opportunities are. Unemployment and job spell durations, as well as job creation and destruction are endogenous outcomes of decisions made by the firms in a forward looking context.

To be consistent with the results of earlier chapters and the remark done by Elsby et al. (2009) about the use of previous *week* as the reference period; this model assumes a discrete time economy where the time period is a week, there are many firms and many infinitely lived workers that maximize their expected lifetime utility $E_t \sum_{t=0}^{\infty} \beta^t y_t$ where $\beta^t \in (0,1)$ is the discount factor and $y_t$ represents the income in time $t$.

Unemployed workers and vacancies meet according to the matching function $m(U_t, V_t)$ where $m(.)$ is assumed to have constant returns to scale, $U_t$ represents the number of unemployed workers in period $t$ and $V_t$ the number of firms at the same time.

From the matching function it is possible to obtain the job finding rate as:

$$f_t = \frac{m(U_t, V_t)}{U_t} = m\left(1, \frac{V_t}{U_t}\right) = f_t(\theta) \tag{5.1}$$

Where $\theta = \frac{V_t}{U_t}$ represents the labour market tightness; when it increases, it is easier for workers to find a jobs, because there are more vacant positions relative to the available workers; therefore $f(.)' > 0$.

It is possible to obtain the probability for a firm to fill a vacancy in a similar way:

$$q_t = \frac{m(U_t, V_t)}{V_t} = m\left(\frac{U_t}{V_t}\frac{U_t}{U_t}\ ,\ \frac{V_t}{V_t}\frac{U_t}{U_t}\right) = m\left(\frac{1}{\theta}, 1\right) \Longrightarrow q(\theta) = \frac{1}{\theta} f(\theta) \tag{5.2}$$

[1] Hagedorn and Manovskii (2008) assumed a constant exogenous separation rate and no firing costs, further developments by Fujita and Ramey (2012) included endogenous separation rates and on the job search, but not firing costs.

### Firms

There is free entry of firms, and each of them posts a single vacancy at a flow cost of $c$ in response to expected profits. Once the position is filled, worker produces an outcome level of $p_t$ which is composed by an aggregated and a specific productivity part, that is:

$$p_t = z_t x \tag{5.3}$$

Where $z_t$ is common to all jobs, and $x$ is an match-specific. The aggregated factor, $z_t$, evolves following and exogenous process:

$$\ln z_t = \rho_z \ln z_{t-1} + \xi_t^z \tag{5.4}$$

Where $\xi_t^z \sim N(0, \sigma_z)$. The specific productivity of all new matches starts at $x = x^h$, but this value can be hit by a shock that comes following a Poisson process with arrival rate $\lambda$; when the shock has occurred, the new value of $x$ is drawn from a fixed distribution $G(x)$, which has $x^h$ as the finite upper support, i.e. , $G(x^h) = 1$.

Therefore, productivity is subject to idiosyncratic as well as global movements, i.e., a shock in $z_t$ changes stochastically the productivity of all jobs whereas a shock in $x$ moves stochastically the productivity of just one job. Besides, whenever the productivity of a given position falls below a certain, endogenously determined critical value $x \leq R$, the job will be destroyed. This means that, in opposition to works of Mortensen (1970), Pissarides (1987), Blanchard and Diamond (1989) or Hagedorn and Manovskii (2008) where the separation rates are assumed constant and exogenous; in this model the separation rate in time $t$ will be given endogenously by: $s_t = \lambda G(R_t)$.

When a separation occurs, the firm has to pay a fixed amount $F$, for simplicity, it is assumed that $F$ are not paid to the worker, instead they are given to a third party. Examples of this type of costs mentioned by Mortensen and Pissarides (1999) include the ones implicit in mandated EPL and in the experience rated unemployment insurance taxes. This charge over firms could indeed lead them to be less likely to dismiss workers but they may be also less likely to hire workers as well because they anticipate future additional costs, therefore the overall impact of firing costs on unemployment is not totally clear.

When a position is filled, the firm will receive the production of worker and will pay her a wage $w_t$; conversely when the position is vacant, the firm has to keep paying a flow cost $c$ until it is filled. Denoting the the firm's value of a filled job by $J_t(x)$ and the firm's value of a vacant job by $V_t$, the following Bellman equations describe the firms problem:

$$V_t = -c + \beta E_t \left[ q(\theta) J_{t+1}(x^h) - (1 - q(\theta)) V_{t+1} \right] \tag{5.5}$$

$$J_t(x) = p_t - w_t + \beta E_t \left[ \lambda \left( \int_R^{x^h} J_{t+1}(y) dG(y) - FG(R) \right) + (1 - \lambda) J_{t+1}(x) \right] \tag{5.6}$$

Free entry of firms means that $V_t = 0 \quad \forall t$, thus equation (5.5) can be written as:

$$\frac{c}{q(\theta)} = \beta E_t J_{t+1}(x^h) \tag{5.7}$$

### Workers

Workers are assumed ex ante identical and can be in two states: Unemployed and searching for a job, or working without looking for a job. This means that it is considered a constant labour force and ruled out from this basic model on-the-job search. When unemployed, the workers receive $b$ which can be understood in a general form as the unemployment benefits for the case of France and the United States,

or the non labour income for the case of Colombia where there are not such compensations. Employed workers earn a wage $w_t$.

Denoting the worker's value of unemployment by $U_t$ and the worker's value of a job by $W_t(x)$, the problem of the worker is defined by the following Bellman equations:

$$W_t(x) = w_t + \beta E_t \left[ \lambda \left( \int_R^{x^h} W_{t+1}(y) dG(y) + G(R) U_{t+1}(x) \right) + (1-\lambda) W_{t+1}(x) \right] \tag{5.8}$$

$$U_t(x) = b + \beta E_t \left[ f(\theta) W_{t+1}(x^h) + (1 - f(\theta)) U_{t+1}(x) \right] \tag{5.9}$$

### Bargaining of the surplus

The surplus of the match is the total gain from forming a match relative to the gains of destroying it; then it is given by: $S_t = W_t(x) - U_t(x) + J_t(x) + F$. At each time wages are set through bargaining in order to maximize the Nash product:

$$Max_w \; S_t(x) \; = \quad [W_t(x) - U_t(x)]^{\pi} \left[ J_t(x) + F \right]^{1-\pi}$$

The worker's bargaining power is $\pi$ and her outside option is $U_t$, since it is what she would get if no agreement is reached. Conversely, the firm's bargaining power is $1-\pi$ and its threat point is $-F$, because if there is no accordance, the match is broken, no production will be reached but the firms would still have to pay the firing cost.

Saint-Paul (1995) highlights how the firing costs have two main direct effects. First, they increase the bargaining power for the worker. Second, they distort separation decisions in firms that would need to fire, they could maintain inefficient matches if firing cost are too high to avoid paying them.

The first order condition of the bargaining is: $\pi \left[ J_t(x) + F \right] = (1-\pi) \left[ W_t(x) - U_t(x) \right]$ and implies a sharing rule where each part will receive a constant part of the surplus generated:

$$\left[ J_t(x) + F \right] = (1-\pi) S_t(x)$$

$$\left[ W_t(x) - U_t(x) \right] = \pi S_t(x)$$

Using equations (5.6), (5.8), (5.9) and the two previous expressions, the surplus is equivalent to:

$$S_t(x) = p_t - b - \beta E_t f(\theta) \pi S_{t+1}(x^h) + F(1-\beta) + \beta E_t \left[ \lambda \int_R^{x^h} S_{t+1}(y) dG(y) + (1-\lambda) S_{t+1}(x) \right] \tag{5.10}$$

The last term is the option value of retaining a match, this measures the extend to which the employer is willing to have a loss now in anticipation of a future improvement in the productivity in the match. Integration by parts of equation (5.10) yields[2]:

$$S_t(x) = p_t - b - \beta E_t f(\theta) \pi S_{t+1}(x^h) + \beta E_t (1-\lambda) S_{t+1}(x) + F(1-\beta) + E_t \frac{\beta \lambda \sum_{i=0}^{\infty} z_{t+i}}{1 - \beta(1-\lambda)} \left[ \int_R^{x^h} \left[ 1 - G(y) \right] dy \right] \tag{5.11}$$

[2]Details to obtain equations (5.10) and (5.11) are presented in the appendix D

Separations occur when $J_t(x) = -F$ or equivalently when the surplus of the match equals zero, because no match means that $W_t(x) = U_t$. Using equation (5.11) and (5.3) evaluated at $x = R$ it can be found the critical productivity value at which the jobs will be destroyed and separations will occur:

$$z_t R = b+\beta E_t f(\theta)\pi S_{t+1}(x^h)-E_t\frac{\beta\lambda\sum_{i=0}^{\infty} z_{t+i}}{1-\beta(1-\lambda)}\left[\int_R^{x^h}[1-G(y)]\,dy\right]-\beta E_t(1-\lambda)S_{t+1}(x)-F(1-\beta) \quad (5.12)$$

This result shows that the derivative of $R$ with respect to $F$ holding $\theta$ is negative, because $\beta \in (0, 1)$. Therefore, to avoid having to pay $F$ the firms will accept lower levels of job specific productivity meaning that the firms will maintain inefficient matches, and thus workers can on average keep their jobs longer.

On the other hand, from equation (5.7) and the definition of match surplus it is possible to obtain and implicit description of the creation of new jobs:

$$q(\theta) = \frac{c}{\beta E_t J_{t+1}(x^h)} = \frac{c}{\beta E_t(1-\pi)S_{t+1}(x^h) - \beta F}$$

Computing additionally $S_t(x) - S_t(R)$

$$S_t(x) - S_t(R) = z_t(x - R) + \beta E_t(1 - \lambda)\left[S_{t+1}(x) - S_{t+1}(R)\right] \Longrightarrow S_t(x) = z_t(x - R) + \beta E_t(1 - \lambda)S_{t+1}(x)$$

Evaluating at $x = x^h$ and considering the steady state when $S_{t+1}(x) = S_t(x) = S(x)$:

$$S(x^h) = \frac{z(x^h - R)}{1 - \beta(1 - \lambda)}$$

$$q(\theta) = \frac{c\left[1 - \beta(1 - \lambda)\right]}{\beta(1 - \pi)z(x^h - R) - \beta F\left[1 - \beta(1 - \lambda)\right]} \quad (5.13)$$

Where it has been used $S(R) = 0$. This equation allows to conclude that open jobs become relatively more scarce in the presence of firing costs since the derivative $\frac{\partial q(\theta)}{\partial F} > 0$ and from equation (5.2) we have: $\theta = \frac{1}{[q(\theta)]^{-1}}$. Overall, this implies that both job destruction and job creation fall in response of and increase in firing costs; the net impact on unemployment depends on which flow falls more, if the flow into unemployment falls more than the flow out of unemployment, unemployment will fall; the opposite will occur if the job creation falls more. Conversely, when $c$ increases, so does the job creation, since firms have incentives to quickly fill them to avoid keep paying such cost.

Finally, it worth to evaluate the impact of unemployment benefits relative to aggregated productivity, $b/z$, on the critical productivity level given that this ratio widely differ between France, the United States and Colombia. Such benefits are part of the opportunity cost of employment of workers; when they increase, workers have a higher outside option in the Nash bargaining, therefore wages they ask for are higher. Equation (5.12) shows that whenever the unemployment benefits increase relative to the aggregated productivity, so will do the productivity threshold below which jobs are destroyed. This means that when $b$ increases there is going to be more job destruction because employers require a higher productivity to maintain the job.

## 5.2 Firing costs and unemployment benefits in Colombia, France and the United States

The simple model presented here leads to the conclusion that firing costs have a negative impact on job destruction and job creation rates; conversely, higher unemployment insurance (UI henceforth) imply

higher separation rates. Divergences across such parameters between Colombia, France and the United States could explain the resulting differences in empirical job finding and separation rates obtained in chapter 4.

Table 5.1 presents several features about the difficulty of hiring, the rigidity of hours, the difficulty and costs of redundancy and the requirements amount and time of unemployment benefits in France, Colombia and the United States.

From the table, the most prominent difference between the three countries is related with the unemployment benefits. Colombia does not have such insurance; conversely, France has the more generous compensation not only in terms of the amount received relative to the previous wage, but also in terms of the duration and working time required. Although severance payments for redundancy dismissal are higher in Colombia, they are not enough to compensate the lack of UI for long periods of unemployment. Thus a Colombian unemployed worker is more vulnerable in comparison with the the ones of France or the United States[3].

On the other hand, hiring conditions and rigidity of hours in Colombia are closer to the ones of the United States than to the French ones; and its paid annual leave is exactly an intermediate case between the two developed economies; however, its firing costs are almost as high as in France. Such features could explain the results obtained in previous chapter about the high level of unemployment in Colombia that coexist with elevated flows of workers between employment and unemployment.

Finally, there is a striking difference in the union density from one country to the other, even if the share of workers that are trade union members is declining all over the world, this figures are very high in France and the United States relative to Colombia; moreover in France the share of workers that are covered by collective negotiations is still very important (about 80%). In flat opposition is Colombia where the share of workers protected by a trade union is low, specially in the private sector, besides, the country has been catalogued as one of the most dangerous countries in the world to be a union activist, several trade unionists have been murdered in the past 20 years by the paramilitary forces. In terms of the simple model presented here, this means that bargaining power of the workers is very weak and therefore $\pi$ should take a lower value for the Colombian calibration than for the other two countries.

## 5.3 Calibration

There are three specifications of the model to calibrate, one for each country. For all the cases it will be assumed a a Cobb-Douglas specification for the matching function , that is:

$$m(U_t, V_t) = AU_t^{\alpha} V_t^{1-\alpha}$$

Dividing by the labour force it yields:

$$m(u_t, v_t) = Au_t^{\alpha} v_t^{1-\alpha} \tag{5.14}$$

Where $u_t$ is the unemployment rate and $v_t$ is the vacancy index relative to the labour force. Parameter choices for each case are presented next.

### 5.3.1 Calibration for the United States

The aggregated productivity is obtained by dividing the real GDP in the number of non-farm business employees reported by the BLS; and the parameters for the process that describes it, $\rho_z$ and $\sigma_z$ are

[3]The absence of unemployment insurance can not be totally covered by other types of private insurance since the access to financial instruments (mainly bank credits or savings accounts) in Colombia is about 66% according to the Self-regulating institution of the country; such value is lower than in the United States where it reaches about 80% as reported by the 2012 *National Survey of Unbanked and Underbanked Households* conducted by the Federal Deposit Insurance Corporation.

**Table 5.1: Hiring and firing conditions and unemployment benefits in Colombia, France and the United States**

| | ***United States*** | ***France*** | ***Colombia*** |
|---|---|---|---|
| Fixed term contracts for permanent task | Permitted | Prohibited | Permitted |
| Maximum length of single fixed term contract | No limit | 18 months | 36 months |
| Minimum wage for a 19-year old worker or an apprentice (2013 USD/month) | 1 245.5 | 782,3 | 277,8 |
| Standard working day (manufacturing) | 8 hours | 7 hours | 8 hours |
| 50-hour workweek for 2 months a year in case of a seasonal increase in production | Permitted | Prohibited | Permitted |
| Premium for night work | 0% | 0% | 35% |
| Paid annual leave (in working days) | 0 | 30 | 15 |
| Dismissal due to redundancy | Permitted | Permitted | Permitted |
| Average notice period for redundancy dismissal (workers of all tenures) | 0 salary weeks | 7.2 salary weeks | 0 salary weeks |
| Average severance pay for redundancy dismissal (workers of all tenures) | 0 salary weeks | 4.6 salary weeks | 16.7 salary weeks |
| Average unemployment insurance (UI) as share of wage | 36% of weekly wage | From 57,4% of net wage | No benefit |
| Previous working time for eligibility to UI | In most States, the first 4 out of the last 5 completed calendar quarters prior to the time of filling the claim. | 122 days or 610 hours during the last 28 months | No benefit |
| Maximum time of unemployment insurance | 26 weeks | 2 years | No benefit |
| Union density in 2011 | 11.3% | 7.8% | 4.5% |

*Source:* Constructed using information from *Doing business 2013* report by World Bank, United States Department of Labour and the Union nationale interprofessionnelle pour l'emploi dans l'industrie et le commerce (Unedic).

assumed equal to the ones proposed by Hagedorn and Manovskii (2008) as well as the weekly value of the discount factor $\beta$.

The parameter for the unemployed outside option, $b$, is set to the statutory share of previous wage that an unemployed worker receives as UI, that is to 37%; such strategy was also followed by Bentolila et al. (2010) to analyse the French and Spanish labour markets.

The elasticity of the matching function with respect to unemployment, denoted by $\alpha$ is set to 0.5 following and Blanchard and Diamond (1989) and Pissarides and Petrongolo (2001). As in Fujita and Ramey (2012), the bargaining power of workers, $\pi$, is set to 0.5 and the flow cost of keeping a vacancy open $c$ to 0.17.

The highest value of the productivity specific to the match $x^h$ is set to generate a mean match productivity of unity; besides $A$ is chosen to obtain a mean quarterly job finding rate close to 50%, which is the average value obtained for such series in section 4 for the United States. The firing costs are set equal to 0.1 of productivity as was proposed by Ahrens and Wesselbaum (2009).

Finally, the arrival rate of the shock to the match specific productivity and its standard deviation are chosen to approximate in the simulated data the first order autocorrelation of the empirical separation rate (logged and detrended with HP filter) obtained in previous chapter.

All calibrated parameters are presented in the first column of table 5.2.

### 5.3.2 Calibration for France

The aggregated productivity process, $z_t$ is obtained by dividing the real GDP by the number of employed workers each year, then the series is logged and and AR(1) process is estimated on it. In the empirical data it is obtained an estimated persistence of 0.92, yielding a weekly autocorrelation coefficient of 0.99. The standard deviation of the innovation process is estimated at 0.0034 at the weekly frequency.

The weekly discount factor $\beta$ is calibrated at 0.974, which is consistent with the annual average of the 3 months EURIBOR from 1999 to 2013. The elasticity of the matching function with respect to unemployment is set to the traditional value of 0.5 which is the standard value estimated for France according to the summary done by Pissarides and Petrongolo (2001). The flow benefit of unemployment, $b$, is calibrated in an identical way as in the United states, and it is set to 57% which is the minimum share of previous net wage that a worker receives as UI; this value is close the one used by Bentolila et al. (2010) for the analysis of French labour market[4].

The bargaining power of the workers is set to 80% to reflect the fact that the share of workers are covered by collective bargaining in France is higher than in the United States case and reaches about 80%. The flow cost of having a vacancy and the firing costs are assumed equal to the values proposed by Bentolila et al. (2010).

Finally, $x^h$ is assumed equal to the calibrated value for the United States meaning that a French worker can be as productive as one working in the United States. The remaining parameters, $\lambda$, $A$ and $\sigma_x$ are set to try to approximate the simulated values of the job finding rate and the first order autcorrelation of the separation rate with the empirical ones.

All the calibration is presented in the second column of table 5.2.

### 5.3.3 Calibration for Colombia

As for the other two countries, the aggregated productivity process, $z_t$ is obtained by dividing the real GDP by the number of employed workers each quarter, then the series is logged and and AR(1) process is estimated, in the data it is obtained an estimated persistence of 0.99, yielding a weekly autocorrelation

[4]Bentolila et al. (2010) set a value $b = 55\%$.

**Table 5.2: Parameter values for calibration of the model**

| Parameter | United States | France | Colombia |
|---|---|---|---|
| $b$ | 0.37 | 0.57 | 0.01 |
| $c$ | 0.17 | 0.6 | 0.5 |
| $A$ | 0.07 | 0.1 | 0.048 |
| $\alpha$ | 0.5 | 0.5 | 0.6 |
| $\pi$ | 0.5 | 0.8 | 0.2 |
| $x^h$ | 1.15 | 1.15 | 1.15 |
| $\lambda$ | 0.1 | 0.0095 | 0.02 |
| $\sigma_x$ | 0.75 | 0.36 | 1.13 |
| $\rho_z$ | 0.9895 | 0.9985 | 0.99 |
| $\sigma_z$ | 0.0034 | 0.0034 | 0.006 |
| $\beta$ | 0.9992 | 0.974 | 0.9962 |
| $F$ | 0.1 | 1.33 | 0.2 |

coefficient of the same magnitude. The standard deviation of the innovation process is estimated at 0.006 at the weekly frequency.

The weekly discount factor $\beta$ is calibrated at 0.9962, which is consistent with the annual average of the 90 days fixed-term deposits interest rates from 1986 to 2013. Given that Colombia does not have unemployment insurance, the flow value of unemployment $b$, is set to 0.01, which represents the share of non labour income in aggregated productivity; such measure could not properly capture the income of an unemployed worker since it could still be perceived while working, but it is the only proxy to the variable of interest available in Colombian household surveys.

To obtain the elasticity of the matching function with respect to unemployment, it is estimated a Cobb-Douglas matching function using the vacancies series constructed by Álvarez and Hofstetter (2012) and the unemployment rate of Bogotá, the dependent variable is the outflow from unemployment since there is no official count of new hires. The bargaining power of workers is set to 0.2, it is less than half of the corresponding for the United States given that union density in Colombia is much lower than in US.

There is not much information about the cost of opening a vacancy in Colombia; however, the report *Doing Business* from the World Bank publishes every year the estimated the cost of starting a new business all over the world. Given the assumptions done in the model, that firms have only one position to be filled, and that there is not capital; the cost of posting a vacancy for a new firm would be equivalent to the cost of creating a business; therefore the information from The World Bank is useful to calibrate the value of $c$ for Colombia. In 2013, the publication indicated that in Colombia it is almost three times more expensive to create a new firm, thus $c$ is set to be 0.5.

Firing cost are set to 0.2 to indicate that dismissing a worker in Colombia is about twice expensive than in the United States. The remaining parameters, $\lambda$, $A$ and $\sigma_x$ are set in a similar way as in the United States case, to try to approximate the simulated values of the job finding rate and the first order autcorrelation of the separation rate with the empirical ones.

All calibrated parameters appear in the last column of table 5.2.

## 5.4 Simulations

The stochastic elements will be represented on grids. First, the exogenous process for $z_t$ will be discretized as a Markov Chain with state space $\{z_1, z_2, ..., z_I\}$ and transition matrix $P^z = \left[p^z_{ij}\right]$ with $p^z_{ij} = Pr\left(z_{t+1} = z_j \mid z_t = z_i\right)$. The approximation for this work is done using Tauchen (1986) method and it will be set $I = 13$.

The distribution of the match specific component is also approximated to a discrete process with support $\left\{x_1, x_2, ..., x^h\right\}$, following Fujita and Ramey (2012) the support should satisfy $x_1 = 1/M$, $x_m - x_{m-1} = x^h/M$ and $x^h = M$ and the associated probabilities $\{\gamma_1, \gamma_2, ..., \gamma_M\}$ are $\gamma_m = g(x)_m/M$ for

$m = 1, ..., M-1$ and $\gamma_M = 1-\gamma_1-\gamma_2-...\gamma_{M-1}$ with $g(.)$ the log normal density. For this work, $M = 200$

To solve the model, there will be needed the exogenous process for aggregated productivity, the free entry condition and the definition of the surplus; that is, equations (5.4), (5.7) and (5.10). Since the process for $z_t$ and the distribution of the match specific productivity have been approximated to be discrete, the surplus can be represented as:

$$S(z_i, x_m) = max \left\{ z_i x_m - b + \beta \left[ \lambda \sum_{jn} p_{ij}^z \gamma_n S(z_j, x_n) + (1-\lambda) \sum_j p_{ij}^z S(z_j, x_m) \right] \right. \\ \left. -\beta A \theta(z_i)^{1-\alpha} \pi \sum_j p_{ij}^z S(z_j, x^h) + F(1-\beta), 0 \right\} \tag{5.15}$$

Where it has been used $f(\theta) = A\theta^{1-\alpha}$ and the second term of the maximum is the surplus when the match specific productivity falls below the endogenous threshold $R$. Previous equation will be iterated for each value of $z_t$ and $x_t$ until the moment when $S_t(z_i, x_m) = S_{t+1}(z_i, x_m)$. When convergence is achieved for the highest value of match specific productivity, that is, when $S_t(z_i, x^h) = S_{t+1}(z_i, x^h)$; it is possible to get the the labour market tightness ($\theta$) using equation (5.7).

$$\theta_t(z_i) = \left( \frac{\beta A(1-\pi)}{c} \sum_j p_{ij}^z S_t(z_j, x^h) \right)^{\frac{1}{\alpha}} \tag{5.16}$$

Having the value of the labour market tightness, it will be possible to obtain the simulated job finding rate and the flow of workers moving out of unemployment:

$$f_{t+1} = A\theta_t^{1-\alpha}, \qquad UE_{t+1} = A\theta^{1-\alpha} U_t \tag{5.17}$$

Where $f$ is the job finding rate, $UE_{t+1}$ the flow of workers moving from unemployment to employment between time $t$ and $t+1$ and $U_t$ is the number of unemployed workers in time $t$.

Likewise, the number of employed workers that flow to unemployment is given by:

$$EU_{t+1} = (R_{t+1}) e_t(x^h) + (1-\lambda) e_t(R_{t+1}) \tag{5.18}$$

With $e_t$ the number of employed workers in time $t$. This implies a separation rate and a law of motion for unemployment of the following form:

$$s_{t+1} = \frac{EU_{t+1}}{e_t(x^h)}, \qquad U_{t+1} = U_t + EU_{t+1} - UE_{t+1} \tag{5.19}$$

Finally, the level of vacancies will be determined by:

$$v_t = \theta_t U_t \tag{5.20}$$

Using these equations, quarterly series for unemployment, vacancies, labour market tightness, job finding and separation rates are simulated, logged and detendred using HP filter with the usual smoothing parameter 1600. Each of the 1000 simulations is done for 113 observations, which is the number of observations in empirical data for Colombia and the United States, or 28 observations as in French case. Results of the simulations are presented next.

**Table 5.3: Simulated job finding and separation rates**

| | United States | | Colombia | | France | |
|---|---|---|---|---|---|---|
| | *Empirical* | *Model* | *Empirical* | *Model* | *Empirical* | *Model* |
| Job finding rate | 0.5 | 0.48 | 0.35 | 0.35 | 0.097 | 0.10 |
| Separation rate | 0.03 | 0.03 | 0.04 | 0.035 | 0.015 | 0.01 |
| Unemployment rate | 0.06 | 0.059 | 0.12 | 0.09 | 0.09 | 0.0875 |

*Note:* Sample period: 1984Q1-2011Q4. All series are logged and HP filtered. Each simulation calculates simulated statistics from a sample of 113 quarterly observations for the United States and Colombia and 28 annual observations for France. Statistics here reported are averages over 1000 simulations.

## 5.5 Results

Table 5.3 presents targets (actual data) and outcomes (simulated data) of the job finding, separation and unemployment rates for the three countries. Since the model is calibrated to obtain a job finding rate close to the empirical one, this values are exactly the same for Colombia and France and fairly close for the United States. As can be observed, simulated separation rates happen to be also identical to their empirical counterparts obtained in section 4, besides the mean unemployment rates resulting from the model are consistent with actual data.

The calibration strategy followed in this work highlights the differences in the labour market of each country, specially the related with the costs of firing a worker, open a vacancy and the unemployment insurance; and according to the results obtained, it seems to be correct. For example, the calibrated values of $A$ indicate that the matching technology is less effective in Colombia than in the United States or France; this means that, for instance, the flow of information between employers and firms about vacant jobs and required skills is weak in the former country; indeed, whereas in France the National Employment Agency[5] was created in 1967 to encourage meetings between supply and demand of labour, in Colombia it was only until 1995 when a similar institution took place, but it still have limited centralization of the information. Similarly, the calibration indicates that a Colombian worker can be as productive as a French or one from the United States; however, the match specific productivity is more volatile in Colombia than in France or the US.

Table 5.4 presents the second order moments of both the empirical data and the simulated series for the United States case. It can be noticed that the model fails to achieve a realistic volatility of the job finding rate which in the empirical data is more than three times greater (first row of table 5.4). Similarly, it yields insufficient variation of the unemployment and separation rates, the vacancies and the labour market tightness.

The model replicates the correct direction of co-movements of all the series with productivity. However, the correlations that derive from the model are larger than the empirical values. Fujita and Ramey (2012) argue that this is a consequence of the inability to replicate the true sluggishness of the labour markets. Finally, the model also predicts a stronger persistence of the the vacancies and the labour market tightness but a weaker of unemployment and job finding rates.

[5]In France it was the *Agence Nationale pour l'Emploi* the responsible to help job seekers to find a job and employers to hire; in 2008 it was merged with the Assedic benefits agency to create a unified employment agency called Pôle emploi. In Colombia such institution is the *Servicio Público de Empleo*.

**Table 5.4: Second order moments of series for the United States**

| | | $u_t$ | $f_t$ | $s_t$ | $v_t$ | $\theta_t$ |
|---|---|---|---|---|---|---|
| Emprical data | Standard deviation | 0.10 | 0.10 | 0.04 | 0.11 | 0.21 |
| | First order autocorrelation | 0.92 | 0.84 | 0.60 | 0.905 | 0.93 |
| | Correlation with productivity | -0.22 | 0.24 | -0.38 | 0.43 | 0.34 |
| Simulated data | Standard deviation | 0.008 | 0.01 | 0.008 | 0.01 | 0.02 |
| | First order autocorrelation | 0.7 | 0.76 | 0.43 | 0.94 | 0.99 |
| | Correlation with productivity | -0.57 | 0.99 | -0.48 | 0.94 | 0.99 |

*Notes:* Sample period: 1984Q1-2011Q4. All series are logged and HP filtered. Each simulation calculates simulated statistics from a sample of 113 quarterly observations. Statistics here reported are averages over 1000 simulations. $u_t$: Unemployment rate, $f_t$: Job finding rate, $s_t$: Separation rate, $v_t$: Quarterly average of monthly composite help wanted index constructed by Barnichon (2010), $\theta$: Labour market tightness.

Likewise, table 5.5 presents the second order moments of the simulated and empirical data for Colombia. The simulation in this case predicts the right direction of the co-movements of all variables with productivity but just as in the United States' simulation for the vacancies and labour market tightness, the magnitudes of the correlation obtained from the model are significantly higher, this time for all the variables. The same is true for the simulated values of the first order autocorrrelation, which are about 25% larger than their empirical counterparts. Furthermore, the model can not explain the volatility of none of the variables.

**Table 5.5: Second order moments of series for Colombia**

| | | $u_t$ | $f_t$ | $s_t$ | $v_t$ | $\theta_t$ |
|---|---|---|---|---|---|---|
| Emprical data | Standard deviation | 0.07 | 0.08 | 0.08 | 0.12 | 0.17 |
| | First order autocorrelation | 0.77 | 0.75 | 0.725 | 0.64 | 0.77 |
| | Correlation with productivity | -0.19 | 0.32 | 0.10 | 0.36 | 0.33 |
| Simulated data. | Standard deviation | 0.006 | 0.01 | 0.008 | 0.03 | 0.04 |
| | First order autocorrelation | 0.984 | 0.985 | 0.984 | 0.985 | 0.985 |
| | Correlation with productivity | -0.95 | 0.98 | 0.98 | 0.99 | 0.99 |

*Notes:* Sample period: 1984Q1-2011Q4. All series are logged and HP filtered. Each simulation calculates simulated statistics from a sample of 113 quarterly observations. Statistics here reported are averages over 1000 simulations. $u_t$: Unemployment rate, $f_t$: Job finding rate, $s_t$: Separation rate, $v_t$: Quarterly average of monthly composite help wanted index based on Álvarez and Hofstetter (2012) series for vacancies, $\theta$: Labour market tightness.

Finally, in table 5.6 are displayed the second order moments of the empirical and simulated data for France. Previous remarks done for the data resulting from the simulations are also valid in this case. The model can not account for the actual volatility of any of the variables. It also predicts a stronger autocorrelation of the simulated series than the observed in the empirical data; moreover, it yields a counter-factual movement of separation rate with productivity and it is unable to have into account the sluggishness of the labour market generating a over estimated correlation between all the series and the productivity.

The inability of the model to account for the cyclical properties of unemployment, vacancies and job finding rates is not a novel conclusion, it has been already highlighted by Andolfatto (1996), Shimer (2003), Hall (2005), Gertler and Trigari (2009) and Hall and Milgrom (2007) among others. Most of them agree in suggesting that the basic mechanism for wage determination assumed in the DMP type of models (period by-period Nash bargaining between firms and workers) induces too much volatility in wages and therefore some wage rigidity may be necessary to the model be able to reproduce a more realistic standard deviation of the central variables. Such changes to the basic model presented here are beyond the scope of this work and are left to future research.

**Table 5.6: Second order moments of series for France**

| | | $u_t$ | $f_t$ | $s_t$ | $v_t$ | $\theta_t$ |
|---|---|---|---|---|---|---|
| Emprical data | Standard deviation | 0.08 | 0.13 | 0.11 | 0.06 | 0.10 |
| | First order autocorrelation | 0.59 | -0.07 | -0.34 | 0.33 | 0.31 |
| | Correlation with productivity | -0.31 | 0.40 | -0.15 | 0.88 | 0.65 |
| Simulated data. | Standard deviation | 0.002 | 0.0001 | 0.0001 | 0.001 | 0.003 |
| | First order autocorrelation | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 |
| | Correlation with productivity | -0.98 | 0.99 | 0.98 | 0.99 | 0.99 |

*Notes:* Sample period: 1984Q1-2011Q4. All series are logged and HP filtered. Each simulation calculates simulated statistics from a sample of 28 annual observations. Statistics here reported are averages over 1000 simulations. $u_t$: Unemployment rate, $f_t$: Job finding rate, $s_t$: Separation rate, $v_t$: Quarterly average of monthly composite help wanted index based on series for vacancies published by INSEE, $\theta$: Labour market tightness.

# 6 Concluding remarks

This work has extended the debate about the behaviour of job finding and separation rates along the business cycle and their contributions to unemployment fluctuations to the Colombian case. Until now, these discussions have mainly focused in the developed economies and few works have been done to examine developing labour markets.

First, assuming that labour force is constant and therefore that workers can only move from unemployment to employment and vice versa, the job finding and separation rates for Colombia have been computed at a quarterly frequency using the stocks of workers in unemployment or employment states and the duration of unemployment spells as main sources. The period of analysis is from 1984 to 2011. The resulting series show that the transition rates move during the business cycle. In all recessions the separation rate has increased while the job finding rate has fallen; besides, the correlation coefficients between the cyclical components of real GDP and these rates can go up to 70%. This finding is in line to Elsby et al. (2009) and Fujita and Ramey (2009) conclusion for the United States where it is shown that separation rate does varies along the business cycle.

Similarly, the works by Shimer (2005) and Elsby et al. (2009) for the United States and by Elsby et al. (2008) for France have been updated until the last quarter of 2011 in order to compare the results obtained for the Colombian case with the corresponding of two opposite labour markets. Traditionally, it has been argued that French labour markets are extremely rigid with low flow of workers within it; conversely, the United States' is considered as one of the most flexible labour markets in the world.

The updating procedure and the comparison done show that during the last 30 years the contribution that the movements of separation rates have on unemployment fluctuations has decreased markedly for France and the United States; whereas for Colombia they have remained equally important as the changes in job finding rate. Besides, the transition rates in the Colombian labour market indicate that there is high turnover and such rates are large when compared with their French counterparts; a typical Colombian employee is four times more likely to loose its job than a French one; but in Colombia a worker finds a job with three times more probability than she would do it in France. Contrariwise, when comparison is done between Colombia and the United States, it happens to be that in the latter country job finding rate is higher whereas separation is lower. Hence, given that people loose his jobs more easily in Colombia and find a new one with more difficulty than in the United Sates, unemployment duration in Colombia must be higher than in the United States, this line of argumentation is consistent with the empirical data exposed in chapter 4.

More surprising is the finding regarding the fact that although Colombia has a high unemployment rate which could be considered of European nature, that is, larger with respect to the one of the United States or other Anglo Saxon countries; the share of workers moving in and out of unemployment is closer to the figures obtained for the United States.

To account for the empirical findings it was proposed a model in the spirit of DMP including firing costs and endogenous separations rates. The calibration procedure has focused in highlighting the notable differences between the costs of opening a vacancy, firing a worker and the unemployment insurance existing in each of the economies. It also has made explicit the lower bargaining power of workers and the less effective matching technology in Colombia compared with the other two economies. The results from the simulations successfully predict the level of the job finding, separation and unemployment rates for each of the countries and suggest that the calibration was correct.

Furthermore, the calibrated parameters for the arrival rate of the match specific component shock ($\lambda$ in the model) imply a mean waiting time between switches in this part of productivity of three months in the US, twelve in Colombia and 26 in France; such implication deserves a more detailed analysis that is not done in this work and is left for further research.

The simple model presented here, fails to generate the sufficient volatility and to explain the persistence of key labour market variables; it also is unable to produce the sluggish dynamics observed in reality. Such drawback is common to all DMP type of models and corrections to it have been widely proposed; mainly they include a sort of wage rigidity that in turn brings the question of what are the reasons that underlie this wage rigidity. Several works have appeared to take on this puzzle and suggestions go from staggered multi-period wage contracting, make wages partially backward-looking to include two-sided asymmetric information.

The model can be certainly improved, just to mention a first direction in which it can be done; the value functions for both firms and workers could be modified to include the differences in firing costs that have temporal and permanent contracts. Similarly, the model could be extended to consider on-the-job-search or movements in and out of the labour force. Such considerations would be useful to have a better understanding of labour market dynamics in both advanced and developing economies.

# A Extension of Elsby et al. (2009) method for quarterly data:

I extend Elsby et al. (2009) procedure to obtain the separation rate in the case of quarterly data. Maintaining the *week* as the reference period for the survey, $\tau$ can take 12 values:[1]

$$\tau \in \left\{0, \frac{1}{12}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{5}{12}, \frac{1}{2}, ..., \frac{11}{12}\right\}$$

Using $U_{t+\tau+1/12} = U_{t+\tau} + s_t E_{t+\tau} - f_t U_{t+\tau}$, the definition of the labour force and solving it forward for one quarter:

$$U_{t+1} = s_t L_t + (1 - s_t - f_t) U_{t+\frac{11}{12}}$$

Solving $U_{t+\frac{11}{12}}$ and replacing it, it would be obtained:

$$U_{t+1} = s_t L_t + (1 - s_t - f_t) s_t L_t + (1 - s_t) - f_t)^2 U_{t+\frac{10}{12}}$$

Continuing with the iteration, at the end it yields:

$$U_{t+1} = s_t L_t \sum_{n=0}^{11} (1 - s_t - f_t)^n + (1 - s_t - f_t)^{12} U_t$$

Which is exactly the expression in (2.6).

[1] Colombian Labour force surveys had important methodological changes in 2000, but despite of them the reference period to classify employed and unemployed workers is the *week*. Details are presented in chapter 3

# B Differences in unemployment of less than 5 weeks in France.

As was presented in section 3.3, the official OECD publication about the number of unemployed workers with less than 5 weeks of unemployment presents a dramatic break in 1992, and a smaller one in 2003 when the LFS changed to be quarterly. To explain why it appears in OECD data and not in the used by Elsby et al. (2008) or the series I obtain, it is necessary to consider in detail the micro data that underlies the construction of the series and realise that the source of information of the OECD data is the European Labour Force Survey, whereas here I am using French data only.

The individual's data from French LFS until 2002 contains four variables related with the unemployment duration:

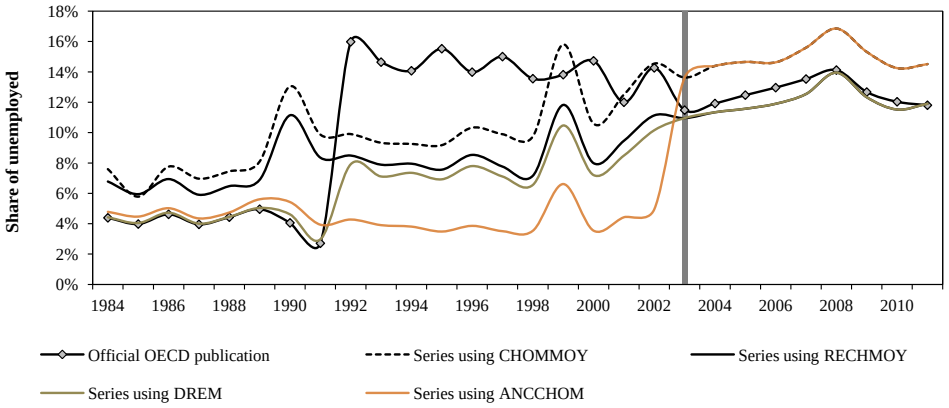
1. Length of time searching for a job (coded as DREM)
2. Average length of time of searching for a job in months (coded as RECHMOY)
3. Length of time unemployed (coded as ANCCHOM)
4. Average length of time unemployed (coded as CHOMMOY)

The variable CHOMMOY is constructed according to the situation of the individual. If the person has never worked before, it is equal to the length of time of searching for a job (variable RECHMOY), if the person has worked before, it takes the lowest value between the length of search and the length of unemployment.

Form 2003 on, only 2 variables register the unemployment duration: *i)* Length of time looking for a job (coded DREMCM) *ii)* Length of time unemployed (coded ANCHOMM).

I built series for unemployment duration using the four variables, and got a break in 1992 similar to the official OECD data although it is less dramatic when the variable DREM was used; this appears in figure B.1. However, the questionnaire and documentation for *Enqute emploi* suggest to use the variable RECHMOY when the interest is to check the duration of searching; for this reason, and given that for the Colombian and United States case the relevant question for classifying the unemployed workers by duration is done according to how long persons have been looking for a job; I classify French unemployed persons using the variable RECHMOY.

**Figure B.1: Alternative series for unemployed workers with less than 5 weeks of unemployment**




*Source*: Author's construction based on household surveys and OECD data

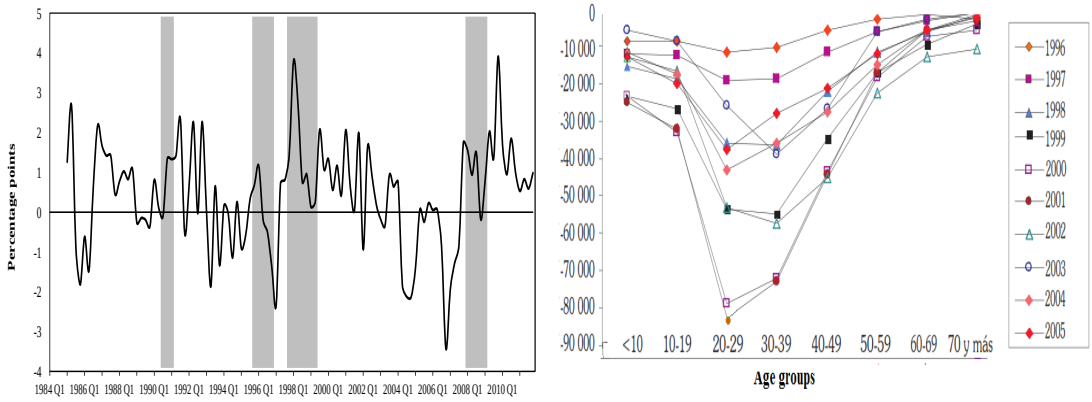
# C Differences in Colombian steady state and actual unemployment rate.

In chapter 4 was pointed out the deviation of predicted steady state and actual unemployment rate for the Colombian economy during the period 1998-2001; a plausible reason given for such divergence was the omission of inactivity state from the analysis, in fact, annual growth of participation rate shows that indeed many people from the working age population become active, this is presented in panel (a) of figure C.1 where it appears that the annual growth of participation rate at the beginning of the recession was higher than the presented in previous ones.

I argued that the pressure imposed by this extra workers who did not find a job was in part eased by the strong flow of international migration that occurred in the two years after the crisis, actually the net flow of migrants for the country was remarkably lower in 2000 and 2001, specially for people belonging to the working age population, as presented in panel (b) of figure C.1, conversely the years following the 1994 and 1995 boom were years of lower movements of people out of the country. It seems thus that in Colombia the net flow of international migration is procyclical and lags the business cycle, and that for the case of post 1998 crisis it helped to reduce the extra pressure on the weakened labour market. However this is just an hypothesis that must be studied in more detail.

**Figure C.1: Annual growth of participation rate and international migration**

(a) ***Annual growth of participation rate*** (b) ***Net flows of international migration***




*Source*: Panel (a) Author's construction based on household surveys.Panel (b) Anuario estadístico entradas y salidas internacionales, Colombia. DANE (2005).

# D Algebraic procedure to obtain equations (5.10) and (5.11)

**Equation (5.10):**

The definition of the surplus is given by: $S_t(x) = W_t(x) - U_t(x) + J_t(x) + F$, using equations (5.6), (5.8)and (5.9) it can be written as:

$$\begin{aligned} S_t(x) &= p_t - w_t + \beta E_t \left\{ \lambda \left( \int_R^{x^h} J_{t+1}(y) dG(y) - G(R)F \right) + (1-\lambda) J_{t+1}(x) \right\} \\ & \quad w_t + \beta E_t \left\{ \lambda \left( \int_R^{x^h} W_{t+1}(y) dG(y) + G(R)U_{t+1} \right) + (1-\lambda) W_{t+1}(x) \right\} \\ & \quad -b - \beta E_t \left\{ f(\theta) W_{t+1}(x^h) + (1 - f(\theta)) U_{t+1} \right\} + F \end{aligned}$$

Using the sharing rule of surplus, the last row of the previous equation can be rewritten in a more convenient way:

$$\begin{aligned} S_t(x) &= p_t + \beta E_t \left\{ \lambda \left( \int_R^{x^h} \left[ J_{t+1}(y) + W_{t+1} dG(y) \right] + G(R) \left[ U_{t+1} - F \right] \right) + (1-\lambda) \left[ J_{t+1}(x) + W_{t+1} \right] \right\} \\ & \quad -b - \beta E_t \left\{ f(\theta) \pi S_{t+1}(x^h) + U_{t+1} \right\} + F \end{aligned}$$

This is equivalent to:

$$\begin{aligned} S_t(x) &= p_t + \beta E_t \left\{ \lambda \left( \int_R^{x^h} \left[ J_{t+1}(y) + W_{t+1} dG(y) \right] + G(R) \left[ U_{t+1} - F \right] \right) + (1-\lambda) S_{t+1}(x) \right\} \\ & \quad -b - \beta E_t \left\{ f(\theta) \pi S_{t+1}(x^h) + U_{t+1} \right\} + F + \beta E_t (1-\lambda) \left[ U_{t+1} - F \right] \end{aligned}$$

Using $\lambda \left[ U_{t+1} - F \right] = \lambda \int_R^{x^h} \left[ U_{t+1} - F \right] dG(y) + \lambda G(R) \left[ U_{t+1} - F \right]$, previous equation can be rewritten as:

$$S_t(x) = p_t - b - \beta E_t f(\theta) \pi S_{t+1}(x^h) + \beta E_t \left\{ \lambda \left( \int_R^{x^h} S_{t+1}(y) dG(y) \right) + (1-\lambda) S_{t+1}(x) \right\} + F(1-\beta)$$

Which is exactly the equation (5.10).

**Equation (5.11):**

To obtain equation (5.11), first the last term of equation (5.10) must be integrated by parts:

$$\int_R^{x^h} S_{t+1}(y)dG(y) = S_{t+1}G(y)\mid_R^{x^h} - \int_R^{x^h} G(y)\frac{dS_{t+1}(y)}{dy}dy$$

Having into account that $G(x^h) = 1$ and that whenever $x = R$ the surplus becomes zero, this is:

$$\int_R^{x^h} S_{t+1}(y)dG(y) = S_{t+1}(x^h) - \int_R^{x^h} G(y)\frac{dS_{t+1}(y)}{dy}dy$$

Moreover:

$$S_{t+1}(x^h) = \int_R^{x^h} \frac{dS_{t+1}(y)}{dy}dy$$

Therefore, the last term of equation (5.10) can be expressed as:

$$\int_R^{x^h} S_{t+1}(y)dG(y) = \int_R^{x^h} \frac{dS_{t+1}(y)}{dy}\left[1 - G(y)\right]dy$$

To obtain a simpler expression of $\frac{dS_{t+1}(y)}{dy}$ we should iterate forward equation (5.10) for the case when $x = y$ and use the law of iterated expectations:

$$S_t(y) = p_t - b - \beta E_t f(\theta)\pi S_{t+1}(y^h) + \beta E_t\lambda\left(\int_R^{y^h} S_{t+1}(m)dG(m)\right) + F(1-\beta) + \beta E_t(1-\lambda)S_{t+1}(y)$$

$$\begin{aligned} S_t(y) &= p_t + \beta(1-\lambda)E_t p_{t+1} - b - \beta(1-\lambda)b - \beta E_t f(\theta)\pi S_{t+1}(y^h) - \beta^2(1-\lambda)E_t f(\theta)\pi S_{t+2}(y^h) \\ &\quad +\beta E_t\lambda\textstyle\int_R^{y^h} S_{t+1}(m)dG(m) + \beta^2 E_t\lambda\int_R^{x^h} S_{t+2}(m)dG(m) + F(1-\beta)\left[1 + (1-\lambda)\right] \\ &\quad +\beta^2(1-\lambda)^2 E_t S_{t+2}(y) \\ &\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\ &\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \end{aligned}$$

Replacing $p$ by its definition in equation (5.3) when $x = y$ this becomes:

$$\begin{aligned} S_t(y) &= (z_t y) + \beta(1-\lambda)E_t(z_{t+1}y) - b - \beta(1-\lambda)b - \beta E_t f(\theta)\pi S_{t+1}(y^h) - \beta^2(1-\lambda)E_t f(\theta)\pi S_{t+2}(y^h) \\ &\quad +\beta E_t\lambda\textstyle\int_R^{y^h} S_{t+1}(m)dG(m) + \beta^2 E_t\lambda\int_R^{x^h} S_{t+2}(m)dG(m) + F(1-\beta)\left[1 + (1-\lambda)\right] \\ &\quad +\beta^2(1-\lambda)^2 E_t S_{t+2}(y) \\ &\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\ &\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \end{aligned}$$

Thus:

$$\frac{dS_{t+1}(y)}{dy} = z_t + \beta(1-\lambda)E_t z_{t+1} + \ldots + \beta^n(1-\lambda)^n E_t z_{t+n} + \ldots$$

Given that $\lambda < 1$ and $\beta < 1$:

$$\frac{dS_{t+1}(y)}{dy} = \frac{E_t \sum_{i=0}^{\infty} z_{t+i}}{1 - \beta(1-\lambda)}$$

When the previous result is replaced in the integrations by parts done earlier, it is obtained:

$$\int_R^{x^h} S_{t+1}(y) dG(y) = \frac{E_t \sum_{i=0}^{\infty} z_{t+i}}{1 - \beta(1-\lambda)} \int_R^{x^h} [1 - G(y)]\, dy$$

Plugging in equation (5.10) yields:

$$S_t(x) = p_t - b - \beta E_t f(\theta) \pi S_{t+1}(x^h) + \beta E_t \frac{\sum_{i=0}^{\infty} z_{t+i}}{1 - \beta(1-\lambda)} \int_R^{x^h} [1 - G(y)]\, dy + (1-\lambda) S_{t+1}(x) + F(1-\beta)$$

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