UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

IVA TOMIĆ

ESSAYS ON THE LABOUR MARKET IN A POST-TRANSITION ECONOMY: THE CASE OF CROATIA

DOCTORAL DISSERTATION

Ljubljana, October 2013

UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

IVA TOMIĆ

ESSAYS ON THE LABOUR MARKET IN A POST-TRANSITION ECONOMY: THE CASE OF CROATIA

(PRISPEVKI O TRGU DELA V POST-TRANZICIJSKOM GOSPODARSTVU: PRIMER HRVAŠKE)

DOCTORAL DISSERTATION

Ljubljana, October 2013

AUTHORSHIP STATEMENT

The undersigned Iva Tomić, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), declare that I am the author of the doctoral dissertation entitled Essays on the labour market in a post-transition economy: The case of Croatia (Prispevki o trgu dela v post-tranzicijskom gospodarstvu: primer Hrvaške), written under supervision of dr. Polona Domadenik and co-supervision of dr. Maja Vehovec.

In accordance with the Copyright and Related Rights Act (Official Gazette of the Republic of Slovenia, Nr. 21/1995 with changes and amendments), I allow the text of my doctoral dissertation to be published on the FELU website.

I further declare

- the text of my doctoral dissertation to be based on the results of my own research;
- the text of my doctoral dissertation to be language-edited and technically in adherence with the FELU's Technical Guidelines for Written Works which means that I
    - cited and / or quoted works and opinions of other authors in my doctoral dissertation in accordance with the FELU's Technical Guidelines for Written Works and
    - obtained (and referred to in my doctoral dissertation) all the necessary permits to use the works of other authors which are entirely (in written or graphical form) used in my text;
- to be aware of the fact that plagiarism (in written or graphical form) is a criminal offence and can be prosecuted in accordance with the Criminal Code (Official Gazette of the Republic of Slovenia, Nr. 55/2008 with changes and amendments);
- to be aware of the consequences a proven plagiarism charge based on the submitted doctoral dissertation could have for my status at the FELU in accordance with the relevant FELU Rules on Doctoral Dissertation.

Date of public defense: October 24th, 2013
Committee Chair: dr. Janez Malačič
Supervisor: dr. Polona Domadenik
Co-supervisor: dr. Maja Vehovec
Member: dr. Danijel Nestić
Member: dr. Mieczysław W. Socha

Ljubljana, October 24th, 2013 Author's signature: _____

ESSAYS ON THE LABOUR MARKET IN A POST-TRANSITION ECONOMY: THE CASE OF CROATIA

SUMMARY

This doctoral dissertation studies the reasons behind high and persistent unemployment in Croatia with the help of the search and matching theory. Huge unemployment rates are probably the most challenging issue of modern labour markets. This is a phenomenon equally challenging for both developed and developing countries. Given that the problem of unemployment has adverse effects not only on individuals but also on societies as a whole, finding a solution to this problem should be one of the primary aims of economic policy. However, in order to find a solution one first needs to discover the reasons behind the appearance, existence, and persistence of huge unemployment in modern economies. Still, because of its complexity, it is not simple to find a clear explanation for the very existence of unemployment in most of the countries.

Hence, the main goal of the dissertation is to extend the existing search and matching models so that they better correspond to the specific situation in the Croatian labour market, but also to take into account their applicability in other transition countries as well as in the rest of Europe. A combination of the methodology that emerges from the equilibrium search and matching theory and empirical evidence from Croatia should enable us to unravel the most important factors behind high unemployment in Croatia. Broad elucidation of some of the main aspects of the Croatian labour market should also help in revealing important weaknesses of the current institutional structure and proposing necessary measures to policy makers. All these issues are examined through three different parts (essays), where each of the essays deals with a specific research topic, but all three are connected through their main aim - to discover the main cause of high unemployment in Croatia.

The first essay studies the employment prospects of different types of job-seekers in Croatia by upgrading the *model of adverse selection with firing costs.* The main assumption of the model is that employers perceive labour market status as a *signal* of job-seekers' productivity, which means that the unemployed group is being perceived as less productive. Since firing costs are high, employers cannot 'afford' to hire from this group and, thus, there is an adverse selection in the labour market. Based on the Labour Force Survey data for the 1996-2009 period, the results suggest that there is an adverse selection in the Croatian labour market. The reservation wage, as the main determinant of firing costs in the model, positively affects the probability of changing job for employed job-seekers, while it has a negative impact on the probability of 'switching' for unemployed job-seekers. However, if the reservation wage is treated as endogenous in the model, instrumental variable estimation shows that its effect on the probability of 'switching' becomes positive and significant only for the unemployed group. This is explained by the effect of educational attainment, which serves as the 'instrument' and obviously works as an efficient signal for workers' productivity among the unemployed. Nevertheless, the effect of the reservation wage on employment probabilities for both groups is declining over time, especially after the legislative reform in 2004, indicating lower impact of firing costs. Finally, the

hypothesis on self-discrimination of the unemployed receiving unemployment benefits is tested, confirming theoretical predictions of positive impact of unemployment benefits on the reservation wage, and a negative one on the probability of finding a job.

The second essay investigates the efficiency of the matching process in the Croatian labour market by panel stochastic frontier estimation of the matching function. The empirical analysis is conducted on a regional level using regional office-level data obtained from the Croatian Employment Service on a monthly basis in the period 2000-2011. The obtained results suggest that the efficiency is rising over time, with great variations across regions. In order to explore these variations, structural characteristics of the labour market together with some policy variables are included into the second-stage estimation. Among structural variables, the proportion of agricultural and high-skilled workers have the most important positive effect on the matching efficiency, while the local unemployment rate and the share of low-skilled and workers without any experience among job-seekers have the most important negative effect. As far as policy variables are concerned, both active labour market programmes and the number of high-skilled employees in regional employment offices positively affect the matching efficiency. Additionally, when regional income per capita is included into the model it shows positive impact on the matching efficiency, indicating that demand fluctuations also affect the matching process. In order to get consistent estimates, panel stochastic frontier model transformation is applied. Preliminary results show that there is no major difference in estimated mean technical efficiency coefficients in comparison to the original model, while the opposite is true for the covariates of technical efficiency.

The importance of structural unemployment in the Croatian labour market is examined in the third essay via occupational mismatch between vacancies and unemployment in the period 2004-2011. The matching function which incorporates the effect of occupational mismatch on the flow of filled vacancies is used not only for the aggregate flow of filled vacancies but also for different submarkets based on the grouping of similar occupations (white-collar and blue-collar occupations). The estimated parameters from regressions are used to calculate the amount of unemployment that can be attributed to occupational mismatch for each submarket as well as for the aggregate function. According to the obtained results, it appears that occupational mismatch does not have an impact on the aggregate flow of filled vacancies, that is, on the matching process in the overall labour market. However, when the labour market is examined through its submarkets, i.e., similar occupational groups, occupational mismatch (significantly) positively affects the matching process in the market for white-collars, while it has a negative (insignificant) impact in the (sub)market for blue-collar occupations. Furthermore, the portion of total unemployment that can be attributed to occupational mismatch is estimated to be only up to 6%, which evidently cannot explain the high and persistent unemployment in Croatia. The portion of unemployment attributed to mismatch in different submarkets varies greatly (up to 20% for white-collar occupations and only up to 1% for blue-collar occupations).

Keywords: matching, adverse selection, firing costs, unemployment, efficiency, stochastic frontier, occupations, mismatch, transition, Croatia

PRISPEVKI O TRGU DELA V POST-TRANZICIJSKOM GOSPODARSTVU: PRIMER HRVAŠKE

POVZETEK

V doktorski disertaciji raziskujemo razloge za visoko in trdovratno stopnjo brezposelnosti na Hrvaškem s pomočjo teorije iskanja in ujemanja. Visoka stopnja brezposelnosti je bržkone najbolj pereča težava sodobnega trga dela. Ta pojav je enako težaven izziv tako za razvite države kot za države v razvoju. Glede na to, da težava z brezposelnostjo neugodno vpliva ne le na posameznike, temveč tudi na družbo v celoti, bi moralo biti iskanje rešitev za to težavo eden od primarnih ciljev gospodarske politike. A če hočemo najti rešitev, moramo najprej odkriti razloge za pojav, obstoj in trdovratnost zelo visoke stopnje brezposelnosti v sodobnih gospodarstvih, vendar pa zaradi njene zapletenosti v večini držav ni tako preprosto najti jasnega pojasnila za njen obstoj.

Zaradi tega je glavni cilj disertacije razširiti obstoječe modele iskanja in ujemanja, da bi ti bolj ustrezali posebnostim situacije na hrvaškem trgu dela in da bi lahko upoštevali tudi njihovo uporabnost v drugih državah v tranziciji in drugje po Evropi. Kombinacija metodologije, ki izvira iz ravnotežja teorije iskanja in ujemanja, in empirični dokazi za Hrvaško, bi morali omogočiti razkritje najpomembnejših dejavnikov visoke stopnje brezposelnosti na Hrvaškem. Obširna razlaga nekaterih glavnih vidikov hrvaškega trga dela bo verjetno pomagala tudi pri odkrivanju pomembnih šibkih točk obstoječe institucionalne strukture in pri predlaganju nujnih ukrepov nosilcem ekonomske politike. Vse te zadeve raziskujemo v treh različnih delih (esejih), od katerih vsak obravnava natančno določeno raziskovalno tematiko, vsem trem pa je skupen glavni cilj – odkriti poglaviten razlog za visoko stopnjo brezposelnosti na Hrvaškem.

Prvi esej obravnava obete za zaposlitev različnih tipov iskalcev zaposlitve na Hrvaškem z nadgradnjo *modela negativne selekcije s stroški odpuščanja*. Glavna predpostavka tega modela je, da delodajalci vidijo status na trgu dela kot posredno mero produktivnosti iskalcev zaposlitve, kar pomeni, da brezposelno skupino vidijo kot manj produktivno. Ker so stroški odpuščanja visoki, si delodajalci ne morejo »privoščiti« zaposlovanja ljudi iz skupine manj produktivnih iskalcev zaposlitve, zato je na trgu dela prisotna negativna selekcija. Rezultati, pridobljeni na podlagi podatkov iz Ankete o delovni sili za obdobje 1996−2009, kažejo, da je na hrvaškem trgu dela prisotna negativna selekcija. Rezervacijska mezda kot glavna determinanta stroškov odpuščanja pri tem modelu pozitivno vpliva na verjetnost menjave službe pri zaposlenih iskalcih zaposlitve, medtem ko pri brezposelnih iskalcih zaposlitve negativno vpliva na verjetnost, da bodo iz brezposelnosti prešli v zaposlenost. Če pa rezervacijsko mezdo v modelu obravnavamo kot endogeno, njen vpliv na verjetnost menjave postane pozitiven in pomemben le pri skupini brezposelnih. To pojasnjujemo z učinkom dosežene izobrazbe, ki služi kot »instrument« in ki očitno deluje kot učinkovita pojasnjevalna spremenljivka delavske uspešnosti med brezposelnimi. Učinek rezervacijske mezde na verjetnost zaposlitve za obe skupini je s časom vendarle upadel, posebno po reformi zakonodaje iz leta 2004, kar kaže na nižji vpliv stroškov odpuščanja. Na koncu preizkušamo domnevo o samodiskriminaciji brezposelnih, ki prejemajo

nadomestilo za brezposelnost, s čimer potrjujemo teoretična predvidevanja o pozitivnem vplivu nadomestila za brezposelnost na rezervacijsko mezdo in negativnem vplivu na verjetnost zaposlitve.

V drugem eseju proučujemo učinkovitost procesa ujemanja na hrvaškem trgu dela s metodo stohastične meje za panelne podatke (angl. panel stochastic frontier estimation) funkcije ujemanja (angl. matching function). Empirična analiza je bila izvedena na regionalni ravni ob uporabi podatkov regijskih uradov, ki so bili na mesečni podlagi pridobljeni od Hrvaškega zavoda za zaposlovanje v obdobju 2000–2011. Rezultati študije kažejo, da se učinkovitost s časom zvišuje, vendar z veliko stopnjo nihanja po posameznih regijah. Z namenom, da bi raziskali omenjena nihanja, smo v drugo fazo ocenjevanja vključili strukturne značilnosti trga dela skupaj z nekaterimi spremenljivkami, ki so povezane z izvajanjem ekonomske politike. Med strukturnimi spremenljivkami ima najpomembnejši pozitivni vpliv na učinkovitost ujemanja delež kmetijskih in visoko usposobljenih delavcev, medtem ko imata lokalna stopnja brezposelnosti in delež nizko usposobljenih delavcev brez kakršnih koli izkušenj najvidnejši negativni vpliv med iskalci zaposlitve. Kar zadeva politične spremenljivke na učinkovitost ujemanja pozitivno vplivajo aktivni programi za razvoj trga dela in število visoko usposobljenih delavcev v regionalnih zavodih za zaposlovanje. Takrat, ko smo v model vključili tudi regionalni dohodek *per capita*, se je pokazal pozitiven vpliv na učinkovitost ujemanja, kar kaže na to, da nihanje v povpraševanju prav tako vpliva na proces ujemanja. Da bi dobili dosledne ocene, smo preoblikovali uporabljeno metodo stohastične meje za panelne podatke. Začetni rezultati kažejo, da se ocenjeni koeficienti pomembno ne razlikujejo od izvirnega modela, nasprotno pa velja za kovariance tehnične učinkovitosti.

Pomembnost strukturne brezposelnosti na hrvaškem trgu dela je obravnavana v tretjem eseju s poklicnim neujemanjem prostih delovnih mest in brezposelnosti od leta 2004 do leta 2011. Funkcija ujemanja, ki vključuje vpliv poklicnega neujemanja na pretok zasedenih delovnih mest, je uporabljena ne le pri agregatnem pretoku zasedenih delovnih mest, temveč tudi pri različnih podtrgih, ki temeljijo na združevanju podobnih poklicev (pisarniški in proizvodni poklici). Ocenjeni parametri regresij so bili uporabljeni pri izračunu skupne brezposelnosti, ki jo je mogoče pripisati poklicnemu neujemanju za vsak podtrg, ter pri agregatni funkciji. Pridobljeni rezultati kažejo, da poklicno neujemanje ne vpliva na agregatni tok zasedenih delovnih mest, t.j. na proces ujemanja na celotnem trgu dela. Ko smo trg dela preizkušali prek njegovih podtrgov, torej prek med seboj podobnih poklicnih skupin, pa je poklicno neujemanje vendarle (pomembno) pozitivno vplivalo na proces ujemanja na trgu pisarniških poklicev, medtem ko je negativno (zanemarljivo) vplivalo na podtrg proizvodnih poklicev. Poleg tega se predvideva, da je lahko delež skupne brezposelnosti, ki jo lahko pripišemo poklicnemu neujemanju, največ 6%, kar očitno ne more pojasniti visoke in trdovratne brezposelnosti na Hrvaškem. Deleži brezposelnosti, ki jih pripisujemo neujemanju na različnih podtrgih, so zelo različni (do 20% za pisarniške poklice in samo do 1% za proizvodne poklice).

Ključne besede: ujemanje, negativna selekcija, stroški odpuščanja, brezposelnost, učinkovitost, stohastična meja, poklici, neujemanje, tranzicija, Hrvaška

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Motivation

The labour market usually presents the largest single market in an economy. Hence, it is vital to understand processes that occur in this market not only because of individual well-being, but also because without understanding the functioning of the labour market it is impossible to understand many other developments in modern economies. For instance, numerous important issues studied in today's economic literature - like unemployment, inequality, education, business cycles, and growth - are all connected with the functioning of the labour market. Perhaps the most challenging issue of the present-day labour market is huge unemployment in most of the countries in the world.

Unemployment is a phenomenon equally challenging for both developed and developing countries. Because of its complexity, it is not an easy task to find a clear explanation for the very existence of unemployment in most of these countries. However, as already mentioned, explaining the problem of unemployment is important because it creates a welfare loss and is also a base for inequality (Soininen, 2007). Moreover, efficient labour markets that move workers more quickly from low to high productivity positions are said to be important for the aggregate growth (Burgess and Mawson, 2003). Usually, it is considered that unemployment is affected by many interacting factors and solving the problem of unemployment should tackle all those factors simultaneously. For instance, according to Layard, Nickell, and Jackman (2005) reasons for high unemployment might lie in a number of factors, which they divide into two main categories: (i) variables that influence the efficiency with which the unemployed can match with vacant jobs and (ii) variables that raise wages in a direct manner despite excess supply in the labour market.[1] Undoubtedly, there are many viewpoints on unemployment, its appearance, existence and persistence, as well as the way to eliminate it or at least alleviate it.

In the last couple of decades, frictions in the labour market have evolved as one of the major standpoints on unemployment.[2] A lot of the recent interest in the so-called search and matching theory stems from the realization that modern labour markets are characterized by large well-documented flows of jobs and workers between activity and inactivity, employment and unemployment, as well as that the process of matching workers and jobs induces certain costs (Mortensen and Pissarides, 1999, 2011; Petrongolo and Pissarides, 2001). As the authors of the theory themselves explain (Mortensen and Pissarides, 2011), a flow approach to labour market led to the theory of equilibrium unemployment which replaced the previously dominant disequilibrium theory under which unemployment reflected the excess supply at a real wage above the one that would clear the market. Hence, the equilibrium search and matching theory became dominant in analysing the problem of unemployment as well in proposing policy

[1] Among other factors, they mention the unemployment benefit system, active labour market policies, employment protection laws, and labour taxes (Layard et al., 2005).

[2] Information imperfections, heterogeneities of both workers as well as jobs, slow mobility in the labour market or the absence of perfect insurance markets are a few of the many reasons that could cause frictions in the labour market.

measures that could solve it. This is also true for the analysis of transition and post-transition economies, and especially their labour markets.

Following the breakdown of the planned system and the beginning of the transformation process in Central and East European (CEE) countries at the beginning of the 1990-ies all labour markets experienced constant flows between different statuses (unemployment, employment, and inactivity). In this process, two main causes of involuntary unemployment were identified: (i) the presence of *moral hazard* that originates from the imperfect monitoring of the worker's effort, while (ii) poor signals of the worker's actual productivity leads to the problem of *adverse selection* (Boeri, 2000). In addition, frictions in the labour market were marked as the most important in slow and costly reallocation of workers from the old state sector to the new private sector (Boeri, 2000).

However, even after the initial phase of restructuring and privatization was over, unemployment stayed at very high levels in most of the CEE countries. Moreover, not only is high unemployment the problem, but there are additional issues in the labour market such as long-term unemployment, inactivity, low productivity, etc. Hence, a number of other possible explanations for the existence and persistence of unemployment in these countries emerged. Faggio (2007), for instance, gives three possible explanations: (i) ongoing reallocation from an inefficient initial allocation of labour and capital to more efficient uses; (ii) finished reallocation with redundant labour (skills and regional mismatch); and (iii) wrong choice of institutional framework. Svejnar (1999), on the other hand, stresses the importance of the demand factors as well as the behaviour of individuals, firms and institutions in the labour market as determinants of unemployment. Similarly, Nesporova (2000) cites several important features of unemployment in transition economies: (i) huge regional disparities (with low mobility between regions); (ii) low frequency of entry into and exit from unemployment (a consequence of long-term unemployment); and (iii) mismatch between supply and demand in the labour market (including both over- and under-skilling).

Munich and Svejnar (2007), additionally, describe how explanations for high unemployment in CEE countries go hand-in-hand with those for high unemployment rates in Western Europe. They list the main causes of unemployment as: (i) macroeconomic policies/major external shocks (aggregate demand shocks); (ii) problems related to economic structures of CEE countries (inefficient matching or mismatch); and (iii) unfinished transition from plan to market (restructuring or hysteresis). All these problems are linked to institutions in the labour market that are often distinguished as the main determinants of the labour market developments in former transition countries (Arandarenko, 2004; Boeri and Terrell, 2002; Feldmann, 2005; Lehmann and Muravyev, 2011).

Evidently, many of the factors that have been marked as the ones responsible for high and persistent unemployment in CEE countries in all these different works are overlapping. Furthermore, they are similar to those singled-out in Western countries. Thus, one can see that the most common of the proposed arguments are: (i) demand factors; (ii) mismatch (skills and regional) between supply and demand in the labour market; and (iii) institutional framework.

The same goes for Croatia. The most usual explanations for the unemployment problem in Croatia are exactly these: (skills) mismatch between vacancies and the unemployed, rigid legislation, and demand deficiency.

Hence, the main motivation of this doctoral dissertation is to study the reasons behind the high and persistent unemployment in Croatia with the help of the search and matching theory. The goal is to put the Croatian labour market in the CEE as well as the EU context by upgrading the existing models stemming from the equilibrium search and matching theory. What is more, the dissertation should also emphasize the effect of the economic crisis on the labour market. In this way, this doctoral dissertation should contribute not only to the comprehension of the issues in the Croatian labour market but also to the use of the proposed models as well as the obtained results in a wider context of the modern European labour markets. Broad elucidation of some of the main aspects of the Croatian labour market should also help in unravelling the major weaknesses of the current institutional structure and proposing the necessary measures to policy makers.

1.2 Search and matching theory

The topic of search and matching has been widely discussed in economic literature. It started to develop back in the 1960-ies and 1970-ies with the appearance of the so-called search theory (Lucas and Prescott, 1974; McCall, 1970; Phelps, 1968; Stigler, 1961, 1962) that studied how agents in the market acquire information about market conditions and how they are brought together based on their individual optimal strategy. However, not until the emergence of the search and matching theory in the late 1970-ies and early 1980-ies (Diamond, 1982a, b; Diamond and Maskin, 1979; Mortensen, 1977, 1982; Pissarides, 1979, 1984, 1985) did the study of frictional unemployment gain the popularity that it has right now. The importance of the search and matching theory was particularly manifested in 2010 when Peter Diamond, Dale T. Mortensen and Christopher A. Pissarides were awarded the Nobel Memorial Prize in Economic Sciences for their analysis of 'markets with search frictions'.[3] Most recently, this topic has gained importance in the studying of job and worker flows in transition countries.[4]

Probably the most detailed overview (with critical reference) of both theoretical and empirical literature on the search and matching theory can be found in Petrongolo and Pissarides (2001). Besides this, a good description of the concept, with some new developments, and more detailed literature surveys can be found in Albrecht (2011), Batyra and de Vroey (2012), Mortensen and Pissarides (1999a, b, 2011), Pissarides (2000), Rogerson and Shimer (2011), and Rogerson, Shimer, and Wright (2005). In this section, only a brief sketch of the basic concepts – the matching function and the Beveridge curve – as well some of the theory's applications are given, while a choice of specific details are discussed in the following chapters.

[3] This means that the search and matching theory is used not only to study interactions in labour markets; it is also applicable for housing markets, marriage markets, or any markets with frictions for that matter.
[4] See, for instance, Boeri (1997b), Boeri and Terrell (2002), Burda (1994), Munich et al. (1999), or Obadić (2003).

The equilibrium search and matching literature is usually divided between two related but distinct branches (Albrecht, 2011; Mortensen and Pissarides, 1999a): (i) the 'matching approach' and (ii) the 'microeconomic approach'. The first approach tries to explain worker and job flows and unemployment in a framework that recognizes that there are frictions in the process of matching, i.e., the offer arrival rate is determined endogenously. The second branch studies the effects of market frictions on the determination of wages under the assumption that employers have power in posting them, i.e., the wage-offer distribution is modelled as the equilibrium outcome of a wage-posting game played by firms. Evidently, the matching approach contributes to understanding the equilibrium unemployment or 'natural rate of unemployment' while the microeconomic approach contributes to understanding the equilibrium wage dispersion.

Over the years, many different theoretical and empirical applications of these two approaches emerged. For instance, Burdett and Mortensen (1998) introduced generating equilibrium wage dispersion in a model of sequential search in which workers are *ex ante* identical with the key of their model: on-the-job search.[5] Mortensen and Pissarides (1994), on the other hand, incorporated endogenous job creation and job destruction into the original model[6] which is also important from a policy perspective because endogenous job destruction is a crucial component of any model designed to understand the effects of, for example, firing restrictions and mandatory severance pay on unemployment and wages (Albrecht, 2011).

Nevertheless, the search and matching model of the labour market is not only used to study frictions in the labour market, or the so-called frictional unemployment. The main ideas behind this theory are often used in studying structural and cyclical unemployment as well.[7] In recent years, it has often been shown how disaggregated data that include some of the heterogeneities for both workers as well as jobs, provide different results than those using the aggregated data or assuming homogeneous workers and firms (Anderson and Burgess, 1995; Fahr and Sunde, 2001; Petrongolo and Pissarides, 2001). For instance, Petrongolo and Pissarides (2001) state that worker heterogeneity can be introduced by assuming that intensity of search is a choice variable while firm heterogeneity can be described by the distribution of wage offers. Still, there are many other ways in the existing literature that show how to differentiate among the prospective employees (or employers). Additionally, attention has also been given to the so-called stock-flow matching (Coles and Petrongolo, 2002; Dmitrijeva and Hazans, 2007; Greg and Petrongolo, 2005; or Jeruzalski and Tyrowicz, 2009), with emphasis on the difference between stocks and flows of both unemployment and vacancies.

In addition, there are works (Shimer, 2005, 2007, 2010) that combine the search and matching theory with the neoclassical growth model, or the so-called real business cycle (RBC) theory, in order to further explore cyclical fluctuations in the labour market. However, Shimer (2005,

[5] Pissarides (1994) even earlier allowed for endogenous job search by the employed in the matching model, while Burgess (1994) showed that this feature significantly affects the nature of aggregate unemployment dynamics over the cycle.
[6] The so-called Mortensen-Pissarides model of equilibrium unemployment.
[7] See, for instance, Jackman and Roper (1987) or Shimer (2005).

2010) shows that the original search and matching models do not explain fluctuations in unemployment, which is, according to him, the result of the rigidity of wages often neglected in the search and matching models. Soininen (2007), on the other hand, emphasizes that most empirical studies do not take into account the non-stationarity of the time series and very few analyse misspecification of the variables. Thus, she studies the difference in aggregate matching during stable and turbulent times on the Finnish labour market using a new method - cointegrated VAR-analysis that takes into account the non-stationarity of the time series. Zanetti (2011) further combines a dynamic stochastic general equilibrium (DSGE) model with search frictions in the labour market and nominal rigidities in the goods market in order to explore the influence of labour market institutions on aggregate fluctuations.

In explaining the rationale for an award[8] given to Mortensen and Pissarides in 2005 for their "path-breaking contributions to the analysis of markets with search and matching frictions" the prize committee emphasized that the analysis of markets with frictions stimulated a vast literature afterwards that led to the "success of job search theory and the flows approach in becoming a leading tool for microeconomic and macroeconomic analysis of the labour markets" (Mortensen and Pissarides, 2011, p. vii). The authors themselves (Mortensen and Pissarides, 1999a, p. 2623) conclude their explication of the new developments in models of search in the labour market by stating that "search equilibrium approaches to modelling markets characterized by friction in the form of information gathering delay and turnover cost have matured", as well as that "they are now capable of providing a framework for understanding empirical observation on labour reallocation flows and wage dispersion and for generating important new insights into the effects of labour market policy".

1.2.1 Matching function

As is sometimes said, the matching function is the workhorse of modern labour search theory (Mandal, 2011). The matching function actually represents a functional relationship that describes the formation of new relationships between unmatched agents of the appropriate types; i.e., it contains important information on how matches are formed (Pissarides, 2000). The basic idea of the matching function in the labour market is that the exchange process in the labour market is decentralized, uncoordinated, and that it takes time and brings costs to both firms and workers. Thus, the matching function in the labour market relates job creation to the number of unemployed, the number of job vacancies, and the intensities with which workers search and firms recruit (Mortensen and Pissarides, 2011). Petrongolo and Pissarides (2001) explain that the first matching function owes its origins to a well-known problem analysed by probability theorists - that of randomly placing balls in urns.[9]

They (Petrongolo and Pissarides, 2001) further explain how the evidence on the key matching-function idea comes from four sources: (i) aggregate data on stocks of unemployment and vacancies and estimation of an equilibrium relation - the Beveridge (*UV*) curve; (ii) aggregate

[8] IZA Prize in Labor Economics.
[9] They trace the first development of the concept back to Hicks and Hut in the 1930-ies, whilst the first formal models as known today appeared only in the 1970-ies (Petrongolo and Pissarides, 2001).

data on employment and unemployment flows and estimation of the aggregate matching function, either for the whole economy or for a particular sector; (iii) data on local labour markets and estimation of the matching function for each; (iv) data on individual transitions and estimation of hazard functions for unemployed workers.

The basic-form matching function looks like the following:

$$M = f(U,V), \tag{1.1}$$

where M denotes the number of successful matches, U represents the number of unemployed and V is the number of vacancies. It is assumed increasing in both its arguments, concave, and usually homogeneous of degree one (Petrongolo and Pissarides, 2001, p. 392), as well as that $f(0,V) = f(U,0) = 0$. In addition, in most of the empirical studies it is assumed to exhibit constant returns to scale (in Cobb-Douglas functional form).

The matching function in fact summarizes the effectiveness of the technology that brings workers searching for jobs together with the employers searching for workers, i.e., it summarizes the complex process by 'well-behaving aggregate function' (Petrongolo and Pissarides, 2001). Namely, if there were no frictions, matching would be instantaneous. Dmitrijeva and Hazans (2007) explain that the matching function presumes the presence of search frictions in the labour market because of information imperfections, underdevelopment of insurance markets, low labour mobility, high individual heterogeneity, high qualification mismatch, and other similar factors, i.e., that the matching function reflects the efficiency of the labour market. Yet, its attractiveness is primarily in its simplicity, since it captures the effects of different sets of variables on equilibrium outcomes, usually without explicit reference to the source of frictions (Petrongolo and Pissarides, 2001).

Nevertheless, Petrongolo and Pissarides (2001, p. 424) conclude that the matching function is a black box: "There is a good intuition about its existence and properties but only some tentative ideas about its microfoundations". This is especially true for the most popular functional form of the matching function – Cobb-Douglas with constant returns to scale - which is driven by its empirical success but lacks microfoundations. Yet, Stevens (2007) examined the microfoundations of a Cobb-Douglas functional form for the aggregate matching function and, by applying the new model for the matching process,[10] she found that that the model exhibits a CES matching function, more or less Cobb-Douglas when search costs are approximately linear.[11]

1.2.2 Beveridge curve

Unlike the matching function that takes both stocks (unemployment and vacancies) and flows (matches) in the labour market into account, the Beveridge curve deals only with stocks

[10] Based on a 'telephone line' Poisson queuing process, which can be integrated directly into standard theoretical search models.

[11] Mandal (2011), on the other hand, tests whether the matching function actually exhibits constant returns to scale and concludes that the functional form of the matching function may not be stable over time and one needs to take into account business cycle fluctuations.

(unemployment and vacancies). The matching of workers to new jobs is only part of the explanation for the flows in the labour market while its outcome, together with the outcome of the process that separates workers from jobs, is often shown graphically in vacancy-unemployment space by the so-called Beveridge curve or *UV* curve (Petrongolo and Pissarides, 2001).

The Beveridge curve in fact equates flows in with flows out of unemployment. It is presented as a convex to origin graphical representation of the relationship between the unemployment rate and the job vacancy rate. Its shape is hyperbolical and it slopes downwards as a higher rate of unemployment normally occurs with a lower rate of vacancies. The main aim of the Beveridge curve is to separate the impact of structural factors in the labour market from that of cyclical factors, both of them affecting the curve's shape and position (CNB, 2010). For instance, if the curve moves outwards over time, then a given level of vacancies would be associated with higher and higher levels of unemployment, which would imply decreasing efficiency in the labour market (mostly caused by mismatches). On the other hand, recessions are indicated by high unemployment rates and low vacancy rates, corresponding to a position of the curve on the lower side of the 45 degree line, and vice versa.

Even though the Beveridge curve concept is often considered to have been first introduced in Blanchard and Diamond (1989), its origins trace back to 1944 and William Beverage, who was the first to implicitly express this negative relationship between unemployment and vacancies.[12] However, its first recognized formal statement was given in the work by Dow and Dicks-Mireaux (1958) who presented the unemployment and vacancy data in an unemployment-vacancy (*UV*) space, and derived an idealized *UV*-curve as a rectangular hyperbola after they had connected successive observations. Pissarides (1986) made an additional step in the development of the graphical presentation of the *UV*-curve using the example of the labour market in Great Britain in the period from 1967 to 1983. The use of the Beveridge curve has had many empirical applications since then. For instance, Nickell, Nunziata, Ochel, and Quintini (2003) examine the Beveridge curves for the OECD countries in the period 1960-1990 and find that the Beveridge curves of almost all countries (except Norway and Sweden) shifted to the right from the 1960-ies to the early/mid 1980-ies. They explain how after this point, the countries divide into two distinct groups: those whose Beveridge curves continued to shift out and those where they started to shift back (Nickell et al., 2003). Recently, Munich and Svejnar (2007) used the concept of the Beveridge curve together with the so-called vacancy-supply curve in the same graphical presentation in order to examine the evolution of unemployment together with that of inflows into unemployment and vacancies in transition countries.

1.3 Institutional setting

As said previously, in order to fully capture the processes on the Croatian labour market, the market needs to be put in a wider context of transition countries and even EU member-states. That is why this section, before describing the main characteristics of the Croatian labour

[12] A detailed explanation of the Beveridge curve can also be found in Pissarides (2000).

market, first briefly sketches the main features of the labour markets in European countries and then the institutional surrounding of the labour markets in transition. Explaining the institutional setting, as well as the impact of the recent economic and financial crisis, in European labour markets, with special emphasis on transition countries, should help in better understanding the processes that have happened on the Croatian labour market since the beginning of the 1990-ies.

1.3.1 Labour market in Europe

European economies have been characterized, for a long time now, by continuing high rates of unemployment, despite moderate economic growth for most of the period after World War II. It is often argued that the poor performance of European labour markets, especially in comparison with that of the United States, is due to labour market rigidities (Boeri, Garibaldi and Moen, 2012; Cases, 2002; Feldman, 2005; Layard and Nickell, 1999; Layard, Nickell, and Jackman, 2005; Nickell, 1997; Siebert, 1997). However, this is usually not confirmed in the literature. For instance, Layard and Nickell (1999) show that for the OECD countries, unions and social security systems are more important than employment protection legislation in explaining growth and unemployment. Boeri and van Ours (2008) emphasize that the same institutions have existed for 30-40 years in Europe, while the labour market situation has dramatically worsened in the last decade or two. They conclude that employment protection legislation is a purely redistributive 'institution' in the labour market. Namely, the authors show that legislation protects those with permanent contracts in the formal sector, while a stricter employment protection legislation index, in general, has a negative impact on unemployed individuals, individuals employed with temporary contracts, or even employers who are required to cover the costs of dismissals (Boeri and van Ours, 2008). Boeri (2011) additionally emphasizes how regulatory changes often create long-lasting asymmetries, two-tier regimes, between a reformed and an unreformed segment of the labour market, while Boeri et al. (2012) further highlight that European labour markets are today much more flexible on average than a couple of decades ago, and are characterized by a dual structure.

Nevertheless, the situation on European labour markets further deteriorated after the start of the economic and financial crisis in 2007 and the Great Recession in 2008.[13] The European Commission, in its 2012 report, stresses the fact that unemployment in the EU is becoming increasingly structural (EC, 2012). The report shows that the Beveridge curve for the euro area has been shifting outward since 2010, which is an indication of worsening labour market matching. Additionally, the report shows how the non-accelerating wage rate of unemployment (NAWRU), the concept of structural unemployment consistent with a constant wage growth, is also on the rise in most EU countries, and a remarkable co-movement is observed between the shift in the Beveridge curve and the NAWRU (EC, 2012). Barakat, Holler, Prettner, and Schuster (2010) examine the influence of the recent economic and financial crisis on European labour market perspectives and find that young male workers have been hit hardest, while older

[13] EC (2012) emphasizes that since the start of the crisis in 2008, the number of jobs lost totalled about 5 million in the EU, or 3 million in the euro area, by the end of 2011. However, about 40% of the growth in unemployment for the overall EU since 2008 is due to the massive increase in Spanish unemployment.

workers and women have been partially protected by non-redeemable contracts and the fact that they work in sectors which have been less severely hit by the crisis.

However, there are considerable cross-country differences between European labour markets, and even between different regions in a single country (EC, 2012). There are Eastern European or transition countries on the one side, and old EU-members on the other. Furthermore, there is the division between the 'North' and the 'South', or even between individual countries that are most often put in the same geographical or economic groups. Some of the labour markets in Europe are more flexible than others, while some of them have completely different workforce structure (in age, skills, and occupations). And even during the recent and ongoing crisis, each country has uniquely reflected its labour market institutions and initial pre-crisis conditions (Bentolila, Cahuc, Dolado, and Le Barbanchon, 2012; Brada and Signorelli, 2012), while policies to fight unemployment are also different in different countries (Leschke and Watt, 2010; Marelli, Patuelli, and Signorelli, 2012). For instance, Eichhorst, Escudero, Marx, and Tobin (2010) investigate the impact of the financial and economic crisis on the labour markets of G20 and EU countries and conclude that the decline in employment and rise in unemployment in relation to output or GDP reductions varies significantly across countries. Apparently, countries that could rely on strong internal flexibility were better able to control employment losses and rising unemployment while, at the same time, the crisis contributed to a further dualization of labour markets given that risks are allocated unequally across different types of employment.

The use of the equilibrium search and matching model in studying the unemployment problem in Europe as well as different policy proposals has been in effect ever since the 1980-ies and the famous Pissarides article on unemployment and vacancies in Britain (Pissarides, 1986). Its use continued afterwards, for instance in the evaluation of the overall effectiveness of the largest labour market reform in Germany in the post-war period - the so-called Hartz reforms (Fahr and Sunde, 2009). The difference between the US and European labour market was also examined through the search and matching theory and the use of the matching function (Boeri et al., 2012; Ljungqvist and Sargent, 2007). Even today, different aspects of the policies to combat unemployment after the start of the Great Recession are examined through the search and matching models (Bentolila et al., 2012; Boeri, 2011; Boeri et al., 2012; EC, 2012).

1.3.2 Institutional framework of the labour market in transition

The transition from centrally planned to market economy that started in Central and Eastern Europe two decades ago is still highly visible in all parts of these societies. For instance, Kornai (2006) emphasizes that despite the fact that the transition process has been an exceptional success story, deep economic troubles are experienced by a considerable portion of the population. At one point, many people that were quite protected from unemployment in the previous system found themselves struggling for a position in the new (competitive) labour market (Rona-Tas, 1996; Simai, 2006). Nevertheless, transition was usually considered as something that would eventually bring prosperity to the people living in those countries.

The labour market has been characterized as the most sensitive and challenging of the three main markets (goods, capital and labour) in this transformation process because it has been most directly connected with political and institutional changes (Simai, 2006), but also because it directly affects people's lives through (un)employment and wages. It was expected that after the initial fall in employment, the emergence of new (private) firms would bring an increase in employment as well as in the overall economic growth (Boeri, 2000).[14] Nonetheless, the output level exceeded the pre-transition level in most CEE countries already in 2003 but the unemployment remained at mid-1990s levels (Gabrisch and Buscher, 2006). Birdsall, Grahm, and Pettinato (2000) also point out that the loss of secure jobs in government and state-owned enterprises has not been compensated by increases in private sector jobs. Still, it is often accentuated that the success of transition is determined by how well the problem of reallocating labour has been addressed (Boeri and Terrell, 2002).

Economic theory predicts that the changes arising from the collapse of the centrally planned system and the emergence of an economy driven by market forces will lead to job destruction and job creation on a massive scale (Haltiwanger, Lehmann, and Terrell, 2003). At its start, a rise in unemployment was not only considered inevitable but was also taken as an indicator of the extent of reform progress (Burda, 1994). It follows that the stated objective of policies was not to prevent the rise of unemployment but to cushion its social costs and to avoid the spread of long-term unemployment. (Boeri, 1997b). Yet, during this process, many state-owned firms have been privatized and restructured, causing massive lay-offs, and clearly indicating that in early transition, job destruction dominates. Svejnar (2002a) explains how transition was typically associated with a rapid drop in labour demand due to the unsustainably high employment in the centrally planned system. Thus, privatization and restructuring of old state-planned firms caused massive discharges, which changed the structure of employed, unemployed and inactive persons in the economy. However, this process did not turn out completely as the theory predicted.

Munich and Svejnar (2007), for instance, explain how models of transition assume that the turnover (inflow) rate would rise dramatically as the old state sector gets rid of workers who go through unemployment into new jobs being created in the emerging private sector; but also that the inflow rate would be high only temporarily. Yet, this was not the case in CEE countries, possibly because there was job-to-job mobility at work or because the restructuring was not as extensive as was expected or because of social policies (Munich and Svejnar, 2007). Additionally, Boeri (2000) explains that the transition process involved stagnant unemployment pools, large flows to inactivity and strikingly low worker mobility as well as that separations from state sector employment were in fact an endogenous rather than policy-choice variable.

Gabrisch and Buscher (2006) further argue that in the first stage the 'spontaneous' privatization and the first restructuring attempts in state-owned enterprises reduced employment in state

[14] One strand of the literature that examines the process of transition and labour reallocation uses the so-called optimal speed of transition (OST) hypothesis (Aghion and Blanchard, 1994; Boeri, 2000; Bruno, 2006; Castanheira and Roland, 2000) with the main assumption that after a rapid initial adjustment private job creation will take time and that it is highly affected by unemployment.

industry, while the *de novo* private sector absorbed a part of the work force which was visibly redundant in the socialist sector. However, when legal privatization actually started and the policy commitment to systemic change became visible, unemployment rose quickly, although output decline gradually came to an end. Domadenik and Vehovec (2006), on the other hand, explain how the speed of restructuring in many transition countries was higher at the beginning of the transition, when mass layoffs were mostly resolved by early retirements and generous government subsidies, with a slight decline in the second half of the 1990-ies. Most of the CEE countries experienced this phase, with many individuals moving to unemployment or inactivity either in response to incentives for early retirement schemes or disability pensions, or as a result of prolonged unemployment spells. This suggests that transition was strongly characterized by a drop in participation rate and an increase of the dependency ratio with increasing government budget expenditures (Bruno, 2006). It is notable that the enormous rise in unemployment in most of these countries occurred despite major declines in labour force participation, competitive devaluation of the currencies, reductions in formerly generous unemployment benefits, and introduction of active labour market policies (Svejnar, 1999).

One additional characteristic of the transition process in CEE countries is the need for the 'restructuring' of skills. Namely, most of the CEE economies before the transition process started were characterized by a large industrial sector, while the service sector was relatively underdeveloped. In the early stages of the transition process, this situation led to massive unemployment of skilled labour from the industrial sectors, which additionally led to a rise in long-term unemployment because the skills of the existing workforce were obsolete for the new, privatized and service-oriented economy. The service sector was emerging but it faced insufficiently skilled labour supply and often had to hire under-educated workers. Hence, there was a huge rise in the demand for education of the service-oriented occupations in the early 1990-ies.

Nevertheless, Boeri (2000) emphasizes that despite all the predictions empirical evidence suggest that transition countries have displayed remarkably low mobility of workers across different labour market states, occupations and sectors, which is mostly due to underdeveloped labour market institutions. As already mentioned, some of the detrimental effects of the negative output shocks ushered by the beginning of the transition process were partially mitigated by the relatively generous welfare schemes. Still, actual levels and structure of non-employment benefits differed across countries, thus marking the subsequent evolution of the labour market in these countries as relatively differentiated (Boeri and Terrell, 2002; Bruno, 2006).

In order to boost the labour market in newly formed market economies new institutions needed to be developed. Yet, the development of institutions that would facilitate different interactions in the labour market was not an easy task given that most of them were non-existent under the previous system (Boeri, 1997a). Cazes and Nesporova (2004) state how the opening up of the transition countries to global competition has forced domestic enterprises to adjust their inputs (including labour), production technology and outputs to market demand. Amended national labour legislation, newly established public employment services and labour market policies have facilitated these changes by reducing high employment protection in existing jobs inherited

from the previous regime. Actually, much of the debate in the literature since the beginning of transition has been devoted to labour market institutions, especially the employment protection legislation. However, labour market institutions are difficult to quantify, as they are complex and mostly qualitative in nature (Feldmann, 2005) and thus some of the results are inconclusive.

For instance, Cazes and Nesporova (2003) investigate whether the persistently high unemployment in Central and Eastern Europe can be attributed to the rigidity of their labour markets. They show that on average employment protection legislation is similarly rigid as the EU average, but with some different effects on (un)employment. For instance, unlike in the OECD countries, the results indicate that in transition countries more protection could contribute to improving employment performance and higher economic activity of people in the formal sector of the economy. Additionally, they show that all selected labour market indicators are positively affected by collective bargaining and active labour market policies, while unemployment - particularly long-term and youth unemployment - tends to rise with higher payroll taxes (Cazes and Nesporova, 2003). Faggio and Konings (2003) additionally emphasize that the flexibility of the labour market is important because it permits the rapid reallocation of resources to the most efficient uses and thus it may be vital for economic growth. Svejnar (2002b) concludes that the flexibility of the labour market is extremely important, but not a major factor in comparison to the imperfections and regulations in other areas such as real estate market, transport infrastructure, capital markets, corporate governance, legal framework and business environment. Boeri and Terrell (2002), on the other hand, explain how CEE countries were more successful than CIS (Commonwealth of Independent States) countries because due to different non-employment benefits, the adjustment was on the employment instead of on the wage side, which led to faster structural change and reduced income inequality, but it also generated more unemployment, especially long-term unemployment. Earlier, Cazes (2002) showed that there is no statistical impact of employment protection legislation (EPL) on the various unemployment rates of transition countries while EPL seemed to influence workers' labour supply. However, she explained that the key labour market institutions were wage-setting institutions and active labour market programmes (Cazes, 2002). Gabrisch and Buscher (2006) also conclude that labour market rigidities do not play an important role in explaining the high unemployment rate in eight CEE countries. Evidently, there is no single conclusion about the effect the institutions in the labour markets in transition economies have on the levels of both employment and unemployment.

Today, most of the former transition CEE countries are part of the EU and they have to struggle with new challenges posed in front of them via a single market, and even a single currency for some of them. The economic and financial crisis that emerged in 2008 only aggravated the existing struggles in their labour markets with different effect in each of them. Policy responses also differentiated greatly. Actually, the eastward enlargement of the EU is often called a second transition for the CEE countries, while the impact of the global financial crisis, which has brought new tensions in the production structures, has indicated the start of the so-called third transition (Pastore, 2012).

1.3.3 Labour market in Croatia

Croatia, as many other countries in this part of the world, has been experiencing transformation from planned to market economy for more than a decade. However, Croatia was somehow specific in this process of privatization and restructuring of the old state-owned firms which dictated the path and the pace of both transition and integration (with the EU) processes (Čučković, 2011). Bićanić and Babić (2008), for instance, argue that in order to understand the current functioning of the Croatian labour market, non-economic variables and the path dependency are of critical importance. According to them, path dependency in the Croatian labour market is evident not only in the current labour market institutions and demographic trends, but also in the educational structure of the unemployed population, and the expectations of both the supply and the demand side in the labour market (Bićanić and Babić, 2008).

First, the form of central planning was far more decentralized and market-related in Croatia than in most other transition economies (Bićanić and Babić, 2008; Hoffman, Bićanić and Vukoja, 2012). Second, the Croatian transition process coincided with the war and violent disintegration from Yugoslavia which also meant that Croatia needed to establish a new independent state and its administrative structures at the beginning of the 1990-ies. Additionally, in the latter stages of the transition process, continued regional instability in the Western Balkans further contributed to Croatia lagging behind most CEE countries in terms of transition and integration. Evidently, this was reflected in weak economic transition outcomes such as missing achievement of the positive economic growth and efficiency gains from economic reforms, privatization and restructuring, structural economic reforms targeted to improve enterprise efficiency and generate visible productivity gains, etc. (Čučković, 2011).

Nevertheless, the privatization process was considered as the key that would determine the success of all other economic reforms, including the labour market reform. Still, things did not turn out as expected. As is often argued, the main motive for privatization in the early years of transition was the change of the ownership structure, while in the second half of the 1990-ies and 2000-s, privatization was largely motivated by the need to cover the budget deficit (Vehovec and Domadenik, 2003). In between, many suspicious and even illegal transactions occurred, and privatization scandals from both the 1990-ies and 2000-s are still emerging to the surface (Čučković, 2011). Clearly, the impact of the privatisation process on the expected labour market mechanisms was also specific in Croatia. Several researches point to some of the specificities, while the main trends went along with those in other CEE countries.

For instance, contrary to theoretical predictions, Nestić (2002) describes how in the period 1973-1983 overall income inequality decreased, while in the latter period (1984-1998) it increased only mildly, which he explains with the expansion of social transfers as well as the absence of any major rise in wage concentration. Matković (2003) shows how in the pre-transition phase (1970-1990) employment grew in size while occupational structure was almost ‘frozen’ due to certain political and institutional choices. During the transition phase (1990-2001), on the other hand, the number of employed plummeted initially, but with different impact in different sectors - relative growth of employment in producer and social service sectors and a drop in the

transformative sector. In the latter part of the nineties, occupational structure stabilised, while the labour market became more dynamic (Matković, 2003).

Škare (2001) analysed the determinants of the demand for labour, i.e., unemployment, in Croatia in the period 1960-1998 and concluded that the unemployment trend was mainly determined by a change in the price level, the structure of GDP with respect to shares of capital and labour, changes in wages and exchange rate policy, with the latter being the strongest factor. Additionally, Katić (2006) explored the dynamics of the (un)employment in Croatia and, using Blanchard's adjustment ratio, showed that most of the adjustment process in Croatia during the transition period (1990-1997) was through lower participation rather than higher unemployment. Comparing the Croatian labour markets to the other countries in Central and Eastern Europe, she concludes that the situation is more severe in Croatia than in most other CEE countries emphasizing low job creation as the main problem (Katić, 2006).

In order to cope with all the reforms that happened after the transformation process started, labour market institutions needed to be developed as well. Some of the institutional arrangements on the Croatian labour market (such as public employment service – the Croatian Employment Service) existed even before the transition process started, but not in a form suitable for the functioning of the market economy. However, most of the new institutional arrangements for the labour market developed in the mid-1990-ies, following the economic transformation.

The first national collective agreement was signed in 1992, and a new labour act was established in 1995 (Table 1.1). Arguably, this law included provisions that maintained substantial labour market inflexibility inherited from the previous system (Hoffman et al., 2012).[15] Indeed, one of the main characteristics of the Croatian labour market in the period after 1995 was its strict legislation. Croatia is among the countries that have had higher than average European employment protection legislation for most of the time after the transition process started (Matković and Biondić, 2003; Rutkowski, 2003). Only in 2003 the labour act was revised to include provisions that drastically transformed labour markets - the state lost its monopoly on job mediation, the labour market was liberalized and unemployment benefits were reduced, and the first elements of employment and wage contract flexibility were introduced, which reduced the costs of layoffs and the right to severance pay and unemployment benefits (Hoffman et al., 2012).

The labour act was to be further liberalised in 2009, but with limited scope (Vukorepa, 2010; World Bank, 2011). For instance, the World Bank (World Bank, 2011) in a document prepared for the Croatian government in 2011 concludes that by European standards employment protection in Croatia is strict and advises that the reform should go in the direction of so-called flexicurity (moving from protecting jobs to protecting workers). Franičević (2011) further argues that due to inherited problems and specific regulations, the Croatian labour market is dual

[15] For example, the new code included advanced notice, severance pay, and preference for full-time employment (Hoffman et al., 2012).

in reality: with protected workers from the state sector on the one side and workers employed in the private sector without collective agreements, those on temporary contracts, the young and the old on the other side. However, other institutional arrangements besides the employment protection legislation, like unemployment benefits or early retirement possibilities, also influenced the existing state of the Croatian labour market.

Table 1.1. Major developments in the Croatian labour law legislation after transformation

Year	Legislation	Main characteristics
1995	Labour Act[16] (came into force on 1 January 1996)	High level of employee's protection; lower flexibility for employers, especially concerning employment contract conclusion and dismissals.
2003	Amendment to the Labour Act[17]	Improved flexibility by regulating atypical forms of work such as work at a separate workplace and temporary agency work as well as reduction of workers' rights to severance payments and notice periods.
2009	New Labour Act[18] (entered into force on 1 January 2010)	More flexibility through limitations in the application of legal provisions for certain categories of workers (two categories of management); improved social security of employees in atypical forms of employment (via limiting discrimination); stricter rules concerning temporary employment contracts.
2012	Act on the Criteria for Participation in Tripartite Bodies and Representativeness for Collective Bargaining[19]	It repealed some provisions of the Labour Act on the parties to a collective agreement and on the trade union collective bargaining committee, and it changed the provision on the after-effect of a collective agreement limiting it to a maximum of three months.

Source: Gotovac (2003), Oračić (1997), Matković and Biondić (2003), Vukorepa (2010), and author.

Even after more than twenty years of transition, the Croatian labour market is still not performing very well. With inadequate qualification structure of its labour force (Bejaković, 2004) and with very low activity and employment rates, the situation does not look very promising at the moment. Even though substantial improvement in the aggregate net job creation rate was visible in the pre-crisis period, it had resulted from a decreasing job destruction rate and not from a higher job creation rate (Šošić, 2008). In addition to all that, demographic ageing is deteriorating the participation and employment rates in the labour market even more

[16] Official Gazette 38/95, 54/95 - corrigendum, 65/95 - corrigendum, 17/01, 82/01, 114/03, 142/03, 30/04, 137/04 - revised text, 68/05. Before this act, labour relations were regulated by the Employment Act from 1992 and the Basic Employment Rights Act from 1991 (Matković and Biondić, 2003).

[17] Prior to these amendments, the Labour Act was amended twice in 2001 – relatively comprehensive changes in connection with the less contentious points were implemented in February 2001, whereas regulations related to maternity rights were amended in September 2001. However, these were only minor changes in comparison to the overall Labour Act and thus were not mentioned separately in Table 1.1.
Additionally, in 2004 there was another amendment to the Labour Act that extended rights to maternity leave for twins, the third or any subsequent child until the child(ren) is (are) three years of age.

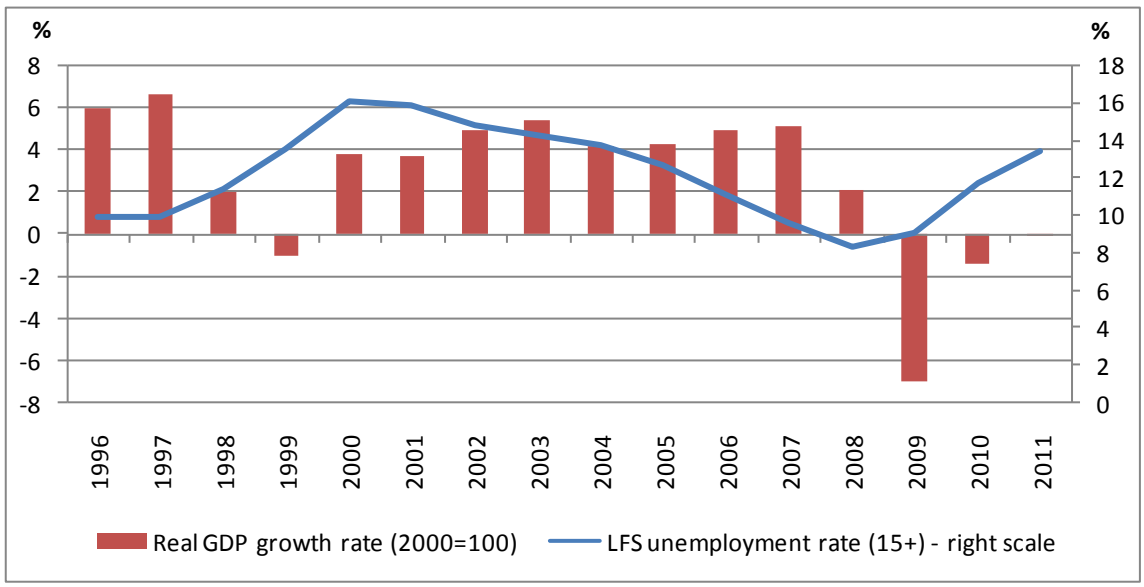
[18] Official Gazette 149/09, 61/11. Although it was enacted as the new Labour Act, in substance it represents amendments to the Labour Act of 1995 since the structure of the Act and basic regime of individual and collective law regulation remained the same. Additional amendments concerning provisions on working time in some industries and regarding specific circumstances, right to proportion of annual leave and several additional points regarding violations and sanctions were made in 2011.

[19] Official Gazette 82/12, 88/12 – corrigendum.

(Vehovec, 2008). The financial and economic crisis that started in the second half of 2008 only highlighted already existing problems on the Croatian labour market (Figure 1.1).[20]

Furthermore, Botrić (2009) explored the differences between the unemployed and employed on the Croatian labour market based on their individual characteristics as well as the differences between long- and short-term unemployed for the year 2006. She concluded that because of the strong significance of the occupation variables in both unemployed-employed, as well as short- and long-term unemployed estimates, the large proportion of the unemployed on the Croatian labour market is probably due to structural factors, and not the result of frictional or cyclical patterns. CNB (2010) estimated the Beveridge curve for Croatia for the period between January 1998 and March 2010. The shape and position of the Beveridge curve in Croatia indicates that the sub-period 1998-2001 is marked by a deterioration of the employment process, while the opposite applies to the sub-period from 2002 to mid-2005. This is followed by a sub-period in which an increase in the economic activity results in the movement along a fixed curve towards its upper left end, lasting almost until the end of 2007. The Beveridge curve then starts turning counter clockwise, moving, characteristically for recession periods, towards its lower right end (CNB, 2010).

Figure 1.1. Real GDP growth vs. unemployment rate (1996-2011)



Source: CBS and Eurostat.

Franičević (2011) emphasizes how in the period 2000-2008 the economy in general presented an attractive picture with high growth (Figure 1.1), increased investment, consumption and FDI, price and exchange rate stability, moderate fiscal consolidation, and increasing international reserves which also brought increasing employment and falling unemployment. But, this period was also characterized by increasing trade and current account deficits, widespread corruption, a

[20] For more details about the impact of the crisis on the labour market in Croatia please refer to Bejaković and Gotovac (2011), Franičević (2011), Gotovac (2011), Matković, Arandarenko, and Šošić (2011) or World Bank and UNDP (2010).

weak judiciary and low capacity for reform with low activity/employment rates, high inactivity and dependency, high long-term unemployment rates, regional disparities, and flexibilisation 'at the margin' which accentuated and prolonged the impact of the crisis (Franičević, 2011). Gotovac (2011), on the other hand, states how unemployment and low activity rates are mainly the consequence of insufficient demand for labour and the mismatch in labour supply and demand, with the latter being a 'major impediment to a more dynamic labour market performance'.

1.4 Purpose and goals

In the last two decades, the literature, as well as the general public, has produced several 'stylised facts' about the labour market in Croatia. Namely, some characteristics of the Croatian labour market are taken as given, rarely ever does anyone question them. This is primarily related to rigid legislation, regional disparities, (skills) mismatch between supply and demand in the labour market, and inadequate structure of the workforce in terms of age and education. All these features have one thing in common – they are perceived as the cause of high unemployment in Croatia. However, rigorous empirical examination of these issues is almost inexistent.[21]

Hence, the main purpose of this doctoral dissertation is to tackle the unemployment problem in Croatia by uncovering some of the popular stylised facts with the use of the most up-to-date methodology. In order to do this, the Croatian labour market has to be put in a wider context of European labour markets, with emphasis on transition economies. A combination of the methodology that emerges from the equilibrium search and matching theory and empirical evidence from Croatia should enable us to unravel the most important factors behind high unemployment in Croatia. Therefore, this dissertation concentrates on the matching aspect of the labour market in analysing the persistent Croatian unemployment.

The goal is to extend the existing search and matching models so that they better correspond to the specific situation in the Croatian labour market, but also to take into account their applicability in other transition countries as well as in the rest of Europe. In this way, important institutional drawbacks could be exposed and certain policy recommendations could be made. This is especially important in the current situation of the ongoing crisis in both Croatia and in many other European countries. Namely, at the start of writing this dissertation the recession was on the horizon. In the meantime, it spread through most of the world, and held on for a longer time than expected. This is especially visible in Croatia where it seems that the recession will hold on for a fifth consecutive year. That is why in some parts of this dissertation the analysis was expanded so as to incorporate the effect of the crisis on the labour market.

It is expected that this doctoral dissertation will provide answers to some of the basic questions concerning the emergence, existence, and persistence of high unemployment in Croatia.

[21] There are some exceptions, of course, including Botrić (2004, 2007, 2009), Matković (2011) or Obadić (2004, 2006a, b).

Primarily, this refers to the impact of rigid legislation on the employment possibilities of unemployed versus employed job-seekers, on the effect that public employment services have on the efficiency of the matching between the unemployed and vacancies on a regional level, and on the mismatch between vacancies and the unemployed of different occupations. Besides that, this dissertation should offer additional insights into the effect that unemployment benefits have on (un)employment, the impact of active labour market policies in combating unemployment as well as the role of educational structure in employment prospects. Evidently, many of the already broadly accepted stylised facts will get their confirmation or disconfirmation.

1.5 Research questions and main hypotheses

Fahr and Sunde (2002) explain how reasons for high and persistent levels of unemployment in Europe are usually looked at from two different perspectives: the labour supply side and the labour demand side. According to them, the first one focuses on the unemployed and blames insufficient incentives (for the unemployed to search for a job actively) and the inefficient labour market (in terms of matching unemployed job-seekers with vacant jobs) for being responsible for persistent unemployment in European labour markets. Policy suggestions in this regard include reforms of the unemployment insurance design and improvements in the efficiency of the matching process and of job placements by employment offices. The second viewpoint on the reason for high unemployment in European labour markets concentrates on the labour demand and tries to alleviate the unemployment problem by policies that promote job creation. However, none of the two perspectives provides a comprehensive and clear answer to the problem of high and persistent unemployment in Europe (Fahr and Sunde, 2002).

Clearly, inefficiency in the labour market may emerge because of different factors. For instance, Munich and Svejnar (2009) mention inadequate labour market institutions leading to decreasing search effort, skills depreciation, rising reservation wage of the unemployed, and geographical or skill mismatch. Increased inefficiency of the matching process implies fewer matches (hires) at the same level of vacancies. Mismatch, on the other hand, is quite a natural consequence of the severe structural changes that happened in CEE countries. However, both the (in)efficiency of the matching process and mismatch may be important determinants of the level of unemployment, with a given number of vacancies (Dur, 1999). Additionally, slow job creation definitely causes fewer matches in the labour market. Thus, it seems that in order to grasp the problem of unemployment in Europe both the demand as well as supply factors should be analysed simultaneously.

Rogerson et al. (2005) further explain how research topics in existing studies that use the search and matching theory usually focus on answering some basic questions, such as why workers sometimes choose to remain unemployed, what determines the aggregate unemployment and vacancies, how there can simultaneously be unemployed workers and unfilled vacancies, what determines the length of employment and unemployment spells, and how homogeneous workers can earn different wages.

This dissertation uses the search and matching theory to provide some answers to the problems in the Croatian labour market, primarily high and persistent unemployment (Figure 1.1). In order to do this, different aspects of the labour market are examined, questioning the role of the institutions in the Croatian labour market (both legislation and the public employment service), as well as (aggregate) demand fluctuations, (inherited) structural problems and the (unfinished) restructuring, using the postulates of the equilibrium search and matching theory. These problems are examined in three different parts (essays) of this dissertation, where each of them posts specific research questions, but all three are connected through their main aim - to discover the main cause of high unemployment rates in the Croatian labour market. These issues are only partially explored in the existing literature (CNB, 2010; Matković, 2011; Obadić, 2003) and thus all three essays present a novelty, in their own way.

The aim of the first essay (Chapter 2) is to discover the main causes of high inactivity and unemployment rates in Croatia during the period of transition as well as post-transition, focusing on different employment opportunities for different types of job-seekers: employed and unemployed/inactive. This essay also assesses the search intensity for unemployed job-seekers receiving unemployment benefits. The main research question in the essay is thus: How does the status in the labour market, together with institutional as well as individual characteristics, influence the matching process in Croatia? Hence, the major hypotheses are formulated as:

H.2.1: The probability of changing labour market status for an employed individual is higher in comparison with an unemployed individual.

H.2.2: The probability of switching from unemployment to employment is higher for individuals not receiving unemployment benefits.

The second essay (Chapter 3) primarily deals with relatively high differences in unemployment on a regional (NUTS3) level in Croatia. The main objective of this essay is to investigate the role played by (regional) employment offices in matchings between vacancies and unemployment in Croatia while controlling for different regional characteristics of the specific labour markets. The central research question is thus: Would better (more adequate) capacity of regional employment offices help in decreasing regional disparities in the Croatian labour market? The main hypotheses of this essay are:

H.3.1: The efficiency of the matching process differentiates with respect to regional division.

H.3.2: After controlling for economic conditions, the quality of services provided by regional public employment offices is important in increasing efficiency of the matching process.

The third essay (Chapter 4) starts from the premise that the reason for high and persistent unemployment in Croatia is the mismatch of skills/occupations in the labour market, i.e., the skills and knowledge of the labour force supply (unemployed population) do not match the skills and knowledge that employers seek (demand). This means that the main assumption is that the highest portion of the unemployment in Croatia is structural unemployment. As a result, the main research question is: To what extent can the existing level of unemployment be attributed

to structural (occupational) mismatch or by how much would unemployment fall if (occupational) mismatch is eliminated? Hence, the central research hypotheses are:

H.4.1: There is a mismatch in terms of occupations between unemployment and vacancies in the Croatian labour market.

H.4.2: Occupational mismatch is responsible for a high portion of unemployment in Croatia.

H.4.3: The size of the mismatch is different in different submarkets (occupational groups).

1.6 Structure of the doctoral dissertation

This dissertation is written in the form of three publishable papers (essays) involving labour market flows in a post-transition economy and some of the main issues that influence these processes using the evidence from Croatia. As already mentioned, shedding light on these important topics enables us to disentangle important drawbacks of the current institutional structure on the labour market in Croatia and propose necessary measures to policy makers. Hence, the structure of the dissertation follows the structure of the three essays, where each of them constitutes a separate chapter while their sub-sections deal with the specificities of each essay.

Besides the three essays, there is an introductory chapter that introduces the overall topic, i.e., the link between the three essays in the form of reviewing the relevant literature as well as providing some background for the history and current state of the Croatian labour market. This part also includes a more detailed description of the methodology used in all three essays – the equilibrium search and matching theory. At the end of the dissertation there is a concluding chapter that summarizes the main findings, discusses the relevance of the hypotheses and describes the main contributions to the existing literature dealing with similar topics.

As already mentioned in the previous section, the first essay (Chapter 2) of this dissertation deals with the employment prospects of different groups of job-seekers within the search model of adverse selection with firing costs. The original model is augmented by reservation wage as the main determinant of firing costs in the model in this dissertation. Thus, the chapter is divided into seven sections, including the introductory and concluding part. The second section, after the introduction, sets the theoretical background by reviewing the relevant literature while the third section provides analytical framework for the theoretical model that incorporates endogenous dismissal costs into the original model of adverse selection with firing costs. The next section describes the institutional and economic environment of the Croatian labour market for the period of the empirical analysis (1996-2009). After that, descriptions of the used data as well as of the empirical model are given. Data used in this essay are from the Croatian Labour Force Survey (LFS) while the empirical model uses probit as well as ivprobit estimation. The results, together with discussion, are presented in the sixth section which, in addition to examining the probability of switching to employment among different groups of job-seekers, presents the effect that unemployment benefits have on the probability of switching. Concluding remarks are given in the final, seventh, section.

The third chapter is primarily focused on the impact of the public labour market institutions (public employment service) on the efficiency of the matching processes on a regional level. In order to explore this, the stochastic frontier approach is used. The structure of this chapter in divided into five different sections. After a brief introduction, the second section presents a background for the topic in the form of a relevant literature review as well as a description of the main 'intermediary' in the Croatian labour market – the Croatian Employment Service (CES). The data obtained from the CES regional offices are also described in this section. The third section of this chapter presents the empirical strategy that explains in detail the stochastic frontier estimation as well as its shortcomings and possible transformations. Estimation results together with the discussion are presented in the fourth section while the fifth section gives some concluding remarks.

The fourth chapter, on the other hand, focuses on the disproportion between labour supply and labour demand by estimating occupational mismatch. After an introductory section, this chapter presents a literature review that defines structural unemployment with emphasis on the (skills) mismatch in transition countries. Further, it provides some background facts and figures together with the data description. The main data source in this chapter is the same as in the previous one – the Croatian Employment Service. After that, the empirical strategy is presented, while estimation results with discussion are given before the final conclusion.

At the very end of the dissertation, after the list of references, there are appendices that contain more specific data for each of the three main chapters (essays). This part consists of some details about the derivation of the models in the main text, additional statistics showing a more comprehensive picture of the issue studied in a specific essay or even additional results that should serve as a robustness check.

2 MATCHING, ADVERSE SELECTION AND LABOUR MARKET FLOWS IN A (POST)TRANSITION SETTING: THE CASE OF CROATIA[22]

2.1 Introduction

High unemployment is a disease that has afflicted almost all European countries for more than two decades now. Both the academic community as well as the economic 'practitioners' developed numerous theories about the causes of this problem. Over the years, they have also suggested several possible solutions, but evidently none of them worked very well. One of the most prominent theories about the sources of high level of unemployment (and inactivity) in Europe is the rigidity of the labour market; that is, strict employment protection legislation (see, for instance, Feldman, 2005; Siebert, 1997). Rutkowski (2003) states how high unemployment is strongly related to the slow pace of job creation, which in turn can be attributed to a poor business environment, especially the strict employment protection legislation. In addition, strict regulations in labour market discourage entry of new firms to the market (Scarpetta, 1996). Analogously, it is believed that a cure for high unemployment is the removal of the rigidities. According to Saint-Paul (2002), employment protection is more likely to arise in economies with slow growth and greater economic rents evidenced in higher wages suggesting that the appropriate time for increasing labour market flexibility is periods of high growth.

All these problems are even more emphasised in the case of the European post-transition countries (Gabrisch and Buscher, 2006; Winiecki, 2008). It is a well documented fact how transition from a centrally planned to market economy leads to large scale reallocation of labour. After the transformation process has started all labour markets in CEE countries experienced constant flows between different statuses (unemployment, employment, inactivity). In general, these flows are dominated by the separation rate in the early stages of transition, while in the later stages hiring rate should outpace the separation rate. However, many of these flows are involuntary, since they are driven by job destruction and job creation (Haltiwanger et al., 2003).

The situation in Croatia did not completely match the theoretical predictions. First of all, at the beginning of transition many of the dismissed workers went out of the labour force by accepting a chance for early retirement (Škare, 2001). Many others became unemployed, and were left in that status for a prolonged period because their skills were obsolete for the new, privatized and service-oriented economy. Even though it was expected that after this first phase the employment will increase and the unemployment decrease, the situation remained quite unfavourable for many years. In addition, the legislation imposed in the labour market did not help to speed up the process of adjustment. Those who were employed were highly protected, which reduced the scope for activating the rest of the population. In fact, high dismissal costs have shown to be the main obstacle to a more flexible labour market in Croatia. For instance, Rutkowski (2003) points out that strict employment protection legislation and high dismissal

[22] Joint with Polona Domadenik. Presented at the 23rd annual EALE (European Association of Labour Economists) conference. Somewhat shortened version published in *Post-Communist Economies*, Vol. 24, No. 1.

costs are the reason for the small number of vacancies and employment, long periods of unemployment and low rates of 'escape' from unemployment, and the concentration of unemployment among groups of disadvantaged workers. Furthermore, high dismissal costs discouraged hiring as employers limited recruitment in order to avoid future costs of employment adjustment to potential shocks. Thus, limited employment is a reflection of limited dismissal (Rutkowski, 2003).

The aim of this paper is therefore to discover the main causes of high inactivity and unemployment rates in Croatia during a period of transition as well as post-transition, focusing on different employment opportunities for different types of job-seekers: employed, unemployed and inactive. The paper also tests the role of labour market institutions in the 'willingness to search for a job' for unemployed job-seekers receiving unemployment benefits. Moreover, it tries to identify a group of active population who may be hurt by implicit discrimination due to underdeveloped labour market institutions. In order to do this, we employ model of adverse selection with firing costs. The model is adjusted to correspond better to the (post)transition setting. First of all, the dismissal costs became an endogenous variable in the model. In this case, dismissal costs are an increasing function of the wage. In addition, reservation wage concept is introduced in order to better capture the process of decision making and subsequent matching of firms and job-seekers in the (Croatian) labour market.

The paper is structured as follows. First we briefly set the theoretical background by reviewing the relevant literature, which permits us to put this paper into a broader framework of studies that cover uncertainty, asymmetric information, and adverse selection in the labour market. We then provide analytical framework for the theoretical model that incorporates endogenous dismissal costs into the original model of adverse selection with firing costs developed by Kugler and Saint-Paul (2004). The reservation wages' influence on dismissal costs and a chance to find an employment is also added into the model. The next section describes the institutional and economic environment of the Croatian labour market for 1996-2009, the period of the empirical analysis. After that, a description of the variables used and a sketch of the empirical model are provided. The empirical methodology uses probit estimation and additionally controls for endogeneity in independent variables by using a nonlinear (probit) IV estimator. The results, together with discussion, are then presented. In addition to examining the probability of switching to employment among different groups of job-seekers, the effect that unemployment benefits have on the probability of switching is also examined in this section. Concluding remarks, which summarise the most important results, are given in the final section.

2.2 Theoretical background

This study is primarily related to works dealing with uncertainty, asymmetric information and adverse selection in the labour market (Akerlof, 1970; Gibbons and Katz, 1991; Spence, 1973) that have made a distinction between different job-seekers. Additionally, studies of Blanchard and Diamond (1994) that introduced ranking among different job applicants and of Domadenik (2007) and Kugler and Saint-Paul (2004) that deal with adverse selection among job-seekers and introduce firing (dismissal) costs, are also acknowledged. The economics of information in the

classical *search theory* developed in the works of McCall (1970) and Stigler (1961, 1962) is used in order to show how agents in the market acquire information about market conditions and how are they brought together based on their individual optimal strategy.

Akerlof (1970) and Spence (1973) stress out the importance of *signalling* in the market that potential seller (job-seeker) sends towards the potential buyer (firm) and *screening* that the buyers need to do before buying the product. Asymmetry in available information appears because the sellers have more knowledge about the quality of their product than the buyers and the purchaser's problem is to identify this quality (Akerlof, 1970). Hence, potential employees confront an offered wage schedule based on their *signals* (Spence, 1973). Gibbons and Katz (1991) extend the analysis giving empirical support for an asymmetric information model of lay-offs. They show how lay-off event, based on the worker's productivity, signals unfavourable information to the market. In that case, the offered wages in the market differ for lay-off and retained workers. However, post-displacement wages and unemployment duration differ according to the cause of displacement: displacement by lay-off or displacement by plant closure. Furthermore, Canzianni and Petrongolo (2001) indicate how firing costs increase the stigma suffered by dismissed workers, reducing their re-employment prospects.

Waldman, on the other hand, (1984), uses the individual's job assignment as an imprecise signal of the individual's ability as an employed job-seeker. In addition, Greenwald (1986) argues that adverse selection in the labour market may seriously impair a worker's freedom to change jobs. He explains this by the fact that the current employer has better information about the ability of its workers and thus firms do their best to prevent turnover among their better workers. In this way, employed persons willing to change their job are of a lower ability than the ones not wanting to change their employer. This has many repercussions in the labour market; for instance, higher turnover costs on workers who seek new job, lower wages offered for the employed job-seekers, and even lower wages that the firms pay their current workforce (Greenwald, 1986).

As already mentioned, Blanchard and Diamond (1994) developed the so-called *ranking model* in order to differentiate among prospective employees. They assume that firms have preferences over job applicants based on the time they were searching for employment, that is, if they compete for the same job short-term unemployed always get the job ahead of long-term unemployed. Here, the duration of unemployment *signals* the productivity of the job applicant. They indicate several reasons for the assumption that ranking by duration is important, including the fact that the training costs of a new worker increase with unemployment duration as well as the decrease in the searching activities of the long-term unemployed (Blanchard and Diamond, 1994).

Another way to make a distinction between job-seekers is to divide them into groups of those that are employed and those that are unemployed or inactive.[23] This is done in the work by

[23] Since it is very hard to make a distinction between unemployed and inactive job-seekers (Fahr and Sunde, 2001; Petronoglo and Pissarides, 2001) they are often grouped together. In addition, it is possible that, owing to the length of time between survey points, the employed job-seekers were actually unemployed for some time before moving to

Kugler and Saint-Paul (2004) where they assume that firms are more willing to employ out of a group of already employed job-seekers and show that increases in hiring and firing costs intensify the discrimination against the unemployed. They also demonstrate that large enough reductions of hiring and firing costs would remove discrimination against unemployed workers completely. This model was adjusted in the work of Domadenik (2007) where she showed that high dismissal costs, created mostly by adverse selection and rigid legislation, introduce distortions in the labour market that are not similar for all groups of job-seekers.

Classical *search theory* considers job-seekers who must screen the signals from the prospective employers in a world of imperfect information. Here, the focus is on information about wage rates, as this is the main determinant of worker's acceptance of a given job offer. In the end, the amount of search depends on the wage rate that the individual thinks his services can command in the labour market and on the opportunity cost of the searching activity (McCall, 1970, p. 114). Stigler (1962) emphasises that one way to reduce hiring costs is to pay higher relative wages which would not only reduce the quit rate of the existing workers but would also attract high-quality workers to accept the job offer. He also states that the marginal cost of search may rise as search increases and, also, that increased search will yield diminishing returns as measured by the expected reduction in the minimum asking price. However, it pays more to continue searching if the prospective period of employment is longer (Stigler, 1961).

2.3 Analytical framework

The model in this paper actually upgrades the one of Kugler and Saint-Paul (2004) in that, on the one hand, we have simplified some aspects to preserve analytical tractability but, on the other hand, we have introduced some novelties in order to better correspond to the situation in a (post)transition setting.

Following Kugler and Saint-Paul (2004), the total labour force is normalised to one and split between two types of workers: 'good' and 'bad'. The proportion of workers who are 'good' is denoted by *z*. However, firms do not observe the productivity of a potential employee before hiring. But, immediately after the production takes place, the firm is aware of its worker's productive potential. It is also assumed that firms enter the market freely by creating vacant positions. Once a position is created, a firm faces a cost equal to *C* of holding a vacancy. Because of free entry in the market, in equilibrium *C* always equals to zero. A job-seeker meets a vacant job with probability *a* per unit of time while a firm decides whether to hire a worker or not conditionally on his or her labour market status. In this model, labour market status serves as a proxy for worker's productivity. At the moment a position is filled, production takes place. The firm's output per unit of time is $m+\eta$, where *m* is a firm-specific and η a worker-specific component. The assumption is that firms make higher profits with 'more productive' workers than with 'less productive' ones; that is, the productivity of a 'good' worker (η_H) is greater than the productivity of a 'bad' worker (η_L). This could be even more accentuated if we assume that the newly created jobs are more productive than the existing ones, as was assumed in Mortensen

new work.

and Pissaridies (1994). When the match is initially formed, the match-specific component is equal to $\overline{m}$ but, with probability γ per unit of time, the firm is hit by a shock that changes the productivity of the match. Every time such a shock occurs, the new productivity is drawn from a distribution $G(m)$ over the interval $[\underline{m}, \overline{m}]$.

Wages are assumed to be equal to a constant fraction, φ, of output with worker-specific productivity, η, and a firm-specific productivity, m, plus a fraction of the reservation (base) wage, w^r:

$$w(m,\eta) = \varphi(m+\eta) + (1-\varphi)w^r, \tag{2.1}$$

where $0 \le \varphi \le 1$. This expression again implies that firms make higher profits with good workers than with bad ones.

Production takes place until either the firm decides to abolish the position or the worker quits voluntarily. When hit by a shock, firms may decide to fire the worker, in which case they have to pay a tax F. In that case, the position is abolished and the firm's value drops to zero. In our model the dismissal costs are set as a function of wage, which in turn depends on the reservation wage and a constant fraction of firms' output (equation 2.1). In Croatia (and other post-transition countries), this assumption is a plausible one as dismissal costs are usually in the form of severance pay to the dismissed workers and are determined in the process of collective bargaining.[24] Hence, in this case the tax (firing costs) is represented as:

$$F(w) = F\left[\varphi(m+\eta) + (1-\varphi)w^r\right], \tag{2.2}$$

where it is assumed that $\frac{dF(w)}{dw} \ge 0$. When a worker quits voluntary, firm does not have to pay the tax F. The day the worker leaves to take another job, the position becomes vacant and its value falls back to C. Highly related to firing costs are the costs of hiring: when firms decide to hire a worker they must take into account training expenses and potential future shocks that would require dismissing some of their employees. Since firing costs are high, firms need to be very cautious when hiring new workers what increases both the time and the costs of the hiring process. Thus the wage function in this case not only affects firing costs but also hiring costs, which are like two sides of the same coin.

In a matching process firms hire workers and then output is produced. If $J(m, \eta)$ is the value of a job to the firm, with worker-specific productivity η and firm-specific productivity m, and given

[24] In the original model it was assumed that this tax F represented firing costs where substantial fraction of these costs goes to third parties such as lawyers, insurers, and the government. Therefore, it was set to be exogenous in the model. Since in the (post)transition setting dismissal costs are usually not paid to third parties but to the dismissed workers, they now become endogenous. Additionally, the conditions and the minimum (maximum) amounts for severance pay are regulated by law in Croatia. Some earlier studies have shown how legal obligations on payment of severance pay can reduce employment (see, for instance, Laezar, 1990 or Scarpetta, 1996). Additionally, firing costs are also influenced by the duration of employment at the present employer in Croatia. Namely, the notice period as well as the severance payments depend on the years that the worker has spent at his/her current firm. It is assumed that all this is captured by the firm-specific component (m) in the wage function, which in the model directly affects the dismissal costs.

that the residual value of firing the worker is zero, the firm fires the worker if $J(m,\eta) < -F(w)$. The quit rate is endogenous and is given by the probability of engaging in on-the-job search times the instantaneous probability of receiving an offer, *a*. Workers also face a flow search cost, *c*, from searching on the job, but the benefit of searching is that they move to a match with the highest possible level of firm-specific productivity. It is also assumed that some fraction υ of employed workers is constantly looking for another job. Search while on the job for an employed worker with firm-specific productivity, *m*, takes place if $E(m,\eta,S) \geq E(m,\eta,NS)$, that is, if worker's value of being employed while searching is greater of his value of a job when not searching. Since the cost of search is constant and the benefit from searching is that the person moves from the current match to the highest possible match-specific productivity, the gains from searching while on the job increase as the current match level decreases. This means that on-the-job search is given up at the unique value, $\tilde{m}$, below which there is always on-the-job search, and which satisfies the condition: $E(\tilde{m},\eta,S) = E(\tilde{m},\eta,NS)$. Since the case of interest is given by the condition where some workers engage in search, we limit ourselves to the case where the *search threshold* exceeds the so-called *dismissal threshold*, that is, $\tilde{m} > m_c(\eta)$, for one or both type of workers. In order to get the expression for *dismissal threshold* we set $J(m_c(\eta),\eta) = -F(w)$[25] and get:

$$m_c(\eta) = \frac{-F(w)(r+\gamma+a) - (1-\varphi)\eta + (1-\varphi)w^r - \gamma\hat{J}(\eta)}{1-\varphi}. \tag{2.3}$$

It is evident that the dismissal threshold for low productivity workers is higher than for high productivity workers ($m_c(\eta_L) > m_c(\eta_H)$)[26] assuming that both types of workers search, that is, $\tilde{m} \geq m_c(\eta_L) > m_c(\eta_H)$. Moreover, the *dismissal threshold* of good workers is more responsive to changes in *F*, that is, *w*, and w^r than the dismissal threshold of bad workers. Consequently, $\left|\frac{dm_c(\eta_L)}{dw}\right| < \left|\frac{dm_c(\eta_H)}{dw}\right|$ and $\left|\frac{dm_c(\eta_L)}{dw^r}\right| < \left|\frac{dm_c(\eta_H)}{dw^r}\right|$ (see the Appendix A.1 for the proof).

The quality (productivity) of the applicant is unobservable, but his status is observable and provides a *signal* to the firm. If we set z_E and z_U to be the proportion of good workers among the employed and unemployed job-seekers, then we can express the expected present discounted values (Π) associated with hiring an employed and an unemployed job applicant:

$$\Pi_E = z_E J(m,\eta_H) + (1-z_E) J(m,\eta_L) \tag{2.4}$$

$$\Pi_U = z_U J(m,\eta_H) + (1-z_U) J(m,\eta_L), \tag{2.5}$$

---

[25] This holds for $m_c(\eta) \leq \tilde{m}$, that is, the case where some workers search before reaching the *dismissal threshold*. If there is no on-the-job search then $m_c(\eta) = \frac{-F(w)(r+\gamma) - (1-\varphi)\eta + (1-\varphi)w^r - \gamma\hat{J}(\eta)}{1-\varphi}$, indicating that search lowers the *dismissal threshold*. $\hat{J}(\eta)$ is expressed as $\hat{J}(\eta) = \int_{m_c}^{\bar{m}} J(m,\eta)g(m)dm - G(m_c(\eta))F(w)$ and represents the average value of the match to the firm over the current value of the shock.

[26] In addition, $J(m, \eta_H) > J(m, \eta_L)$.

where $\Pi_E > \Pi_U$.[27] Therefore, the firm hires a worker if $\Pi_i > 0$, where *i = E, U*.

From the above equation, we can see that $\frac{\partial \Pi_U}{\partial z_U} = J(\overline{m}, \eta_H) - J(\overline{m}, \eta_L) > 0$ which means that there exists a unique value of $\bar{z}_U$ such that $\Pi_U = 0$ is satisfied. If $\Pi_U = 0$ all employed applicants are hired and unemployed ones are hired with probability p_U. Hence, lower hiring rate of the unemployed relative to employed workers reflects statistical discrimination since firms use employment status to predict productivity ($p_U < 1$). However, what we are ultimately interested in is the effect of changes of the firing costs *F*, being endogenously determined as a fraction of the wage bill, on the hiring of the unemployed. It is shown that an increase in firing costs decreases the job loss rate more for good workers than for bad workers and, thus, worsens the quality of the unemployed, that is, $\frac{dz_U}{dF(w)} \Rightarrow \frac{dz_U}{dw} < 0$ (see Appendix A.2 for the proof). Moreover, higher firing costs increase the value of $\bar{z}_U$ such that $\Pi_U = 0$ is satisfied further lowering the probability for the unemployed to be hired and increasing statistical discrimination against unemployed job-seekers.

The reservation (alternative) wage in the model is defined according to Addison, Centeno, and Portugal (2009) for unemployed job-seekers and van den Berg and Ridder (1998) for employed job-seekers. In the first case the reservation wage is dependent[28] upon unemployment benefits, wage offer and the discount rate, while in the second case it is assumed that an employed job-seeker accepts a wage offer if and only if it exceeds his current wage (van den Berg and Ridder, 1998, p. 1187). Thus the reservation wage of an employed job-seeker is equal to his current wage. Essentially, this variable is different for these two types of job-seekers. Usually, employers set the wage and frictions in the labour market are regarded as the time required for workers to gather information about wage offers in the market (Mortensen and Pissarides, 1999a). Evidently, employed job-seekers would generally have a higher wage rate than those without a job. But government aid, like social and unemployment benefits, could increase reservation wage for those out of the employment (Boeri and Terrell, 2002; Boeri and van Ours, 2008).

2.4 Development of labour market institutions in Croatia

Before turning to data description and the empirical model, we should say something about the institutional and economic environment in the Croatian labour market in the period 1996-2009, for which the presented study is done.

[27] Since $z_E > z_U$ and $J(\overline{m}, \eta_H) > J(\overline{m}, \eta_L)$.

[28] The reservation wage is expressed as: $w^r = b + \frac{\delta}{\rho}\int_{w_r}^{\infty}(w - w^r)\partial F(w)$, where b is the (constant) amount of unemployment benefits net of any search costs, δ is the parameter from the Poisson process according to which independent realizations of wage offers from a known wage offer distribution are received, ρ is the discount rate, w is the wage offer, and $F(w)$ is the cumulative wage distribution (Addison et al., 2009, p. 2).

In the early transition, privatization and restructuring of the old state-owned firms was indispensable. However, the labour market adaptation to numerous supply and demand shocks was reflected in lowering employment, not wages.[29] For instance, Vehovec and Domadenik (2003) show that in 1995-2000 privatized firms reduced their employment by more than 22% while the average wage increased by more than 18% (with the increase of productivity by 30%). Šošić (2008), on the other hand, shows how after 2000 corporate restructuring in Croatia slowed down, with smaller job destruction, mostly in large, state owned enterprises, and growth in total employment.

Thus, many people in the nineties were left without the work. Some of them accepted incentives for early retirement, some left the labour force, and most of the others remained unemployed. This new spell of unemployment was mostly considered as structural problem (Obadić, 2003), and the situation asked for new incentives and policy measures. A new institutional structure needed to be developed as well. Therefore, legislation on the labour market was introduced and changed every couple of years in order to adapt to market conditions. However, the system of protecting workers' rights inherited from socialism remained in the newly developed market economy, especially in the public sector.

The first Labour Act in Croatia was adopted in 1995, and came into force on 1 January 1996. The intention of the Labour Act was to encompass and arrange all the issues concerning the labour market following Western European (German) practice. Thus, high level of employees' social rights was embedded in the Act which meant lower flexibility for employers, especially concerning hiring and firing procedures. The Labour Act imposed a series of barriers, difficulties and responsibilities for employers during layoffs. This Law, aimed at providing strong protection of those employed and union members in the period of transition from planned to market-oriented economy, could have been a factor that slowed the restructuring of the Croatian economy (Oračić, 1997). After two changes concerning less contentious items in 2001, the Labour Act was finally amended in 2003 with the aim of more flexible labour legislation.[30] The changes introduced with this Act can be divided into the following categories: modernization and democratization of labour relations; simplification of regulation of labour relations (greater flexibility) in order to facilitate employment and the consequent increase of employability in the labour market; and the need for further harmonization of labour relations regulation in Croatia with those in the European Union (Gotovac, 2003). Flexibility was improved by introducing atypical forms of work such as work in a separate place of work and temporary employment agencies as well as reduction of workers' rights to severance payments and notice periods what caused the most disagreement among the general public. However, it has been argued that more flexibility in the labour market was only quantitative in nature,

[29] This can be explained with powerful unions in Croatia (see, for instance, Vehovec and Domadenik, 2003). As known from microeconomic literature, unions may have different objectives that lead to different strategies. Unions in the most developed countries of former Yugoslavia were very powerful in the period of economic transition and it resulted in slow institutional labour market development and higher wages (Rutkowski, 2003). Anecdotal evidence shows that preserving wages at current levels was much more important for unions than employment level being already protected by rigid employment legislation.

[30] The articles concerning firing procedures (notice period and severance payment) entered into force on 1 January 2004.

especially in the case of severance payments[31] but the overall effect might have been negligible. Although the overall employment protection legislation index (EPL) decreased in 2004, it still remained above the EU and OECD average (Matković and Biondić, 2003). The relaxation of the EPL was accompanied by certain government concessions in the form of an increased level and duration of unemployment benefits (Šošić, 2004). New Labour Act was adopted in 2009, and entered into force on 1 January 2010. It aimed towards further adjustment with the EU laws, but because of its complexity and difficulty in the application it is expected that it will affect the increase in total labour costs which will further undermine the international competitiveness of Croatian economy. Therefore, it is believed that this new Labour Act, although some of its provisions are amended to boost employability and social security of workers, will paradoxically contribute to endangering of the overall level of their social security (Vukorepa, 2010).

In spite of the orientation towards market rules and accompanying legislation, the situation in the Croatian labour market remained quite unfavourable for many years after the transition started. For instance, job destruction continued to exceed job creation until 2001, although there was strong output growth for a number of years, and even though an improvement in the aggregate net job creation rate has recently been observed, it resulted from a decreasing job destruction rate and not from a higher job creation rate. Even though it was expected that the new private sector will contribute to new job creation, it actually reported a significant proportion of job destruction as well (Šošić, 2008), which indicates deeper structural problems. Though one may say that the slow pace of restructuring in state-owned enterprises is a consequence of the poor management, it appears that in the private sector it is generally prevented by institutions and regulations (Rutkowski, 2003). While the adjustment of employment in state-owned and privatized enterprises on average takes a long time, the new private sector bears a disproportionate burden of adjustment which lends support to the *dualism hypothesis* in Croatian labour market (Šošić, 2004). Adjustment has been further limited also by inherited process of collective bargaining preserving the existing wage structure (Vujčić and Šošić, 2008).

However, Croatia is still, twenty years after the transition process started and after all sorts of institutional and legislative adjustments, a country characterized by underdeveloped labour market institutions with strict employment protection legislation. Additionally, very high inactivity rates among the working-age population (38.5% in 2010) and high share of those who are unemployed for more than 12 months (46% of total unemployed persons in 2010) aggravated the situation in the labour market even before the current economic crises. The financial and economic crises that in Croatia started at the end of 2008, brought to light all the problems in the labour market that were hidden under the surface all those years before. Massive lay-offs in the private sector with public sector employees protected by unions and collective agreements once more showed all the inflexibility embedded in the Croatian labour market system. The recent situation is the rate of unemployment of 14.7%[32] while the rate of activity for

[31] Now defined in a gross amount, as opposed to earlier definition in net amount.

[32] Based on Labour Force Survey for the period January-March 2011. However, the registered (at the Croatian Employment Office) rate of unemployment for June 2011 was much higher, amounting to 16.9%. This might suggest that a number of people actually work in the informal sector of the economy.

those over 15 years of age is only 45.9%. A low activity rate usually reflects poor employment opportunities associating with the effect of discouraged workers (Rutkowski, 2003).

All these problems call for a further assessment of what actually happened in Croatia in the period of analysis, taking into account different factors in the labour market. Thus economic and institutional as well as individual characteristics are taken into account when assessing the reasons for high unemployment and inactivity in Croatia.

2.5 Empirical model and description of the data

2.5.1 Data description

The data used in this study are from the Croatian Labour Force Survey (LFS) conducted on consecutive years in 1996-2009. Following the structure of the survey, together with the changes in legislation concerning dismissal costs, the data are pooled into four different groups based on four different time periods: 1996-1998, 1999-2003, 2004-2006, and 2007-2009. The first group of data are pooled since the first Labour Act in Croatia came into force on 1 January 1996, while a second reason concerns the specific structure of the survey, which was different in many aspects if compared to the surveys after 1998. This period is characterized by quite a rigid labour market but with solid rate of economic growth. The second group is composed of the data from surveys conducted in 1999-2003, before the new amended Labour Act that implemented reduced dismissal costs came into force at the beginning of 2004. In addition, political (government) changes that happened in this period also affected the overall economic activity. Thus, looking only at the legislative changes, we have two sub-periods:

- *pre-reform*, before 2004 with more rigid labour market legislation, and
- *post-reform*, after 2004 with more flexible labour market legislation.

Following group consists of the data from 2004 to 2006, the period of more flexible labour market and higher economic growth. In these years surveys were mostly conducted on half-yearly basis with independent sample. From 2007 onwards, the structure of labour force survey changed significantly, being conducted on a quarterly basis with rotating sample.[33] The period of 2007-2009 is also characterised by the economic slowdown and the beginning of the financial crisis that caused huge disruptions in the Croatian labour market.

Research on the labour market participation follows the assumption that their labour market status is mutually exclusive. According to their answers to similar questions in the surveys, respondents have been grouped into one of three homogeneous statuses:

- *employment*, including those holding permanent or temporary paid jobs, or the self-employed;
- *unemployment*, including those who are jobless and registered at the employment agency;

[33] In the period of 2007-2009 only one (second) quarter per year is used in the analysis.

- *inactivity*, including those still undergoing some kind of schooling, those holding domestic unpaid jobs, and retirees; while those undergoing military service, imprisoned or disabled are left out of the sample.

Table 2.1 presents summary statistics of the main variables used in the analysis for each of the above-mentioned periods, indicating separately pre- and post- labour market legislation reform period as well. The data in the table are presented for two groups: the entire Labour Force Survey sample and the sub-sample of the so-called *switchers*, who are defined as the individuals within a group of the employed who switched from inactivity or unemployment to employment or from one employer to another in the period of one year. However, besides the *successful switchers* (those that became employed or changed their employer within a year) who are presented in the table, we also have the *unsuccessful switchers* who searched for a job or wanted to change their existing job but failed to do so in a given year. All the variables, that is, all the characteristics of the individuals from the survey are grouped into four different categories: individual characteristics, distribution by occupation, distribution by industry, and general economic conditions.

It needs to be emphasised that all variables except age, local rate of unemployment, wages, and years of schooling are in a binary (dummy) form (1 or 0). Several variables deserve additional clarification. Industry variables are defined according to NACE[34] classification, that is, *services* are codes G to N, *manufacturing* is D to F, while all other NACE codes are in the category *other industry*. Similar is done with occupations, where the division was done according to ISCO[35] classification: *white collar* for codes 1 and 2, *blue collar* for codes 5, 6, 7, 8, and 9, while other ISCO codes are in *other occupations*. Local rate of unemployment is calculated for each year separately on a county (NUTS 3) level. Unfortunately, for the first group of data (1996-1998) there is no information about the identification of counties and, therefore, no local unemployment rate could have been calculated.

The reservation wage is represented by the net monthly wage in the current job for employed job-seeker and the net wage for which the unemployed/inactive would be 'willing' to accept a job offer, for which the Labour Force Survey provides information. Obviously, for the first group of the respondents (employed job-seekers) it is an objective measure of their actual monthly earnings while for the second group (unemployed job-seekers) it is a subjective measure of their desires and expectations. Hence, in the empirical analysis the reservation wage will be differentiated for the two types of job-seekers. In addition, for the year 1999 the data about wages in the survey were missing, so they were imputed by using the predicted coefficients from the regression of wages to a unique set of variables for all other years in the sample. Similar is done with the data from 2007 to 2009 where there was no information about reservation wages for unemployed individuals.

If we look at the presented data in Table 2.1 we can see that those persons that became employed or changed their employer within a year were on average younger, male, single, more

[34] Classification of Economic Activities in the European Community.
[35] The International Standard Classification of Occupations.

educated, worked in a service sector, and had lower reservation wage relative to the entire sample. Looking at the changes over periods, we can observe that people included in the survey are getting older, both in the entire sample and in the sub-sample of switchers. Naturally, both the reservation wage and the average industry wage have increased over time also. In addition, years of schooling increased a little bit, while local unemployment rate decreased on average in the three sub-periods for which it was calculated. No significant changes are visible in the data before and after labour legislation reform. However, this is only descriptive statistics; stronger evidence is presented in the next section using probit estimation.

We are aware of certain limitations on using the Croatian LFS for studying switching behaviour of individuals. Probably the major limitation of the data is that the Croatian Labour Force Survey has not been structured in a 'panel mode' (until couple of recent years) which disabled tracking individuals over the years. Therefore, different groups (based on their labour market status) among 'switchers' were created and analysis was done following these groups. Another limitation is the change of the survey configuration over the years, which made it impossible to have the same construction of the used variables in all the years.[36] However, it is important to mention that we have utilized all LFS series available in order to analyse labour market dynamics as deeply as possible. From an institutional point of view, the beginning of our analysis falls in the period of late privatization of former socialist firms, while the latter period corresponds with the period of intense restructuring.

[36] Some of the questions were left out from the survey in some years, and additional questions were added that helped to define our variables in different time-periods. For example, the definition of 'switchers', i.e., those job-seekers who successfully found a job or changed their employer relied on different, yet similar, set of questions depending on the time period. In 1996-1998 a combination of questions was used in order to get labour market status of a person one year ago (there was a question that asked about the number of years spent at current employer); later there was a precise question about the labour market status one year preceding the survey; while in the last period there was no question indicating number of years at current employer (thus, the year of the first employment in combination with the year that the survey took place was used).

Table 2.1. Summary statistics

period/variable	pre-reform				post-reform			
	1996-1998		1999-2003		2004-2006		2007-2009	
	entire sample	switchers	entire sample	switchers	entire sample	switchers	entire sample	switchers
Individual characteristics								
age	39.48	30.67	40.82	31.81	42.79	32.07	43.92	32.23
	(21.86)	(9.61)	(22.22)	(10.37)	(22.50)	(10.73)	(22.61)	(10.69)
gender – female[#]	0.52	0.45	0.52	0.45	0.52	0.45	0.52	0.45
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
marital status - single[#]	0.23	0.46	0.24	0.47	0.25	0.51	0.25	0.55
	(0.42)	(0.50)	(0.43)	(0.50)	(0.43)	(0.50)	(0.44)	(0.50)
years of schooling	9.39	11.67	9.67	11.66	9.83	11.68	10.13	11.79
	(3.98)	(2.48)	(3.88)	(2.47)	(3.78)	(2.36)	(3.65)	(2.21)
training in the last 3 months[#]	0.01	0.03	0.01	0.01	0.01	0.02	0.01	0.01
	(0.11)	(0.18)	(0.08)	(0.11)	(0.08)	(0.12)	(0.07)	(0.12)
head of household[#]	0.55	0.44	0.58	0.47	0.60	0.43	0.60	0.39
	(0.50)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)	(0.49)	(0.49)
urban settlement[#]	0.52	0.59	0.48	0.50	0.44	0.46	0.43	0.43
	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)
unemployment dummy[#]	0.08	0.23	0.10	0.36	0.09	0.36	0.07	0.31
	(0.26)	(0.42)	(0.29)	(0.48)	(0.28)	(0.48)	(0.26)	(0.46)
Distribution by occupation								
white collar[#]	0.11	0.12	0.12	0.12	0.12	0.11	0.13	0.10
	(0.32)	(0.33)	(0.33)	(0.32)	(0.33)	(0.31)	(0.34)	(0.30)
blue collar[#]	0.65	0.67	0.63	0.67	0.64	0.69	0.62	0.67
	(0.48)	(0.47)	(0.48)	(0.47)	(0.48)	(0.46)	(0.48)	(0.47)
other occupation[#]	0.24	0.21	0.25	0.21	0.24	0.20	0.25	0.23
	(0.43)	(0.41)	(0.43)	(0.41)	(0.42)	(0.40)	(0.43)	(0.42)
Distribution by industry								
services[#]	0.44	0.57	0.46	0.56	0.46	0.55	0.47	0.57
	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
manufacturing[#]	0.34	0.34	0.35	0.32	0.35	0.32	0.35	0.32
	(0.47)	(0.47)	(0.48)	(0.47)	(0.48)	(0.47)	(0.48)	(0.47)
other industry[#]	0.21	0.09	0.18	0.11	0.19	0.12	0.18	0.11
	(0.41)	(0.28)	(0.39)	(0.31)	(0.39)	(0.32)	(0.38)	(0.31)

(table continues)

(continued)

General economic conditions								
local rate of unemployment	n.a. (n.a.)	n.a. (n.a.)	0.15 (0.06)	0.15 (0.06)	0.13 (0.06)	0.14 (0.06)	0.09 (0.05)	0.10 (0.05)
reservation wage	1995.88 (1201.48)	1928.33 (1008.53)	2783.86 (1596.91)	2560.84 (1526.66)	3295.41 (1907.06)	3014.09 (1770.96)	3589.76 (1595.24)	3463.80 (1398.48)
average industry wage	2313.25 (501.51)	2285.42 (484.59)	3256.17 (805.20)	3218.48 (737.85)	4054.39 (891.65)	4030.01 (824.84)	4704.97 (1099.66)	4646.99 (990.57)
regionally adjusted industry wage	n.a. (n.a.)	n.a. (n.a.)	2770.97 (791.14)	2849.14 (640.55)	3344.58 (898.79)	3436.16 (690.16)	3756.34 (866.28)	3842.24 (671.57)

Notes. Standard deviation is in parentheses.
Data are represented as mean values or as share (for dummy variables - #) in the associated sample.

Source: Authors' calculation based on Croatian Labour Force Survey for the period 1996-2009.

2.5.2 The empirical model

In the model it is assumed that firms don't have perfect information about job applicants when trying to fill a vacant position. Yet hiring depends on the information available to potential employers who are guided by the profit maximization goal (Mortensen and Pissaridies, 1994). We have already stated how one of the main assumptions in the model implies that firms make higher profits with good workers than with bad ones. Owing to the high dismissal costs employers will become very cautious when employing a new worker, which means that hiring costs are dependent upon firing costs. In the asymmetric information model, firms can use discretion in terms of whom to fire and, thus, low-quality workers are more likely to be dismissed than high-quality workers. As a consequence, the portion of low-quality workers is higher among the unemployed than among the employed, and the employers who intend to hire are aware of this fact.

Therefore, we first make the distinction between two types of job-seekers: one who is already employed and the other who is searching for a job while being either unemployed or out of the active population. Nonetheless, all these potential employees have one thing that ultimately determines whether they will accept a job offer or reject it and continue searching. It is assumed that the individual will continue searching until the expected marginal return equals the marginal cost of search (Stigler, 1962). In this fashion, all job-seekers set their optimal reservation wage (Blackaby, Murphy, Sloane, Latreille, and O'Leary, 2006).

Success in finding a job depends on the *contact rate*, the *job offer rate* and the *acceptance rate*. The main difference between 'good' and 'bad' workers is in the job offer rate, which depends on the expected productivity of potential employee. The dependent variable *y* takes the value of 1 if the person was successful in finding a job within a given time interval and the value of zero otherwise. If *J(m, η)* is the value of a job to the firm, we might assume that firms extend a job offer if the expected profits *(J)* out of hiring an applicant are greater than or equal to the hiring cost, and they do not make a job offer if the expected profits fall below the hiring cost, or:

$$y = \begin{matrix} 1 & if & EJs \geq C \\ 0, & otherwise & \end{matrix} \tag{2.6}$$

Assuming *EJs–C* to be a continuous random variable measuring expected individual productivity over hiring costs, it can be expressed as a linear function of a vector of explanatory variables and a random term, ε:

$$EJ - C = y_{it}^* = \beta_0' X_{it} + \beta_1' OCC_{it} + \beta_2' IND_{it} + \beta_6' Y_t + \beta_3 U_{it-1} + \beta_4 u_{it}^l + \beta_5 w_{it}^r + \varepsilon_{it} \tag{2.7}$$

From this, we can derive the following:

$$y = \begin{matrix} 1 & if & y_{it}^* = \beta_0' X_{it} + \beta_1' OCC_{it} + \beta_2' IND_{it} + \beta_6' Y_t + \beta_3 U_{it-1} + \beta_4 u_{it}^l + \beta_5 w_{it}^r + \varepsilon_{it} \geq 0 \\ 0 & if & y_{it}^* < 0 \end{matrix} \tag{2.8}$$

Thus, if ε is assumed to be normally distributed the expression for the probability of finding a job is:

$$\begin{aligned}\Pr(y=1) &= \Pr(\beta_0' X_{it} + \beta_1' OCC_{it} + \beta_2' IND_{it} + \beta_6' Y_t + \beta_3 U_{it-1} + \beta_4 u_{it}^l + \beta_5 w_{it}^r + \varepsilon_{it} \geq 0) = \\ &= \Phi(\beta_0' X_{it} + \beta_1' OCC_{it} + \beta_2' IND_{it} + \beta_6' Y_t + \beta_3 U_{it-1} + \beta_4 u_{it}^l + \beta_5 w_{it}^r),\end{aligned} \tag{2.9}$$

where Φ is cumulative normal distribution, index *i* stands for an individual, while index *t* determines the period (year). X_{it} is a vector of individual characteristics of job-seekers like: age, gender, marital status, whether the person has had any training in the last three months, is a head of household, and place of residence in terms urban vs. rural settlement. Variables OCC_{it} and IND_{it} represent vectors of job-seeker's occupation and industry, respectively. Here, the *white collar* category in occupations and *services* in industries are treated as the base, captured in the regression constant. U_{it-1} is unemployment dummy being 1 for those that were unemployed a year before, u_{it}^l is local unemployment rate, w_{it}^r represents reservation wage; and Y_t is the annual dummy variable that controls for general economic conditions.

Evidently, variables contained in vector *X* influence all three parts of the *job finding rate*: the *contact rate*, the *job offer rate*, and the *acceptance rate*.[37] However, the *acceptance rate* is also influenced by the reservation wage (w^r) while the *job offer rate* is mainly characterized by the employment status in the previous period (U) which serves as a signal of the applicant's productivity. *Contact rate*, on the other hand, should be additionally affected by the local unemployment rate (u^l) and economic activity (proxied by year dummies). Hence, our model estimates the probability of finding a job for different types of job-seekers, that is, the probability of switching from inactivity or unemployment to employment, or from one employer to another in the period of one year.

However, it is expected that in the original specification of the model (equation 2.9) the reservation wage is endogenous, that is, this variable is determined within the model. It is usually explained that there is a correlation between this (endogenous) variable and the error term, that is, $\mathrm{cov}(w^r, \varepsilon) \neq 0$. Therefore, instead of the original probit estimation, we actually have:

$$\Pr(y=1 \mid X=x, Z=z) = \Phi(\beta_x' x + \beta_z' z), \tag{2.10}$$

where $X = (1, X_*')'$, X_* is a vector of covariates presumably measured without error, and $Z(w^r)$ is a predictor vector subject to measurement errors (Buzas and Stefanski, 1996). If the endogeneity of w^r is ignored, the coefficient is inconsistently estimated.

In order to solve this problem, instrumental variable probit estimation[38] is used. This technique deals with the problem of endogeneity using instrumental variables (instruments) that have to be

[37] Brown, Merkl, and Snower (2009) similarly show how matching and separation probabilities can be understood in terms of *job offer*, *job acceptance*, *firing*, and *quit* probabilities, which may be derived from the optimizing decisions of firms and workers. Thus, they showed that this evades the need for the classical matching function.
[38] By default, ivprobit uses maximum likelihood estimation.

uncorrelated with the error term and correlated with the endogenous independent variable, that is, $\text{cov}(z,\varepsilon)=0$ and $\text{cov}(z,w^r)\neq 0$. Usually it is very hard to find variable that is correlated with endogenous variable (*reservation wage* in our case*)* but not with the error term in the model. For example, Addison et al. (2009) use unemployment benefits, unemployment duration, and job offers as determinants of reservation wage. Yet they used only the reservation wages for unemployed, while this study defines reservation wage for both employed and unemployed. Therefore, information on unemployment benefits and unemployment duration could not be used in this instance since they apply only for those that are currently unemployed, while the information on job offers does not exist in the Croatian Labour Force Survey.

Taking into account institutional characteristics and variables in equation 2.9, years of schooling and regionally adjusted industry wage,[39] were chosen as the appropriate instruments for reservation wage in our model. We assume that they greatly affect reservation wage, but not switching to employment.[40] Average wage, in the individual's industry (according to NACE classification) in all the regions except the one where he/she lives (works) evidently has impact on his/her reservation wage, but there is no visible impact on the probability of switching to employment. This is especially plausible in the Croatian case where geographical mobility of workers is almost non-existent (Botrić, 2007). For the first group of data (1996-1998) there is no information about the identification of counties and, therefore, a different instrument needed to be used. In this case the wage for each sector (industry) in a particular year served as an instrument for the endogenous regressor, that is, reservation wage. Our choice of instruments was mostly based on characteristics of the wage setting process in Croatia. We have already mentioned that labour market adjustment did not occur as much through changes in relative prices, i.e., relative wages of different categories of workers, as through an adjustment in quantities (Vujčić and Šošić, 2008). Central bargaining at the industry level sets the initial wage structure imposing minimum levels for different levels of education. Employers, especially in the state sector, stick to this pre-determined wages. Therefore, we argue that educational attainment explains variation in reservation wage[41] but it is not correlated with error term in the main equation. Part of variation in dependent variable (switching to employment) that might be contributed to educational attainment is already picked up by variables indicating blue/white collar occupation (see correlation matrices in the Appendix A.3).

2.6 Results

Based on equation 2.9, which represents the central part of our empirical model, we first ran probit estimation in order to predict the probability that a person would switch to employment (either from unemployment and inactivity or to switch employers) within a period of one year using all the variables that could have impact on the *job finding rate* (presented in Table 2.1). After this first step, in order to correct for endogenous independent variable (reservation wage),

[39] Average wage in the industry of employment but different regions. For those not employed at the time of the survey the industry of previous employment was used in order to calculate average industry wage.

[40] Correlation matrices in the Appendix A.3 show that these variables are correlated with reservation wage but not with the variable that determines 'switchers'.

[41] Years of schooling usually serves as an important explanatory variable for wage differentials as showed, for instance, in Mincer (1974) or Tachibanaki (1998).

we ran instrumental variable probit (IV probit) estimation with the same set of variables used in the first step, but with the change that reservation wage has been 'instrumented' by years of schooling and regionally adjusted industry wage (industry wage for the period 1996-1998). Finally, we test the effect that unemployment benefits have on the probability of switching (via reservation wages).

2.6.1 Probability of switching

Since the coefficients from the probit model are difficult to interpret, marginal effects of different variables on the probability of switching to employment for all four groups of data (1996-1998; 1999-2003; 2004-2006; and 2007-2009) are presented in Table 2.2 Table 2.3 presents the same analysis but with the IV probit estimation. Additionally, in order to better grasp the differences in probabilities of employment between different types of job-seekers, the result for both probit and IV probit models are presented separately for employed and unemployed/inactive job-seekers.[42] The control group in both models is represented by male, married, white-collar workers working in the service sector.

In general, results in Table 2.2 show that younger male job-seekers have the highest probability of switching from unemployment (or inactivity) to employment or from one employer to another. Yet if they work in manufacturing industry or live in a region with a higher unemployment rate they are less likely to change their job or to become employed. The latter means that since the *contact rate* is smaller in the regions with higher unemployment rate, all other things being constant, the overall *job finding rate* should be smaller for job-seekers who live in counties with a higher unemployment rate. Looking at the results over periods, one can observe that there is a general increase in the probability to 'switch' for the control group, with this effect being higher for the unemployed type of job-seekers.

Indeed, more interesting results emerge when we look at the two types of job-seekers separately. For instance, the age variable has much higher negative impact on the probability of finding employment for unemployed job-seekers indicating that unemployed job-seekers are most probably subject to statistical age discrimination. When looking at the estimates between two periods based on the changes in legislation one can observe even stronger effects of the age and gender variables for the unemployed group after 2004, which confirms previously said about the partial reform and only quantitative increase of flexibility in the labour market.

Additionally, reservation wage has a positive impact on the probability of changing a job for employed job-seekers, while it negatively affects the probability of switching for unemployed job-seekers. The first case probably indicates that these flows are more supply than demand driven. If people with higher reservation wages are more likely to switch and if they switch on

[42] Descriptive statistics for the two types of job-seekers (employed and unemployed/inactive) are given in Table A.1 in Appendix A. Unemployed and inactive are grouped together because even though a year before the survey took place some of them were inactive in the labour market, when they started to look for a job they were probably unemployed for some time (not visible in the survey data) before they become employed. In addition, the share of those inactive is pretty low to be singled out in a separate group (except for the period 1996-1998 (see Table A.1)). Therefore, for the rest of this chapter, this group will be called only 'unemployed', while keeping in mind that it is composed of both unemployed and inactive job-seekers.

their intention, there are no dismissal costs. Nevertheless, the second case is much more compelling. Here, the higher the reservation wage the lower the probability of finding an employment. The lower probability of employing this type of people signals the effect of firing costs. As explained earlier, firing costs in the model depend on the reservation wage. Employers evidently perceive labour market status as a *signal* of job-seekers' productivity, that is, they believe that there are more bad workers among the unemployed group and since firing (and hiring) costs are high they cannot 'afford' to hire from this group. Hence, the *job offer rate* is smaller for the unemployed job-seekers, which indicates that there is *adverse selection* in the Croatian labour market when it comes to employment of different types of job-seekers (employed vs. unemployed). However, this coefficient declines in every observed period, especially after labour reform - and even becomes insignificant in the last survey - indicating smaller effects of firing costs on the employment of unemployed job-seekers.

Other important differences between these two types of job-seekers are in their occupation and industry of employment, mostly demand driven processes. For instance, job-seekers being employed in service sector had a higher probability of switching jobs within a period of one year, compared to employees in manufacturing or other industries. Similarly, unemployed job-seekers that fell into the group of white-collar occupations exhibited higher probability of switching to employment in almost all periods under study while there were no significant differences in the case of employed job-seekers. Additional variables in the tables (not explained earlier) are year dummies which should control for economic conditions (along with local unemployment rates) and affect the *contact rate*. In each of the four groups of data the first year is taken to be a base against which the effects of other years in the pool are estimated. As shown in Table 2.2, there are different effects of general economic conditions on the probability of finding employment for different types of job-seekers. For example, there was a recession in the year 1999 (which is the base year for the second pool), but the probability of finding employment deceased in subsequent years for the unemployed job-seekers while it increased for the employed ones.[43] This came out as a surprise since one would expect that after the economy starts to recover both the employed as well as unemployed would find a job much easier. Then again, the unemployed ones might have been discriminated.

Table 2.3 reports the estimated coefficients using IV probit methodology, which controls for endogeneity of the reservation wage. If we look at the outcomes in Table 2.3 and compare them to those in Table 2.2 we find some interesting distinctions.

[43] Results for this pool, but without imputed data for 1999, i.e., for the pool 2000-2003, are given in Table A.2 in Appendix A.

Table 2.2. Marginal effects of different variables on the probability of switch to employment for different types of job-seekers (after probit estimation)

period/variable	pre-reform				post-reform			
	1996-1998		1999-2003		2004-2006		2007-2009	
	emp	unp/inct	emp	unp/inct	emp	unp/inct	emp	unp/inct
Individual characteristics								
age	-0.004***	-0.025***	-0.006***	-0.018***	-0.005***	-0.025***	-0.006***	-0.025***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
gender – female[#]	-0.037***	-0.074***	-0.068***	-0.028**	-0.045***	-0.053***	-0.054*	-0.035
	(0.014)	(0.026)	(0.011)	(0.013)	(0.015)	(0.019)	(0.031)	(0.037)
marital status - single[#]	0.024	0.121***	0.007	0.109***	0.016	0.052*	-0.027	0.082
	(0.020)	(0.034)	(0.016)	(0.019)	(0.022)	(0.027)	(0.042)	(0.052)
training in the last 3 months[#]	0.124***	0.296***	-0.094**	-0.044	-0.104**	0.146*	-0.030	n.a.
	(0.049)	(0.090)	(0.041)	(0.044)	(0.046)	(0.087)	(0.113)	(n.a.)
head of household[#]	-0.028	0.047	0.003	-0.005	0.028	0.018	-0.093**	0.037
	(0.018)	(0.034)	(0.015)	(0.018)	(0.021)	(0.027)	(0.043)	(0.053)
urban settlement[#]	0.035**	-0.026	-0.010	-0.017	0.023	-0.026	-0.003	0.070**
	(0.014)	(0.024)	(0.011)	(0.012)	(0.026)	(0.017)	(0.030)	(0.034)
Distribution by occupation								
blue collar[#]	-0.001	-0.167***	0.033*	-0.118***	0.036	-0.179***	0.080	-0.250***
	(0.023)	(0.043)	(0.019)	(0.024)	(0.026)	(0.036)	(0.056)	(0.067)
other occupation[#]	-0.036	-0.128***	-0.011	-0.098***	-0.018	-0.106***	0.121**	-0.240***
	(0.023)	(0.046)	(0.020)	(0.023)	(0.028)	(0.034)	(0.055)	(0.068)
Distribution by industry								
manufacturing[#]	-0.070***	-0.037	-0.080***	-0.064***	-0.064***	-0.028	-0.103***	-0.066*
	(0.014)	(0.026)	(0.012)	(0.013)	(0.016)	(0.019)	(0.032)	(0.037)
other industry[#]	-0.110***	0.020	-0.134***	0.084***	-0.139***	0.018	-0.206***	-0.171***
	(0.018)	(0.042)	(0.014)	(0.022)	(0.018)	(0.028)	(0.041)	(0.046)
General economic conditions								

(table continues)

(continued)

local rate of unemployment	n.a.	n.a.	-0.409***	-0.939***	-0.406***	-0.394***	-0.610**	-1.153***
	(n.a.)	(n.a.)	(0.097)	(0.106)	(0.128)	(0.152)	(0.294)	(0.335)
year dummy# (1)[a]	-0.040**	0.078**	0.045**	-0.045**	0.024	-0.057***	-0.017	0.084**
	(0.018)	(0.036)	(0.018)	(0.019)	(0.017)	(0.021)	(0.033)	(0.038)
year dummy# (2)[b]	-0.051***	-0.007	0.112***	-0.088***	0.041**	-0.040*	-0.039	0.050
	(0.015)	(0.029)	(0.018)	(0.018)	(0.018)	(0.021)	(0.035)	(0.041)
year dummy# (3)[c]	n.a.	n.a.	0.095***	-0.028	n.a.	n.a.	n.a.	n.a.
	(n.a.)	(n.a.)	(0.017)	(0.018)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
year dummy# (4)[d]	n.a.	n.a.	0.079***	0.007	n.a.	n.a.	n.a.	n.a.
	(n.a.)	(n.a.)	(.017)	(.020)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
reservation wage - empl	0.088***	n.a.	0.151***	n.a.	0.166***	n.a.	0.225***	n.a.
	(0.015)	(n.a.)	(0.015)	(n.a.)	(0.020)	(n.a.)	(0.054)	(n.a.)
reservation wage – unp/inct	n.a.	-0.264***	n.a.	-0.140***	n.a.	-0.093***	n.a.	-0.153
	(n.a.)	(0.036)	(n.a.)	(0.020)	(n.a.)	(0.035)	(n.a.)	(0.100)
y = Pr(switch to employment) (predict)	0.251	0.450	0.309	0.345	0.332	0.363	0.540	0.497
Number of observations	4549	2304	8136	7411	4650	4108	1395	1260
Log likelihood	-2499.85	-1196.93	-4857.97	-3953.94	-2853.36	-2051.50	-897.48	-632.31
Pseudo R^2	0.041	0.248	0.043	0.191	0.042	0.255	0.068	0.277

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. Standard errors are in parentheses.
emp – employed job-seeker; *unp/inct* – unemployed/inactive job-seeker.
- dy/dx is for a discrete change of the dummy variable from 0 to 1.
a - 1997 for the first pool; 2000 for the second pool; 2005 for the third pool; and 2008 for the fourth pool;
b - 1998 for the first pool; 2001 for the second pool; 2006 for the third pool; and 2009 for the fourth pool;
c - 2002 for the second pool;
d - 2003 for the second pool.

Source: Authors' calculation based on Croatian Labour Force Survey for the period 1996-2009.

Table 2.3. Marginal effects of different variables on the probability of switch to employment for different types of job-seekers (after ivprobit estimation)

period/variable	pre-reform				post-reform			
	1996-1998		1999-2003		2004-2006		2007-2009	
	emp	unp/inct	emp	unp/inct	emp	unp/inct	emp	unp/inct
Individual characteristics								
age	-0.004***	-0.016***	-0.005***	-0.014***	-0.005***	-0.020***	-0.004**	-0.024***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
gender – female[#]	-0.066***	0.090***	-0.095***	0.068***	-0.088***	0.046**	-0.197***	0.021
	(0.020)	(0.028)	(0.014)	(0.015)	(0.020)	(0.022)	(0.036)	(0.044)
marital status - single[#]	0.024	0.089***	0.002	0.115***	0.004	0.073***	-0.039	0.080
	(0.020)	(0.030)	(0.016)	(0.018)	(0.022)	(0.025)	(0.040)	(0.051)
training in the last 3 months[#]	0.150***	0.236***	-0.081*	-0.072*	-0.091*	0.096	0.006	n.a.
	(0.050)	(0.077)	(0.043)	(0.040)	(0.048)	(0.081)	(0.105)	(n.a.)
head of household[#]	-0.026	-0.030	0.006	-0.008	0.043**	0.008	-0.048	0.046
	(0.018)	(0.030)	(0.015)	(0.017)	(0.021)	(0.025)	(0.042)	(0.053)
urban settlement[#]	0.045***	-0.027	-0.004	-0.046***	0.030**	-0.035**	0.006	0.051
	(0.015)	(0.021)	(0.011)	(0.012)	(0.015)	(0.016)	(0.028)	(0.035)
Distribution by occupation								
blue collar[#]	-0.069*	0.082*	-0.045	0.092***	-0.091*	0.060	-0.315***	-0.077
	(0.041)	(0.047)	(0.033)	(0.030)	(0.052)	(0.046)	(0.079)	(0.109)
other occupation[#]	-0.074***	0.005	-0.048**	0.011	-0.087**	0.009	-0.125*	-0.147*
	(0.028)	(0.044)	(0.023)	(0.027)	(0.034)	(0.040)	(0.072)	(0.085)
Distribution by industry								
manufacturing[#]	-0.072***	-0.024	-0.090***	-0.036***	-0.076***	0.000	-0.132***	-0.042
	(0.014)	(0.022)	(0.012)	(0.013)	(0.016)	(0.019)	(0.030)	(0.039)
other industry[#]	-0.124***	0.024	-0.155***	0.111***	-0.179***	0.098***	-0.283***	-0.100*
	(0.019)	(0.037)	(0.015)	(0.020)	(0.021)	(0.028)	(0.036)	(0.059)
General economic conditions								

(table continues)

(continued)

local rate of unemployment	n.a.	n.a.	-0.440***	-0.708***	-0.501***	0.116	-0.892***	-0.824**
	(n.a.)	(n.a.)	(0.097)	(0.107)	(0.130)	(0.160)	(0.275)	(0.367)
year dummy# (1)[a]	-0.051***	0.152***	0.036**	-0.025	0.022	-0.029	-0.062**	0.089**
	(0.018)	(0.029)	(0.018)	(0.018)	(0.017)	(0.020)	(0.031)	(0.037)
year dummy# (2)[b]	-0.064***	0.113***	0.099***	-0.050***	0.037**	0.004	-0.106***	0.059
	(0.016)	(0.026)	(0.019)	(0.018)	(0.017)	(0.021)	(0.034)	(0.040)
year dummy# (3)[c]	n.a.	n.a.	0.084***	0.007	n.a.	n.a.	n.a.	n.a.
	(n.a.)	(n.a.)	(0.018)	(0.018)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
year dummy# (4)[d]	n.a.	n.a.	0.068***	0.045**	n.a.	n.a.	n.a.	n.a.
	(n.a.)	(n.a.)	(0.018)	(0.019)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
reservation wage - emp	-0.066	n.a.	-0.009	n.a.	-0.087	n.a.	-0.649***	n.a.
	(0.076)	(n.a.)	(0.058)	(n.a.)	(0.088)	(n.a.)	(0.169)	(n.a.)
reservation wage – unp/inct	n.a.	0.685***	n.a.	0.625***	n.a.	0.837***	n.a.	0.484
	(n.a.)	(0.098)	(n.a.)	(0.077)	(n.a.)	(0.124)	(n.a.)	(0.230)
y = Probability of positive outcome (predict, p)	0.255	0.466	0.311	0.376	0.337	0.385	0.533	0.498
Number of observations	4545	2286	8132	7409	4650	4108	1395	1260
Log likelihood	-4720.81	-2052.04	-7786.26	-5622.99	-4520.14	-1716.53	-1004.60	-68.51
Wald test of exogeneity (Prob > chi2)	0.039	0.000	0.004	0.000	0.004	0.000	0.000	0.031

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. Standard errors are in parentheses.
emp – employed job-seeker; *unp/inct* – unemployed/inactive job-seeker.
- dy/dx is for a discrete change of the dummy variable from 0 to 1.
a - 1997 for the first pool; 2000 for the second pool; 2005 for the third pool; and 2008 for the fourth pool;
b - 1998 for the first pool; 2001 for the second pool; 2006 for the third pool; and 2009 for the fourth pool;
c - 2002 for the second pool;
d - 2003 for the second pool.

Source: Authors' calculation based on Croatian Labour Force Survey for the period 1996-2009.

When we control for endogeneity of the reservation wage, the age effect is less negative for unemployed job-seekers but has the same magnitude for employed job-seekers. The significant change appears in the case of gender differences: if we control for endogeneity of the reservation wage, unemployed women exhibit higher probability of employment indicating that average unemployed men had lower education then average unemployed women.[44] As expected, local unemployment rate (where significant) always negatively affects the probability of switching. In addition, general economic conditions (proxied by year dummies) in most of the cases have opposite effects on employed and unemployed switchers. Again, the overall probability of finding an employment in a given year is higher for the unemployed/inactive population (except in the last period), while pre- and post-reform estimations give similar results as with the probit estimation.

Still, the most interesting result is with the endogenous variable in the original model – the reservation wage. This variable is significant and positive only for the unemployed job-seekers while for the employed ones is negative and insignificant.[45] When modelling the reservation wage, which depends on educational attainment (in addition to regionally adjusted industry wage), unemployed job-seekers with higher education were obviously more likely to switch to employment than their less educated counterparts. Evidently, educational attainment signals higher productivity individuals in the pool of unemployed job-seekers.

2.6.2 Willingness to search for a job

Although previous results (Tables 2.2 and 2.3) indicated that statistical discrimination against the unemployed exists in the Croatian labour market, how can one be sure that the employers are the ones who are discriminating, not the unemployed themselves? Namely, willingness to search for a job (or accept an offered one) depends greatly on the amount of income an unemployed person has at his/her disposal. Clearly, government transfers like social and unemployment benefits could increase the disposable income of those out of the employment, and thus lower their willingness to search for a job. For instance, Mortensen and Pissarides (1999a) explain how unemployment insurance influences both the incentives to accept a job and, therefore, the duration of unemployment and wages. Even though it has already been noted that information on unemployment benefits relates only to those who are currently unemployed and thus could not be used in the model for the overall sample, this standard assumption in the literature should be further checked.

In order to examine this, we calculate elasticity estimates of the reservation wage with respect to unemployment benefits, following the methodology used in Blackaby et al. (2006). From our discussion above, we can see that the reservation wage for the unemployed population (as defined according to Addison et al., 2009) depends upon unemployment benefits, wage offer,

[44] These differences in the average years of schooling for unemployed women vs. unemployed men in 1996-1998; 1999-2003; 2004-2006; and 2007-2009 are 0.36; 0.08; 0.20; and 0.23, respectively.
[45] Results for 2007-2009 period are somehow misleading because we did not have information on reservation wage for unemployed/inactive for that period and data were imputed (as explained earlier in the text).

and the discount rate. Pretty much the same definition is used in the Blackaby et al. (2006).[46] Accordingly, they express the elasticity of the reservation wage with respect to state benefits as:

$$\frac{\partial Lnw^r}{\partial Lnb} = \frac{b}{w^r}\frac{1}{1+\theta/\rho} = \frac{b}{w^r}\frac{x-w^r}{x-b}, \tag{2.11}$$

where w^r is the reservation wage; b is the amount of unemployment benefits; θ is the probability of finding a job (the product of the job arrival probability and the probability of accepting a job offer which is also the *hazard rate*); ρ is the discount rate; and x represents expected wages in employment ($x = E(w \mid w > w^r)$).

In addition, assuming that the wage offer distribution is Pareto distributed, they also expressed the elasticity of the *hazard rate* with respect to the unemployment benefits:

$$\frac{\partial Ln\theta}{\partial Lnb} = \frac{f(w^r)}{1-F(w^r)^{1+\theta/\rho}} = -\frac{b}{\sigma w^r}\frac{x-w^r}{x-b}, \tag{2.12}$$

where $f(\cdot)$ is the density function of wage offers and σ is the standard deviation of the log of wage offers, which in turn equals to $(x-w^r)/x$.

Since in our original database (LFS) there was no information about the monetary amount of unemployment benefits we used the average monthly amount of the unemployment benefit[47] for the respective year for every person who indicated that he/she received unemployment benefits in monetary terms[48] at the time the survey was conducted. The expected wages in employment are also represented as the averages in each year of study. In order to proceed with the estimation, one additional requirement needs to be satisfied, the so-called *rationality condition*: $b \le w^r \le x$. Elasticity estimates based on expressions 2.11 and 2.12 are reported in Table 2.4.

Values of the elasticity of reservation wages to unemployment benefits fall within a narrow range for all the periods analysed – from 0.172 to 0.233. In addition, the changes expressed in monetary terms[49] range between 0.398 and 0.554, that is, the increase in benefits by 1 Croatian kuna increases the reservation wage by between 0.40 kunas and 0.55 kunas. These results are similar to those obtained in the work by Blackaby et al. (2006), although somewhat higher. However, this is not a surprise since this analysis is done for unemployed persons, while their research used data for the economically inactive population. In addition, after the reform of labour market legislation in 2004, the elasticities increased. However, this result is expected

---

[46] $w^r = \frac{\lambda}{\rho}\int_{w_r}^{\infty}(w-w^r)dF(w) + b - c$, where b are non-employment benefits, λ is the arrival rate of job offers, ρ is the discount rate, $F(w)$ is the wage offer distribution, and c is the cost of search (Blackaby et al., 2006, p. 3).

[47] Obtained from the Croatian Employment Service.

[48] There is also the possibility to get pension and/or health insurance while unemployed and registered at the Employment Office.

[49] In this case we use formulae from Lancaster and Chesher (1983) where $\frac{\partial w^r}{\partial b} = \frac{1}{1+\theta/\rho}$ and $\frac{\theta}{\rho} = \frac{w^r - b}{x - w^r}$ yields: $\frac{\partial w^r}{\partial b} = \frac{x-w^r}{x-b}$.

since that law increased both the level and the duration of unemployment benefits for the unemployed. On the other hand, increasing benefits reduces the *exit rate*, with elasticity estimates ranging from -0.465 to -0.671. Again, this result is expected since higher benefits for the unemployed should decrease their probability of finding a job. On the whole, putting these two results together should tell us that the higher the unemployment benefits the higher the reservation wage and the lower the *exit rate*. This is very similar to the estimations reported in Table 2.3.[50]

Table 2.4. Elasticity estimates based on the means of the data

period/variable	pre-reform		post-reform	
	1996-1998	1999-2003	2004-2006	2007-2009
reservation wage w.r.t. unemployment benefits	0.177	0.172	0.174	0.233
	(0.398)	(0.458)	(0.483)	(0.554)
hazard rate w.r.t. unemployment benefits	-0.671	-0.502	-0.465	-0.557
Number of observations	542	1992	1069	421

Notes. Figures in brackets show the change in reservation wages with respect to unemployment benefits in monetary terms. We get similar results if, instead of the average wage (x), we employ average wage in the respective industry (x') (NACE classification). In this case elasticites of the reservation wage with respect to unemployment benefits are somewhat smaller (ranging from 0.126 to 0.180), while elasticities of the hazard rate with respect to unemployment benefits are somewhat higher (ranging from -0.557 to -0.817). Yet, this does not change our main conclusions.

Source: Authors' calculation based on Croatian Labour Force Survey for the period 1996-2009.

However, since a relatively small number of unemployed persons in Croatia receives monetary benefits during the period of unemployment,[51] this variable probably has no significant negative impact on the employability of unemployed job-seekers. In addition, the *replacement rate*,[52] as well as the duration of eligibility for those who actually receive it, is also quite low. All these factors mean that unemployment benefits are probably not significant de-motivating factor for the population, so one can assume that the system of unemployment benefits has no greater impact on the level of unemployment in Croatia (Rutkowski, 2003). Therefore, some other conclusion should apply here. Evidently, according to our second model, if we model variation in reservation wage as explained by different educational attainment, the higher the reservation wage the higher the probability of becoming employed for the unemployed.

2.7 Conclusions

This paper combines several different aspects of the job search literature in order to study employment prospects of different groups of job-seekers in Croatia. It addresses the issue of

[50] These results should be taken with caution since we have used the average monetary benefit in one year for all the unemployed persons who stated they receive benefits, and the situation in reality is different since the amount of monetary benefits depends on many factors and almost every person receives a different amount. Still, the results are in accordance with the theory, that is, the assumption that unemployment benefits increase reservation wage and reduce the probability of finding a job.

[51] Coverage ratio was below 20% during most of the period observed, while, despite its increase, in 2009 only 28% of all the unemployed were covered by the unemployment benefits (World Bank and UNDP, 2010).

[52] The share of monetary fee in the average wage.

matching and adverse selection in transition and post-transition context by augmenting the standard *model of adverse selection* in a country characterized by underdeveloped labour market institutions with strict employment protection legislation. Although some aspects of the model are simplified to preserve analytical tractability, new variables, like (endogenous) dismissal costs and reservation wage, are introduced in order to capture the process of decision making and subsequent matching between employers and employees. Additionally, when addressing these issues, the study focuses on differences in institutional characteristics over time and controls for moral hazard problems.

Using the data from the Croatian Labour Force Survey in the period 1996-2009, the analysis covers a considerable time span, which captures both the period during the transition as well as the one after transition, even capturing the recent global economic crisis. Based on the institutional and economic environment in the Croatian labour market, in addition to the structure of the survey, the empirical analysis was conducted by grouping the data into four different periods: 1996-1998; 1999-2003; 2004-2006; and 2007-2009. The main goal was to identify the characteristics of job-seekers (employed and unemployed/inactive) who have the highest probability of switching, that is, changing employer or finding employment in a period of one year.

Employing probit estimation, our main results show that adverse selection exists in the Croatian labour market for unemployed (inactive) job-seekers. The reservation wage has a positive impact on the probability of changing job for employed job-seekers, while it negatively affects the probability of switching for unemployed job-seekers. One of the main assumptions of the model is that employers perceive labour market status as a *signal* of job-seekers' productivity, that is, they believe that there is a higher proportion of lower productivity workers among the unemployed group. Since firing (and hiring) costs are high they cannot 'afford' to hire from this group and, thus, lower probability of employing the unemployed signals the effect of firing costs, that is, adverse selection in the labour market due to high dismissal costs. Still, the overall probability of finding employment in a given year is higher for the unemployed/inactive population. The results show no significant differences between the periods, except that there is a general increase in the probability of switching for the control group (male, married, white-collar workers working in the service sector), with this effect being higher for the unemployed type of job-seekers.

However, if we treat the reservation wage variable as being endogenous and use instrumental variable (IV) probit estimation, the effect of reservation wage on the probability of switching becomes significant and positive only for the unemployed job-seekers and insignificant for the employed job-seekers. This result could be explained by the effect of one of the 'instruments'. Educational attainment, used as an instrument, appeared to be more important variable for the unemployed than for the employed 'switchers'. Education, therefore, serves as an important signal of higher-productivity individuals in the pool of unemployed job-seekers.

Finally, we test the possibility of self-discrimination for the unemployed job-seekers receiving unemployment benefits. In order to do that, we estimate the elasticities of the reservation wage

with respect to unemployment benefits. Depending on the period of analysis, an increase in benefits by 1 Croatian kuna increases the reservation wage by between 0.40 kunas and 0.55 kunas, with the higher increase after the reform of labour market legislation in 2004. On the other hand, increasing benefits reduces the *exit rate*, that is, probability of finding employment. These results are consistent with regression estimation without controlling for educational attainment.

Moreover, the effect of reservation wage on employment probabilities for employed and unemployed job-seekers is declining, indicating lower impact of reservation wage on firing costs. This indicates less stringent labour market regulation that leads to lower firing costs at the firm level. Even though changes in legislation were not considered to be sufficient they evidently have some impact on the decreasing effect of firing (and hiring) costs on employment.

3 THE EFFICIENCY OF THE MATCHING PROCESS: EXPLORING THE IMPACT OF REGIONAL EMPLOYMENT OFFICES IN CROATIA[53]

3.1 Introduction

Even though it is often considered that labour market institutions reduce the size of the market by introducing a wedge between labour supply and labour demand they are still needed because of different inefficiencies, inequities and policy failures in modern labour markets (Boeri and van Ours, 2008). In order to respond to these market failures, intermediaries between workers and firms arise, usually in the form of state or private employment agencies, labour unions, craft guilds and similar. However, the precise economic function of these intermediaries is questionable (Autor, 2008). Nevertheless, the study of the situation in the labour market would not be complete if the labour market institutions were left out of the analysis.

A traditional rationale for labour market institutions has been to facilitate the matching process in the labour market (Calmfors, 1994; Jeruzalski and Tyrowicz, 2009). This is especially true in the case of transition countries that experienced huge changes in their labour markets after the breakdown of the former socialist system and shift towards market economy. Croatia belongs to this group of countries as well. Even though the shift in the (un)employment was less than expected in the early years of transition, high unemployment rates, combined with low employment and activity rates, persisted to date. The problem was only highlighted with the prolonged economic and financial crisis that started in the second half of 2008. Fahr and Sunde (2002) explain how reasons for high and persistent unemployment may lie on the labour supply side, with inadequate incentives for the unemployed to search for a job actively and inefficient labour market in terms of matching between the unemployed and vacancies, or on the labour demand side, with insufficient demand for labour as the main culprit for high unemployment. Brown and Koettl (2012) as well as Kuddo (2009), on the other hand, stress the importance of the capacity of relevant institutions. Hence, the right form of institutions (intermediaries) in the Croatian labour market is needed now more than ever.

However, even in the case of Croatia, there are huge regional differences in the labour market. Some regions (counties) have pretty low unemployment, while others are struggling with high and increasing unemployment rates. That is why this paper examines the efficiency of the labour market on a regional level. The main objective of the paper is to estimate and explain the efficiency changes that may have taken place both over time and across regions. Additionally, the impact of regional employment offices on the matching efficiency is taken into account. Even though Croatian Employment Service (CES) is centralised in a way that financial structure and main policies are brought at the central level, the sole implementation of the policy is locally specific. Thus, the aim of the paper is to investigate the role played by employment offices in increasing successful matchings of vacancies and the unemployed in Croatia while controlling

[53] Earlier version presented at the 18th Dubrovnik Economic Conference - Young Economist's Seminar section. Slightly modified version published in *EIZ Working Papers*, EIZ-WP-1204.

for different regional (both structural and policy) characteristics of the labour markets. In this respect, the stochastic frontier approach will be used since it allows for a more detailed analysis of the determinants of regional matching (in)efficiencies.

This article should contribute to the literature in several ways. First of all, it adds to the existing literature that uses stochastic frontier estimation of the matching process in order to determine its efficiency. Secondly, by estimating matching efficiency on a regional level, the article also assesses the role of (regional) employment offices in matching the registered unemployed job-seekers and posted vacancies. Methodological approach used here upgrades the standard estimation of the matching function by combining regional data on vacancies and the unemployed with additional data measuring the quality of services provided by regional employment offices. This could provide valuable policy information concerning further investments in (active) labour market policies in Croatia, especially taking into account the on-going economic and financial crisis. Moreover, modified panel stochastic frontier model is applied for the first time to the labour market issues (matching process) by the estimation of the basic-form transformed panel stochastic frontier model. Namely, suggested modifications of the classic panel stochastic frontier model (Wang and Ho, 2010) were, up to this point, applied only to financial markets.

The chapter is organised into five sections. After a brief introduction, the second section presents a background for the topic in the form of a relevant literature review as well as a description of the main 'intermediary' in Croatian labour market – the Croatian Employment Service. In addition to that, data used in subsequent empirical analysis are also described in this section. The third section presents methodology used for the empirical assessment of the matching efficiency on a regional level, while results of the conducted analysis are presented in the fourth section. Section five gives some concluding remarks.

3.2 Background and data description

3.2.1 Literature review

The literature on the persistence of regional unemployment in transition economies and the difference of regional unemployment from that in market economies is thoroughly examined by Ferragina and Pastore (2006). They explain how the process in transition countries was driven by massive and prolonged structural change, while the differences persisted over time for three main reasons: (i) restructuring is not yet finished; (ii) foreign capital was concentrated in successful regions for many years; and (iii) various forms of labour supply rigidity impeded the full process of adjustment (Ferragina and Pastore, 2006).[54] This topic was further elaborated in a number of works.[55] The issue was mainly to establish efficiency of the local labour markets, predominantly by the use of the matching function.

[54] Additionally, Pastore (2012) examines the causes of regional imbalances in the labour market focusing on the role of structural change.

[55] See for instance, Bornhorst and Commander (2006) where they explain that only part of the reason for this regional disparity is that movement away from full employment necessarily revealed different underlying

Ibourk, Maillard, Perelman, and Sneessens (2004) explain how the efficiency of the matching process determines the number of matches that will be observed at given input values. Additionally, Ibourk et al. (2004) and Jeruzalski and Tyrowicz (2009) explain how the efficiency can be considered as a product of two factors: (i) the rate at which job-seekers and employers meet (search intensity) and (ii) the probability that a contact leads to a successful match. Destefanis and Fonseca (2007) explain similarly that the efficiency term is influenced by the search intensity of firms and workers, by the effectiveness of search channels, and by the labour mismatch across micro markets defined over areas, industries, or skills. They also argue how empirical measures of efficiency will reflect the evolution not only of the unemployment rate, but also of the separation rate and the rate of growth in the labour force (Destefanis and Fonseca, 2007). Munich and Svejnar (2009) state how the inefficiency may emerge by inadequate labour market institutions leading to decreasing search effort, skills depreciation, rising reservation wage of the unemployed, or geographical or skill mismatch. Given that the main issue in all these works is to estimate efficiency and being that the matching function is usually interpreted as a production function – the stochastic production frontier approach is generally used. In this way, aggregate matching efficiency becomes a stochastic function of the variables accounting for the heterogeneity of job-seekers and firms (Ibourk et al., 2004). The authors explain main advantages of this method in comparison to traditional fixed-effects model and conclude that "the stochastic frontier approach introduces powerful tools to measure the efficiency of production activities and analyse its determinants" (Ibourk et al., 2004, p. 2).

In their article, Ibourk et al. (2004) use stochastic (translog) production frontier model on data for 22 French regions in the 1990-1994 period and show that aggregate matching efficiency has decreased in the observed time period with wide cross-regional differences. Among explanatory variables, which explain about 30% of the variations of efficiency, in addition to long-term unemployment and population density, the most important ones are the share of the young, females and immigrants in the total stock of job-seekers. Fahr and Sunde (2002), on the other hand, show that inefficiencies in German labour market are determined by the composition of the labour market with respect to the age and education structure, as well as the current labour market conditions as indicated by labour market tightness. Disaggregation by region delivers a heterogeneous picture of the efficiency of the matching process but the authors consider the disaggregation across occupations to be more policy relevant than across different regions. Nevertheless, the same authors (Fahr and Sunde, 2006) further investigate regional dependencies in job creation by applying stochastic frontier analysis and show that search intensity or competition among firms, as indicated by labour market tightness, significantly increases matching efficiency as does search intensity and competition among job-seekers measured by the level of local unemployment. In addition, they present novel evidence on the complex interactions between spatial contingencies among regional labour markets since matching efficiency decreases with spatial autocorrelation in hiring, implying indirect evidence for crowding externalities (Fahr and Sunde, 2006).

---

employment levels given structural shocks, while the continuing absence of integration in national labour markets has also been a major contributory factor.

Destefanis and Fonseca (2007) use a matching theory approach with stochastic frontier estimation to assess the impact of the so-called 1997 Treu Act on the Italian labour market. They prove the existence of large efficiency differences between the South and the rest of the country where Treu Act had a positive impact on the matching efficiency in the North (mainly for skilled labour), and a negative impact on the matching efficiency of unskilled labour in the South. They interpret this finding in terms of a ladder effect, i.e., the need to focus on the skill mismatch in the Southern labour market both from the demand side and from the supply side (Destefanis and Fonseca, 2007). Hynninen, Kangasharju and Pehkonen (2009) examine the matching (in)efficiencies for 145 local labour offices in 19 NUTS3 regions in Finland and show that the net inefficiency in the matching process and the differences in structural factors across regions substantially contribute to the aggregate unemployment rate. However, inefficiencies in practices and management processes in local labour offices affect unemployment more than variations in structural factors. Furthermore, Jeruzalski and Tyrowicz (2009) try to determine the efficiency of the matching process on a regional level in Poland. They show that matching abilities are driven only by demand fluctuations while other variables, like unemployment structure across time and regions, ALMPs coverage, and local labour office capacities, remain mostly insignificant. Additionally, Tyrowicz and Wójcik (2010) showed that the unemployment rates across regions in Poland were stable over the period between 1999 and 2008, i.e., no convergence except the convergence of clubs for high unemployment regions. However, they demonstrated that whenever job prospects worsen throughout the country, the more deprived regions are hit harder.

Hagen (2003) as well as Dmitrijeva and Hazans (2007) argue that raising the efficiency of matching process is usually regarded as the main aim of ALMPs, and can be reached by adjusting human capital of job-seekers to the requirements of the labour market (important in transition economies) and by increasing search intensity (capacity) of the participants. Dmitrijeva and Hazans (2007) estimate the impact of ALMP programmes on outflows from unemployment in Latvia and find positive and significant effect of training programmes on outflows from unemployment to employment indicating also that the hiring process is driven mainly by a stock of the unemployed at the beginning of the month and the flow of vacancies during the month.[56] However, Brown and Koettl (2012) stress the fact that ALMPs improving labour market matching have an impact only in the short run. Still, they accentuate that these measures are highly cost-effective, though not during crises (Brown and Koettl, 2012).[57] Several additional works focus more on the active labour market policies and their impact on a regional level. For instance, Altavilla and Caroleo (2009), using data for Italy, show how active labour market policies settled at national level generate asymmetric effects when regions have different economic structures. Hujer, Blien, Caliendo, and Zeiss (2002) analyse macroeconomic effects of the ALMP using regional level data and find positive effects of vocational training and job creation schemes on the labour market situation for West Germany, whereas the results for East Germany do not allow for bold statements. Nevertheless, budget constraints are limiting the

[56] The so-called *stock-flow matching* (Dmitrijeva and Hazans, 2007).

[57] They emphasize significant effects of intensified job-search assistance for unemployed on their employment probabilities and even earnings, especially for the long-term unemployed (Brown and Koettl, 2012).

prospects of implementing active labour market measures with real impact in most of the transition countries that, together with enormous staff caseload in most of the regions, limits the scope of ALMP measures (Kuddo, 2009). Brown and Koettl (2012) also stress weak public institutions as barriers to raise the effectiveness of job matching in developing countries.

The existing literature indicates regional labour market disparities in Croatia as well. Puljiz and Maleković (2007), for instance, by applying various inequality measures to regional and local units, such as coefficient of variations, Gini coefficient and Theil index, show how in the period 2000-2005 regional differences in unemployment rates increased, with the absence of any convergence. Luo (2007) examined labour market performance in Croatia in 2002-2004 period and concluded that both individual characteristics and regional characteristics played important roles in the determination of employment and earnings. However, according to him, large part of the difference in regional labour market performance is associated with the difference in human capital endowment (Luo, 2007). Botrić (2004) empirically tests the existing differences on a NUTS2[58] level in Croatia and shows substantial differences between Croatian regions regarding unemployment. Furthermore, using county-level (NUTS3) data from LFS in the period 2000-2005, she demonstrates quite visible differences in regional labour market indicators, implying the underdeveloped equilibrating mechanisms in the Croatian labour market (Botrić, 2007). Furthermore, Obadić (2004), using disaggregated (translog) matching function, confirms the existence of regional mismatch in some of the Croatian counties. In addition, Obadić (2006a, b), when explaining the problem of structural unemployment for selected transition countries, finds that the biggest differences in the movement of regional mismatch among the observed countries are persistent in Croatia.

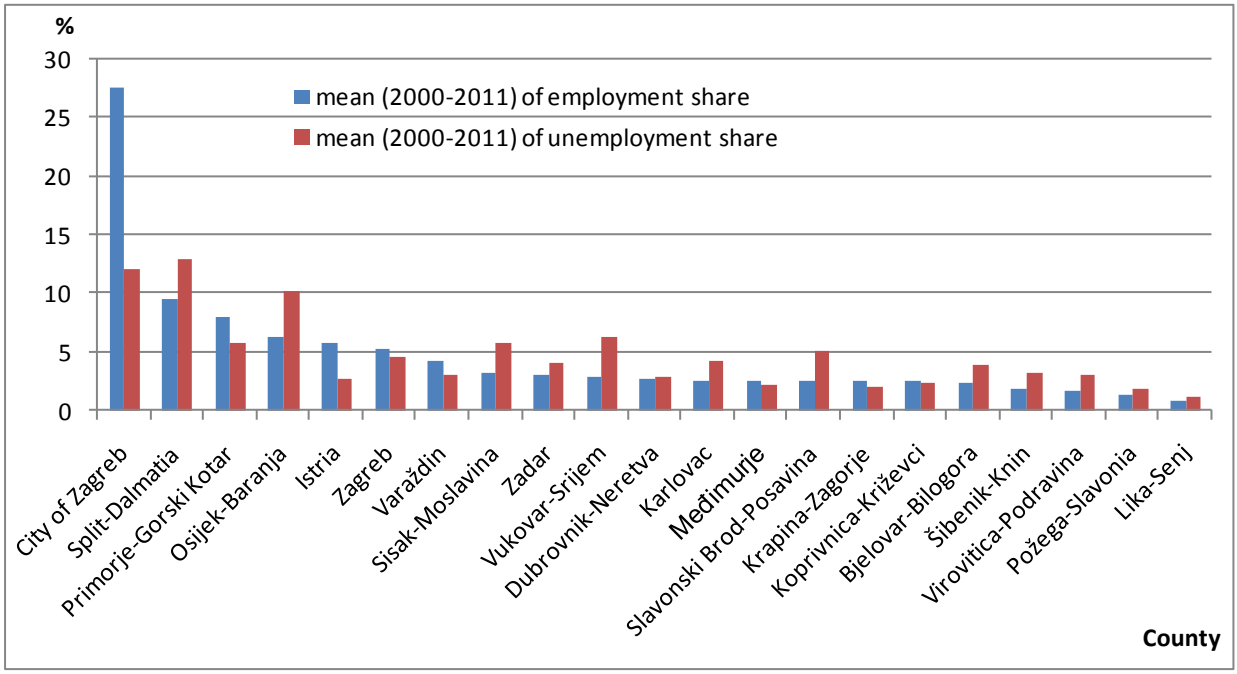
3.2.2 Croatian Employment Service

Figure 3.1 confirms the existence of regional disparities in Croatia by examining the shares of each region's (county's) employment and unemployment in total (national) employment and unemployment. Evidently, in some of the counties the share in national employment is much larger than the share in total unemployment (City of Zagreb or Istria county, for instance) while in others the share in total unemployment is much larger than the share in employment (Split-Dalmatia or Vukovar-Srijem county, for example). A similar occurrence is observable with regards to regional unemployment rates (Figure B.1 in Appendix B). One way to deal with these issues is via the actions of the Croatian Employment Service (CES), especially its regional offices.

Typically, public employment services are responsible for all aspects of employment service provision – registering the unemployed, paying unemployment benefits to those who are entitled, giving advice, guidance and counselling to job-seekers, and delivery of active labour market programmes (Kuddo, 2009). Actually, one of the main aims of public employment services should be to match the unemployed workers with open job positions as efficiently as possible. The Croatian Employment Service operates on these postulates as well.

[58] Proposed NUTS2 level at that time included five different regions: Northern Croatia; Central Croatia; Eastern Croatia; Western Croatia and Southern Croatia.

Figure 3.1. Regional shares in total employment and unemployment



Source: Author's calculation based on CBS and CES.

In its work the CES operates on two main levels:[59] Central Office and Regional Offices. Central Office is responsible for the design and implementation of the national employment policy, i.e., it creates a unique methodology for professional and operational implementation of the procedures from the field of the CES activities. On the other hand, 22 Regional Offices[60] perform professional and work activities from the CES priority functions, and provide support for them via monitoring and analysis of (un)employment trends in their counties. The main task of Regional Offices is to identify the needs of their county and implement their activities in line with those specificities. Thus, the Central Office provides guidelines for the work in the Regional Offices through its logistical support for all the aforementioned activities.

CES functions as an off-budget beneficiary, which means that its financial operations are based on the funds from the state budget. Its activities are mainly financed from the contributions on the gross wage, but other sources are used as well. These other sources include revenues from the help from abroad to co-finance EU projects, as well as income support and donations from domestic entities to finance expenditures for job fairs. The largest share in total expenditures is represented by expenditures for rights during unemployment (approximately 70-80% of total expenditures in 2008-2010 period). As of 2006 the financing of active employment programmes is also included in total CES expenditures. These expenses comprise approximately

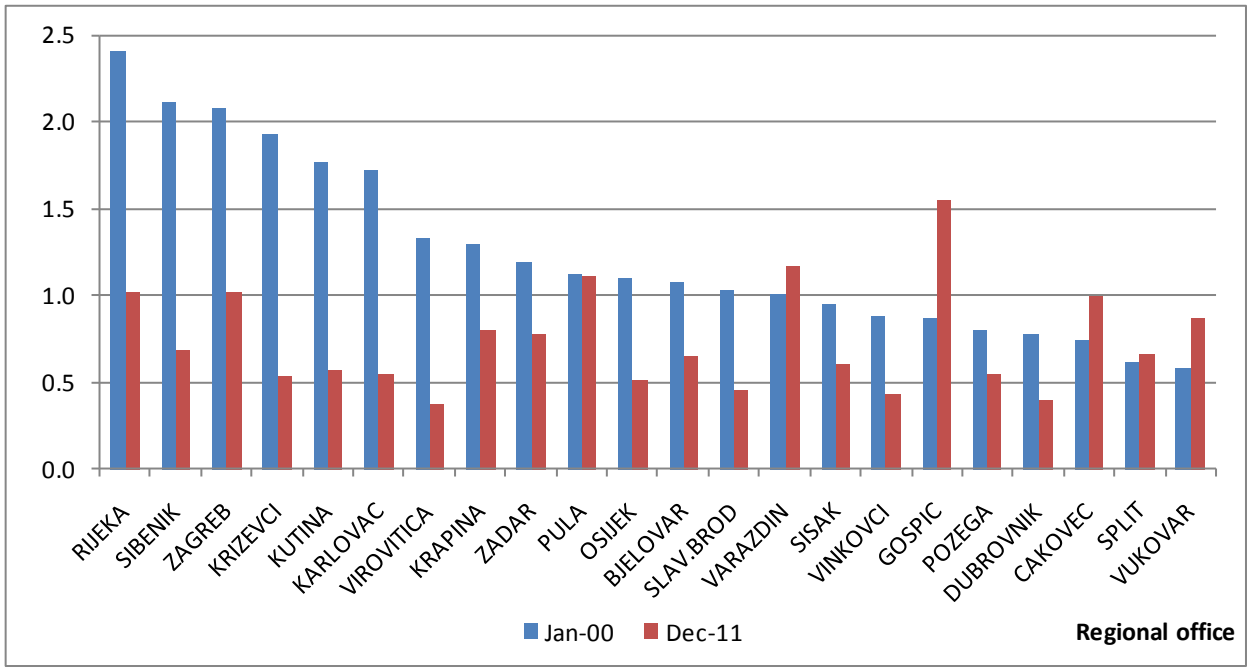
[59] Basic information about CES are obtained from their official web page: http://www.hzz.hr.

[60] One office in each county, with two offices in two counties: Sisak-Moslavina and Vukovar-Srijem, and Zagreb county and the City of Zagreb placed together in one regional office (see Table B.2 in Appendix B). Furthermore, within Regional Offices there are 96 Local Offices and the CES priority aims and functions are achieved by their presence and activities throughout the entire country (http://www.hzz.hr).

8% of total expenditures of the Service, while material and financial expenses are only 3% of total expenditure of the CES. Lately, an increasingly significant share of total expenditures is allocated to projects co-financed from the EU pre-accession programmes.

However, the effectiveness of employment offices varies by regions. For instance, some offices are much more effective than others in collecting information on job vacancies and in matching the unemployed with jobs. As stated in Kuddo (2009), in addition to (inadequate) funding, public policies to combat unemployment largely depend on the capacity of relevant institutions. The vacancy penetration ratio (Figure 3.2) approximates the capacity of regional employment office to collect information on job vacancies (World Bank and UNDP, 2010). Such capacity is important because it determines the effectiveness of job intermediation services provided by employment offices. The vacancy penetration ratio less than one suggests that some of the unemployed have found jobs on their own while ratio higher than one means that some of the available vacancies cannot be filled in (possibly due to skills or regional mismatch). Figure 3.2 indicates that this ratio (effectiveness of regional employment offices) has decreased in the crisis. Nevertheless, an employment office can be effective in collecting vacancy information but less effective (or ineffective) in matching the unemployed with vacancies.

Figure 3.2. Effectiveness of regional employment offices (vacancy penetration ratio)



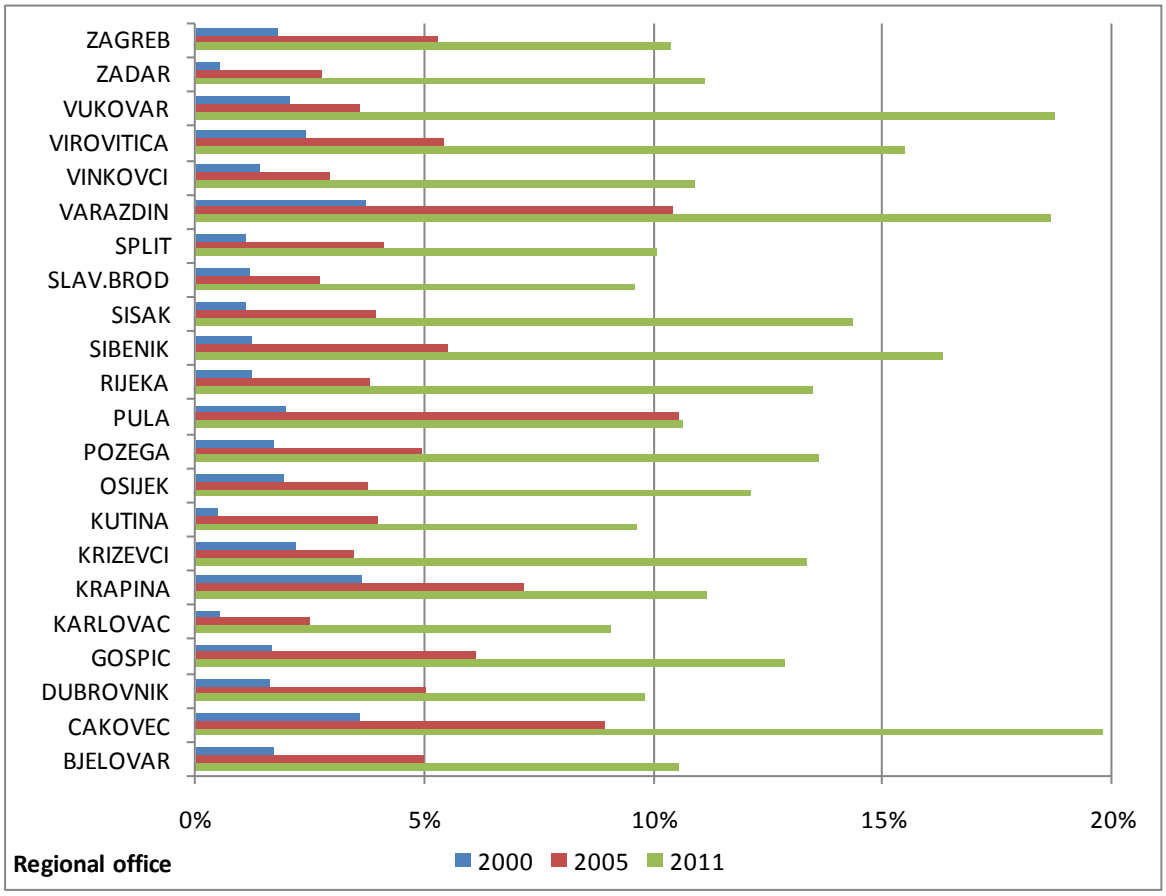
Notes. Vacancy penetration ratio (V/M) - the ratio of the number of vacancies collected by the employment office to the total number of available job vacancies. The total number of vacancies is not known, but it can be approximated by the number of the unemployed who were placed to jobs (M) (World Bank and UNDP, 2010).

Source: Author's calculation based on CES data.

On the other hand, high unemployment/vacancies ratio (Figure B.2 in Appendix B) has important policy implications too. Besides indicating that the problem probably lies in the demand deficiency, it also negatively affects the effectiveness of employment services, such as

job search assistance and job brokerage (World Bank and UNDP, 2010). Matching the high number of the unemployed with the low number of jobs is difficult and costly, while the effect is bound to be limited. Hence, the returns to job matching services are sharply diminishing when the unemployment/vacancies ratio goes up (as in the time of the crisis). Under such conditions, the main policy challenge is to enhance job opportunities by supporting job creation (World Bank and UNDP, 2010). Another indicator of regional employment office capacity is the ratio of the number of unemployed per one job counsellor (see Figure B.3 in Appendix B).[61] There are high variations between regions in this indicator which points once again to different capacities of the employment offices. This is further confirmed by examining the outflow rate (M/U), i.e., hiring probability by regions (Figures B.6, B.7 and B.8 in Appendix B).

Figure 3.3. ALMP coverage rate across regional offices (2000, 2005 & 2011)



Notes. ALMP coverage rate – share of persons included in one of the active labour market programmes in total unemployment.

Source: Author's calculation based on CES data.

As was already mentioned, active labour market programmes, which are meant to help job-losers to find new jobs, besides poor financing (less than 10% of total expenditures), also have an extremely low coverage[62] (Figure 3.3 and Figures B.4 and B.5 in Appendix B) in Croatia.

[61] Unfortunately, these data were not available prior to 2009.
[62] The programme coverage rate is the percentage of the unemployed who participated in any active labour market programme.

The total spending on labour market programmes, both passive and active, is very low by the European standards. For instance, in 2007 Croatia spent roughly 0.4% of its GDP on all labour market programmes, which is substantially less than what was spent by EU countries at a similar income level, such as Hungary, Poland or Slovakia (0.6% to 1.2% of GDP) (World Bank UNDP, 2010).[63] In the years preceding the crisis, the coverage rate for active programmes was slightly over 3%, and it fell to 2.5% in 2009 (Figure B.4 in Appendix B). However, recently, in an attempt to fight the impacts of the crisis on the labour market, the funds for the ALMPs somewhat increased, as well as the coverage rate for the unemployed (Figure 3.3 and Figure B.4).

Nonetheless, the allocation of funds to regional employment offices, which in the end implement active labour market programmes, is mainly driven by the offices' absorption capacity[64] while local needs, measured by the unemployment share, seem to be only a secondary factor (World Bank and UNDP, 2010).[65] As it seems, regional allocation of ALMP funds is largely historically determined and changes little in response to changing local labour market conditions. Although this capacity-based allocation rule ensures that programme funds are absorbed, it may come at a cost for regions where capacity is relatively low but needs are high (World Bank and UNDP, 2010). Still, evidences from the literature show that ALMPs are much more effective at addressing structural, rather than demand-deficient, unemployment (Kuddo, 2009).

3.2.3 Data

The data used for this research are regional data collected on a monthly basis within the NUTS3 (county) level obtained from the Croatian Employment Service over the period 2000-2011. Instead of the county-level data, for the purpose of exploring the role of employment offices, CES regional office–level data are used (see the difference in Table B.2 in Appendix B). Main variables used in the analysis are: (1) the number of registered unemployed persons (U), (2) the number of reported vacancies (V), (3) the number of newly registered unemployed (U_new), and (4) the number of employed persons from the Service registry (M). Besides these variables, the analysis also includes additional data that should affect the efficiency in the labour market. Detailed review and descriptive statistics of all the variables used in the analysis are provided in Table B.1 in Appendix B.[66]

However, several important points concerning the data should be stressed here. First of all, some of the variables in the analysis are 'stock' variables (as reported at the end of the (previous (t-1)) month) while other variables are 'flow' variables (during a respective (t) month). It is interesting to notice how the reported vacancies are available only as a 'flow' variable, i.e., vacancies reported by each regional office are only those vacancies posted during the respective month.

[63] Similar is confirmed for earlier periods where, for instance, in 2000 the share of total spending on active labour market programmes was only 0.27% of GDP in Croatia while the average for OECD countries was above 1% of GDP (Babić, 2003).
[64] This is historically determined and it basically means that those regional offices that absorbed all of the funds allocated to them in the past will get more funds in the future as well.
[65] Unfortunately, due to data unavailability this observation could not be confirmed in the paper.
[66] Additionally, these variables are explained more thoroughly in section 3.4.2.

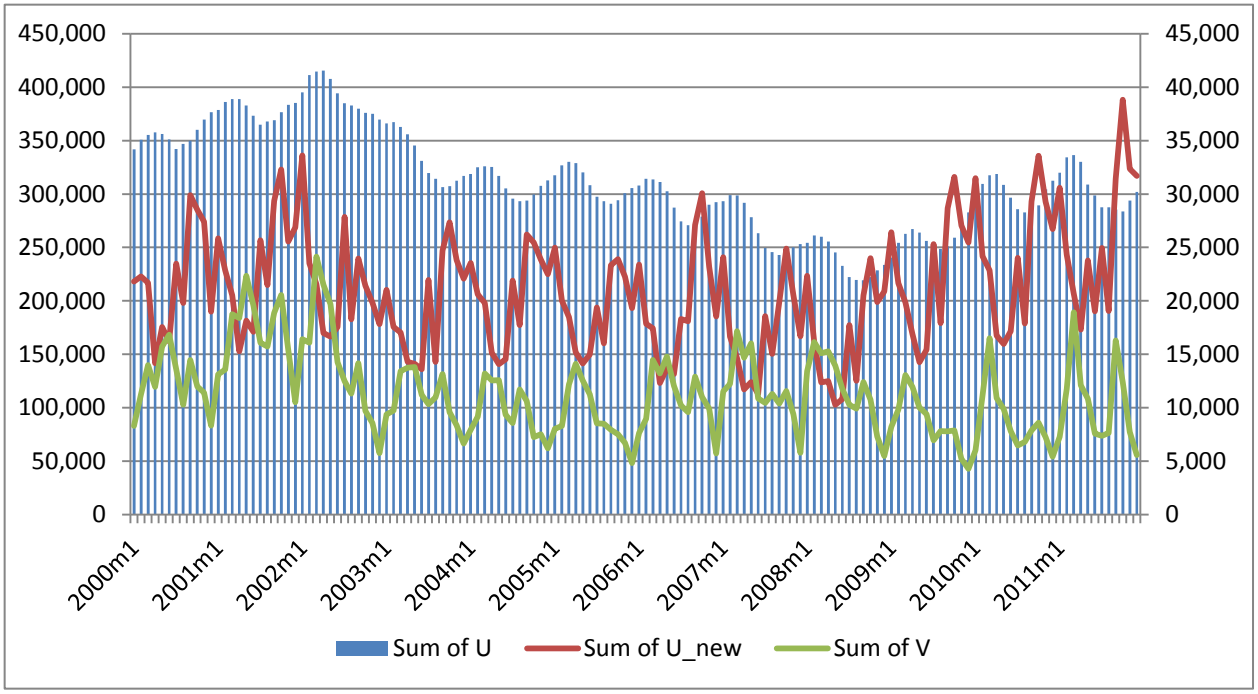
However, we do not consider this as a big obstacle, since it has been shown in a number of works (Coles and Petrongolo, 2002; Dmitrijeva and Hazans, 2007; Greg and Petrongolo, 2005; or Jeruzalski and Tyrowicz, 2009) that the dynamics between stocks of unemployed and flows of vacancies fits best the nature of the matching process. Nevertheless, the problem still exists since only a relatively small portion of vacancies are registered at public employment services (Kuddo, 2009; Jeruzalski and Tyrowicz, 2009). Jeruzalski and Tyrowicz (2009) argue how vacancies are systematically underreported and cannot serve for more than a proxy of the employers' need, whereas the extent of underreporting may differ from region to region. In the Croatian case, as of 2002 the employers are no longer legally obliged to report vacancies to the CES, while all effects of the changes in legal obligations on reporting vacancies on the labour market were no longer visible as of 2004 (CNB, 2010).[67]

Additionally, in order to get an indicator of the quality of services of regional public employment offices, a number of inquiries has been sent to the CES Central Office concerning the number and quality (like education, position held, working tenure) of its staff on a regional level, as well as some other characteristics of each individual office (like the amount of financial resources allocated to each office, IT equipment and similar). Unfortunately, only educational structure of the CES staff on a regional level has been obtained. In addition to that, in order to evaluate the impact of ALMPs on the overall efficiency we tried to obtain the data concerning persons included in different programmes of active labour market policies (as well as the data on the amount of funds for each of the ALMP measures). However, data provided on a monthly basis included only the number of new participants included in different programmes of active labour market policies,[68] while the data on the exact number of persons included in ALMPs in each month were unavailable. Since these figures are too low (or inexistent) in the majority of the months for most of the counties (see Figure B.5 in Appendix B) this variable was not used in the empirical exercise. In the end, the data on the number of persons included in different programmes of active labour market policies on a yearly basis are provided and used in empirical analysis as a proxy for the policy variable determining the efficiency of the matching process.[69]

Figure 3.4 shows the stocks of unemployment plus flows of unemployment and vacancies in a given period (2000m1-2011m12). Apart from the exceptionally large total number of unemployed, the figure shows that the number of newly registered unemployed is higher than the reported vacancies in the same month (also observable in Figure B.2 in Appendix B). This is evident during the, more-or-less, whole observed period and not only after 2004. This indicates that the problem of high unemployment in the Croatian labour market might lie in the demand deficiency.

[67] This means that during some period after the legal obligation of posting vacancies at CES was abandoned there were visible effects in the labour market (including the matching process), but as of 2004 these effects vanished. Evidently, both the Croatian Employment Service and firms needed some time to adjust to a new situation.
[68] These data were available only after 2002 (see Figure B.5 in Appendix B).
[69] Since the reporting standards with job-seekers in activisation programmes and programmes themselves were defined differently across years, we use the sums of people covered by programmes in each regional labour office at each point in time (year), i.e., we consider ALMPs coverage at the end of the year.

Figure 3.4. Stocks of unemployment plus flows of unemployment and vacancies - national sums



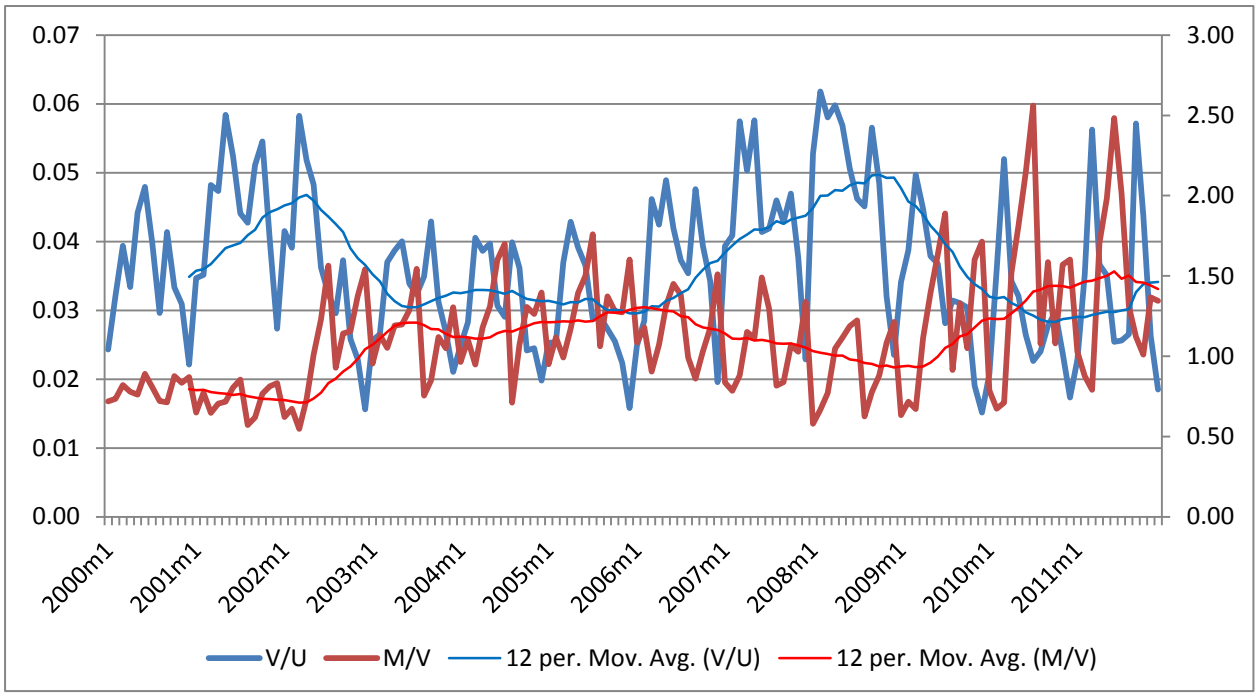
Notes. U – left scale; U_new and V – right scale.

Source: CES.

Furthermore, vacancies (Figure 3.4) as well as vacancy ratios (Figure 3.5) demonstrate pretty high volatility over time. Average vacancy ratios (number of job offers per one job-seeker) have ranged between 0.015 and 0.062, with the mean value of 0.036 offers per one job-seeker (having in mind that this contains only the number of job offers posted at CES offices). Naturally, this property of the data may lead to many estimation problems (Jeruzalski and Tyrowicz, 2009). Among others, it seems that the time trend needs to be controlled for in a non-linear way, taking into account the up and down swings in the labour market outlooks. Figure 3.5 also demonstrates the (average) anti-cyclicality of vacancies over time, opposite to the pro-cyclical dynamics of flows to employment in relation to a number of job offers at disposal in the labour offices. Actually, relatively high values observed at the right scale, imply that indeed public employment services dispose of only a fraction of unsubsidised vacancies available in the economy.[70] In the periods of high labour demand (both cyclical and seasonal) considerably more of the unemployed find jobs than are at the disposal of local labour offices (Jeruzalski and Tyrowicz, 2009).

[70] Kuddo (2009) explains how in most of the Eastern European and Central Asian countries a relatively small portion of vacancies are registered at PES (public employment service). He suggests that "in order to increase vacancy notifications, PES and jobseekers themselves should be more proactive in identifying job openings and breaking into the 'hidden job market', be it better marketing and services to employers from PES side to more active networking or direct employer contact from the jobseekers' side" (Kuddo, 2009, p. 4).

Figure 3.5. Vacancy ratio and flows from unemployment to employment (over vacancies)



Notes. V/U – left scale; M/V – right scale.

Source: Author's calculation based on CES data.

3.3 Empirical strategy

The estimation methodology used in this paper has a foothold in the classical matching function:[71]

$$M = f(U,V), \tag{3.1}$$

where M is the number of jobs formed during a given time interval, U is the number of unemployed workers looking for work and V the number of vacant jobs.

The matching function can be estimated using different methodological approaches.[72] The existing empirical literature, however, seldom goes beyond the basic matching function specification, despite the fact that the expanding literature has recently proposed a number of extensions, allowing for a large variety of externalities, market imperfections and particular forms of matching process (Dmitrijeva and Hazans, 2007). Most of the studies estimate a matching function in a Cobb-Douglas functional form, but there are some exceptions, of course.[73] In addition, it is often argued how the aggregation of local labour market data might

[71] See for instance, Petrongolo and Pissarides (2001) or Pissarides (2000).
[72] For instance, Destefanis and Fonseca (2007), Fahr and Sunde (2002; 2006), Ibourk et al. (2004), or Jeruzalski and Tyrowicz (2009) use *stochastic frontier estimation* in order to determine the efficiency of a matching process. Yet, due to possible problems with endogeneity, and, consequently, inconsistent estimated coefficients, Jeruzalski and Tyrowicz (2009) and Munich and Svejnar (2009) suggest rather the use of the *first-difference estimation*. Dmitrijeva and Hazans (2007), on the other hand, use OLS and GLS technique to estimate the so-called *augmented matching function* which, among the possible determinants of job matches, includes policy variables.
[73] See, for instance, Ibourk et al. (2004).

result in biased estimates of the matching function (Petrongolo and Pissarides, 2001). Therefore, an analysis is usually carried out on a regional or occupational level. In this paper, in order to capture regional disparities in both the matching process as well as in the work of local employment offices, the estimation is performed on a regional level.

Two main techniques for evaluating matching efficiency on a regional (occupational/industrial) level that are usually used are stochastic frontier estimation and panel data regressions. However, while the fixed-effect model implies an unrealistic time-invariance assumption of the matching efficiency and it is difficult to test for the potential influence of explanatory variables on matching (in)efficiencies, the use of stochastic frontier approach allows a more detailed analysis of the determinants of regional matching efficiencies (Ibourk et al., 2004). Thus, in order to explore the efficiency on a regional level, stochastic frontier approach will be used in this paper.

3.3.1 Stochastic frontier estimation

Stochastic frontier estimation stems from the estimation of the production function. The basic idea behind the stochastic frontier model is in estimating the efficiency of the production process, where the main assumption is that each firm potentially produces less than it might, due to some degree of inefficiency,[74] i.e.:

$$y_{it} = f(x_{it}, \beta)\xi_{it}, \tag{3.2}$$

where ξ_{it} is the level of efficiency for firm *i* at time *t*; and ξ_{it} must be in the interval (0; 1]. If $\xi_{it} = 1$, the firm is achieving the optimal output with the technology embodied in the production function $f(x_{it}, \beta)$. When $\xi_{it} < 1$, the firm is not making the most of the inputs x_{it} given the technology of the production function $f(x_{it}, \beta)$. Because the output is assumed to be strictly positive ($y_{it}>0$), the degree of technical efficiency is assumed to be strictly positive as well, i.e., $\xi_{it} > 0$.

However, output is also assumed to be subject to random shocks,[75] meaning that:

$$y_{it} = f(x_{it}, \beta)\xi_{it} \exp(\upsilon_{it}), \tag{3.3}$$

[74] First proposed in the works by Aigner, Lovell, and Schmidt (1977) and Meeusen and van den Broeck (1977). Battese and Coelli (1993, p. 1) nicely explain how the stochastic frontier production function postulates the existence of technical inefficiencies of production of firms involved in producing a particular output: "For a given combination of input levels, it is assumed that the realized production of a firm is bounded above by the sum of a parametric function of known inputs, involving unknown parameters, and a random error, associated with measurement error of the level of production or other factors, such as the effects of weather, strikes, damaged product, etc. The greater the amount by which the realized production falls short of this stochastic frontier production, the greater the level of technical inefficiency."

[75] These shocks are not directly attributable to the producer or the underlying technology. They may come because of uncontrollable phenomena like weather changes, economic adversities and similar. Even though each producer is facing a different shock, the assumption is that the shocks are random and they are described by a common distribution.

where $\exp(\upsilon_{it})$ represents a stochastic component that describes random shocks affecting the production process.

In logarithmic form:

$$\ln(y_{it}) = \ln\{f(x_{it}, \beta)\} + \ln(\xi_{it}) + \upsilon_{it}. \tag{3.4}$$

Assuming that there are *k* inputs and that the production function is linear in logs, defining $u_{it} = -\ln(\xi_{it})$ yields:

$$\ln(y_{it}) = \beta_0 + \sum_{j=1}^{k} \beta_j \ln(x_{jit}) + \upsilon_{it} - u_{it}. \tag{3.5}$$

Because u_{it} is subtracted from $\ln(y_{it})$, restricting $u_{it} \geq 0$ implies that $0 < \xi_{it} \leq 1$, as specified above.

Additionally, υ_{it} in equation 3.5 represents the idiosyncratic error ($\upsilon_{it} \sim \mathrm{N}(0, \sigma_{\upsilon}^2)$), while much of the literature has been devoted to deriving estimators for different specifications of the random inefficiency term that constitutes the only panel-specific effect, u_{it}.

For example, Aigner, Lovell, and Schmidt (1977) assume that u_{it} has half-standard normal distribution. However, this assumption presumes that (in)efficiency is time-invariant. Batesse and Coelli (1995), on the other hand, assume that non-negative technical inefficiency effects are a function of time and firm-specific variables and that they are independently distributed as truncations of normal distributions with constant variance, but with means which are a linear function of observable variables, i.e.:

$$u_{it} = z_{it}\delta + \omega_{it}, \tag{3.6}$$

where ω_{it} is defined by the non-negative truncation of the normal distribution with zero mean and variance σ_{ω}^2, such that the point of truncation is $-z_{it}\delta$, i.e., $\omega_{it} \geq -z_{it}\delta$. Consequently, u_{it} is a non-negative truncation of the normal distribution with $\mathrm{N}(z_{it}\delta, \sigma_u^2)$.

Fahr and Sunde (2002) further explain how u_{it} can vary over time, i.e.:

$$u_{it} = \exp^{-\eta(t-T_i)} u_i, \tag{3.7}$$

where T_i is the last period in the *ith* panel, η is an unknown (decay) parameter to be estimated, and the u_i's are assumed to be *iid* non-negative truncations of the normal distribution with mean μ and variance σ_u^2: $u \sim \mathrm{N}^{+}(\mu, \sigma_u^2)$. The non-negative effects u_i decrease, remain constant, or increase over time, if $\eta>0$, $\eta=0$ or $\eta<0$, respectively. u_i and v_{it} are distributed independently of each other and the covariates in the model.

The method of maximum likelihood is proposed for simultaneous estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects, while the likelihood function is expressed in terms of the variance parameters (Batesse and Coelli, 1995). Total variance of the process of matching which is not explained by the exogenous shocks is denoted as σ_s^2 ($\sigma_S^2 = \sigma_\upsilon^2 + \sigma_u{}^2$) and the share of this total variance accounted for by the variance of the inefficiency effect is γ ($\gamma \equiv \sigma_u{}^2 / \sigma_S^2$), where γ actually measures the importance of inefficiency for a given model specification (Fahr and Sunde, 2002).

Thus, the technical efficiency of the matching process is based on its conditional expectation, given the model assumptions:

$$TE_{it} = \exp(-u_{it}) = \exp(-z_{it}\delta - \omega_{it}) \tag{3.8}$$

3.3.2 Applying stochastic frontier estimation to the matching function

The same approach as the one described above can be applied to labour market, i.e., to the process of matching between workers who seek for a job and firms that look for workers. In this case, the output is the number of matches/hires while inputs are the number of unemployed workers looking for work and the number of vacant jobs (equation 3.1). The application of this type of estimation to the labour market was first introduced by Warren (1991) while recently the model has been applied in a number of works estimating the efficiency of the matching process on specific labour markets: Destefanis and Fonseca (2007) for Italy, Fahr and Sunde (2002; 2006) for Germany, Hynninen et al. (2009) for Finland, Ibourk et al. (2004) for France, and Jeruzalski and Tyrowicz (2009) for Poland.

For instance, Ibourk et al. (2004) explain how the matching process can be compared to the production process, where (in)efficiency of the matching process (ξ_{it}) corresponds to total factor productivity, i.e., it determines the number of matches that will be observed at given input values. On the other hand, Fahr and Sunde (2002) differentiate between productivity and efficiency in the matching function,[76] and say that in labour markets exhibiting high levels of matching efficiency, but low productivity, the objective for the policy-maker should be to increase the productivity.

The model in this paper is mostly based on Ibourk et al. (2004)[77] and Jeruzalski and Tyrowicz (2009) where the total number of matches is a function of the total number of job vacancies and

[76] They explain the productivity in terms of the stocks of job-seekers and vacant positions in relation to creating new employment. For example, if the elasticity of new matches with respect to these determinants is high in a certain region, these stocks exhibit a high matching productivity. However, if at the same time inefficiencies are high, an increase in the stocks would lead to fewer new matches than is technically feasible. In such an environment, policies that aim at reducing the inefficiencies would be advisable. On the other hand, finding high efficiency estimates given the stocks of unemployed and vacancies as inputs indicates that creating a vacancy or increasing the available labour force in the respective region would lead to additional job creation with high probability (Fahr and Sunde, 2002, p. 3).

[77] Even though in the first version of the paper Ibourk, Maillard, Perelman, and Sneessens (2001) used the Cobb-Douglas function specification, in the version from 2004 they used the translog production frontier model

job-seekers, plus a set of variables representing the share of each group *j* in total unemployment. Namely, it is explained how policy relevant variables can be introduced into the model if the assumption about the homogeneity of the unemployed is relaxed by varying the individual search intensities.[78] Thus, we use a non-stochastic model where different groups of job-seekers can have different search intensities:

$$M_{it} = E_{it} V_{it}^{\beta_1} (\sum_j (1 + c^j) U_{it-1}^j)^{\beta_2}, \tag{3.9}$$

where c^j represents deviations from the average search intensity, so that negative values are characteristic for less than the average search effort. If all groups had identical search intensity, then c^j would be equal to 0 for each *j* and we would be back to the standard model without the heterogeneity.

Rearranging equation 3.9, one obtains:

$$M_{it} = E_{it} V_{it}^{\beta_1} (U_{it-1} + \sum_j c^j U_{it-1}^j)^{\beta_2} = E_{it} V_{it}^{\beta_1} U_{it-1}^{\beta_2} \left(1 + \sum_j c^j \frac{U_{it-1}^j}{U_{it-1}} \right)^{\beta_2}. \tag{3.10}$$

Taking logs of Equation (3.10) and assuming the term in between brackets is close to 1, we get:

$$m_{it} \approx e_{it} + \beta_1 v_{it} + \beta_2 u_{it-1} + \sum_j \delta_j \frac{U_{it-1}^j}{U_{it-1}}, \tag{3.11}$$

where small letters indicate the log of the variables and $\delta_j = \beta_2 c^j$. A similar development could be made with respect to job vacancies.

Following Battese and Coelli (1995), the assumption is that the effects of heterogeneity that affect search intensity have direct impact on the matching efficiency (and not on the matching process itself), i.e., that they are included in term z_{it} in the following equation:

$$m_{it} = [\alpha + \beta_1 v_{it} + \beta_2 u_{it-1} + \upsilon_{it}] + [z_{it}\delta + \omega_{it}], \tag{3.12}$$

where ω_{it} is defined by the truncation of the normal distribution with zero mean and variance σ_ω^2.

---

explaining how by using a restrictive functional form like Cobb-Douglas one may bias the estimate of the return to scale parameter (Ibourk et al., 2004). However, we stick to the Cobb-Douglas functional form because it is predominant in the empirical literature.

[78] Dmitrijeva and Hazans (2007) also suggest that policy relevant variables can be introduced into the model if the assumption about the homogeneity of unemployed is relaxed by varying the individual search intensities. They do that by assuming that the unemployed who have completed some kind of training programme have higher search intensities than their non-trained peers, ceteris paribus. However, they neglect problems of adverse selection and reverse causality, and by taking the share of the trained directly in the stochastic frontier estimation (instead of two-stage approach), they risk endogeneity consequences (Jeruzalski and Tyrowicz, 2009).

Additionally, this model may be augmented to distinguish between the stocks and the flows (of both vacancies and unemployed), as advocated by Coles and Petrongolo (2002), Dmitrijeva and Hazans (2007), Greg and Petrongolo (2005) as well as Jeruzalski and Tyrowicz (2009).

Efficiency coefficient is obtained by computing conditional estimates (as in equation 3.8):

$$\hat{e}_{it} = E\left[e^{Z_{it}\hat{\delta}+\hat{\omega}_{it}} \mid M,V,U,Z\right] \tag{3.13}$$

Furthermore, Ibourk et al. (2004) also emphasize how the unemployed workers who enter special training programmes (ALMPs) are not included in the unemployment variable, u_{it-1}, which could further decrease matching efficiency in the labour market. In other words, if the special employment programmes are in effect targeted on workers with lower employment prospects, removing them from the market will increase the observed matching efficiency:

$$m_{it} \approx e_{it} + \beta_1 v_{it} + \beta_2 u_{it-1} + \sum\nolimits_j \delta_j \frac{U^j_{it-1}}{U_{it-1}} + \varphi \frac{S^j_{it-1}}{U_{it-1}} \tag{3.14}$$

where $S^j_{t-.1}$ represents the number of unemployed workers of group j who enter a special training programme and are withdrawn from the official unemployment statistics and $\varphi = \beta_2 \phi$ where $\phi \equiv -\sum_j \left(S^j_{t-1} / S_{t-1}\right) c^j$, i.e., the weighted search intensity of unemployed withdrawn from the market and entering special training programmes.

Jeruzalski and Tyrowicz (2009) emphasize that although by construction ALMPs and other variables should not be simultaneously correlated, endogeneity might occur in the form of the statistical phenomenon and thus they follow the approach commenced by Ibourk et al. (2004), incorporating the ALMPs effects to determine the technical efficiency scores, but not the matching process itself. Additionally, Dmitrijeva and Hazans (2007) explain how using expenditure on ALMPs or the number of current participants in ALMPs in the model leads to the problem of endogeneity because, if, for instance, the situation in the labour market worsens the expenditures may rise, which may lead to selection bias. However, they argue that when units are regions and not individuals the selection issue is less of a problem. Therefore, in this paper the used model assumes that different groups of job-seekers may exhibit different search intensities, either due to the individual characteristics (e.g., age, education) or because of ALMPs.

Possible shortcoming of the estimation of the efficiency of the matching function comes from the fact that the data from Croatian Employment Service do not observe job-to-job flows. However, this is a frequent problem in this type of research. Consequently, the estimation of the matching efficiency of a particular office (as opposed to whole regional labour markets) rests upon the vacancies that are filled exclusively from the category of the unemployed. Additionally, due to data limitation, the interregional migration is also neglected.

3.3.3 Model transformation

Munich and Svejnar (2009) argue that previous matching processes through the flow identities predetermine the explanatory variables in the matching function (unemployment and vacancies). Thus, in order to obtain consistent estimates, they suggest that one needs to apply the first-difference approach to the estimation of the matching function, i.e.:

$$\Delta m_{it} = \beta_1 \Delta u_{it-1} + \beta_2 \Delta v_{it-1} + \Delta \varepsilon_{it}. \tag{3.15}$$

In addition, they also suggest that further lags of Δu_t will be uncorrelated with $\Delta \varepsilon_t$ which they use as an argument in favour of the instrumental variables as a method of estimation (Munich and Svejnar, 2009). However, Jeruzalski and Tyrowicz (2009) argue that this approach does not allow capturing the relation between local conditions and the matching performance which is the main aim of this research.

Some of these issues, primarily those concerning stochastic frontier estimation, are further explored in works by Greene (2005a, b) and Wang and Ho (2010). Greene (2005a) argues that the traditional panel stochastic frontier estimation approach has two main shortcomings: (i) it usually assumes that (technical) inefficiency is time invariant and (ii) it forces any time invariant cross unit heterogeneity into one term that is being used to capture the inefficiency, i.e., it does not distinguish between an unobserved individual heterogeneity and inefficiency. Greene (2005a, b) proposes some extension of both fixed and random effects estimator of the stochastic frontier models that should deal with these issues. Even though the first limitation is generally solved by Batesse and Coelli (1995), the second problem remains in most of the empirical works. For instance, Wang and Ho (2010) explain how even in the cases where time-invariant inefficiency assumption has been relaxed, the time-varying pattern of inefficiency is the same for all individuals.

Wang and Ho (2010) argue that Greene's (2005a, b) 'true fixed-effect stochastic frontier model' may be biased by the problem of incidental (fixed-effect) parameters.[79] Even though Greene (2005a, b) showed that the incidental parameters problem does not cause bias to the slope coefficients, the estimation problem arises in the error variance estimation, upon which the inefficiency of the stochastic frontier is actually based on.[80] Hence, Wang and Ho (2010) present a solution to the problem in a form of first-difference and within transformation that can be analytically performed on the model to remove the fixed individual effects, and thus the estimator becomes immune to the incidental parameters problem. Namely, they remove the fixed individual effects prior to the estimation by simple transformations, thus taking into account both time-varying inefficiency and time-invariant individual effects. Their initial model resembles the one in equation 3.5, i.e.:

$$y_{it} = \alpha_i + x_{it}\beta + \varepsilon_{it}, \tag{3.16}$$

[79] Possible inconsistency due to the number of parameters growing with the number of firms.

[80] Hynninen et al. (2009) choose true fixed-effects modelling strategy augmented by detailed analysis of the relationship between the fixed-effects and inefficiency terms in Finnish labour market.

where α_i is individual *i's* fixed unobservable effect; $\varepsilon_{it} = \upsilon_{it} - u_{it}$; $\upsilon_{it} \sim \mathrm{N}(0,\sigma_\upsilon^2)$; $u_{it} = h_{it} \cdot u_i^*$; $h_{it} = f(z_{it}\delta)$; and $u_i^* \sim \mathrm{N}^+(\mu,\sigma_u^2)$. Neither x_{it} nor z_{it} contains constants (intercepts) because they are not identified and u_i* is independent of all *T* observations on v_{it}. Both u_i* and v_{it} are independent of all *T* observations on (x_{it}; z_{it}).[81]

Fixed individual effect α_i can be removed from the model by first-differencing[82] it:

$$\Delta y_{it} = \Delta x_{it}\beta + \Delta\varepsilon_{it}, \tag{3.17}$$

where $\Delta\varepsilon_{it} = \Delta\upsilon_{it} - \Delta u_{it}$; $\Delta\upsilon_{it} \sim \mathrm{MN}(0,\Sigma)$; $\Delta u_{it} = \Delta h_{it} \cdot u_i^*$; and $u_i^* \sim \mathrm{N}^+(\mu,\sigma_u^2)$. The truncated normal distribution of u_i* is not affected by the transformation. This key aspect of the model leads to a tractable likelihood function.[83]

In order to compute technical efficiency index, the conditional expectation estimator is used, i.e., conditional expectation of u_{it} on the vector of a differenced ε_{it}. The advantages of using this estimator are: (i) the vector $\Delta\tilde{\varepsilon}_i$ ($\Delta\tilde{\varepsilon}_i = (\Delta\varepsilon_{i2}, \Delta\varepsilon_{i3}, ..., \Delta\varepsilon_{iT})$) contains all the information of individual *i* in the sample, and (ii) the estimator depends on $\hat{\beta}$ (for which the variance is of order 1/((N-1)/T)) but not $\hat{\alpha}_i$ (for which the variance order is 1/T). The derivation of the equation looks like the following:

$$E(u_{it} \mid \Delta\tilde{\varepsilon}_i) = h_{it}\left[\mu_* + \frac{\phi\left(\frac{\mu_*}{\sigma_*}\right)\sigma_*}{\Phi\left(\frac{\mu_*}{\sigma_*}\right)}\right] \tag{3.18}$$

which is evaluated at $\Delta\tilde{\varepsilon}_i = \Delta\hat{\tilde{\varepsilon}}_i$ and where $\mu_* = \frac{\mu/\sigma_u^2 - \Delta\tilde{\varepsilon}_i'\Sigma^{-1}\Delta\tilde{h}_i}{\Delta\tilde{h}_i'\Sigma^{-1}\Delta\tilde{h}_i + 1/\sigma_u^2}$; $\sigma_*^2 = \frac{1}{\Delta\tilde{h}_i'\Sigma^{-1}\Delta\tilde{h}_i + 1/\sigma_u^2}$; $\Delta\tilde{\varepsilon}_i = \Delta\tilde{y}_i - \Delta\tilde{x}_i\beta$; and Φ is the cumulative density function of a standard normal distribution.

Although the individual effects α_i's are not estimated in the model, their values can be recovered after the model's other parameters are estimated by the transformed model proposed above. A *T*-consistent estimator of α_i may be obtained by solving the first-order condition for α_i from the untransformed log-likelihood function of the model, assuming all other parameters are known. Hence, in order to get more consistent estimates we will use Wang and Ho's (2010) model transformation of the stochastic frontier estimation of the matching function.

[81] The model exhibits the so-called "scaling property" that is, conditional on z_{it}, the one-sided error term equals a scaling function h_{it} multiplied by a one-sided error distributed independently of z_{it}. With this property, the shape of the underlying distribution of inefficiency is the same for all individuals, but the scale of the distribution is stretched or shrunk by observation-specific factors z_{it}. The time-invariant specification of u_i*allows the inefficiency u_{it} to be correlated over time for a given individual (Wang and Ho, 2010).

[82] Wang and Ho (2010) show that the within-transformed and first-differenced models are algebraically the same (by within-transformation, the sample mean of each panel is subtracted from every observation in the panel).

[83] For details, please see Wang and Ho (2010).

Additionally, even though the two-stage estimation procedure is justified on the grounds of problems with endogeneity (Jeruzalski and Tyrowicz, 2009), Batesse and Coelli (1995), Ibourk et al. (2004), as well as Wang and Schmidt (2002) argue in favour of the one-stage instead of the two-stage stochastic frontier estimation. Ibourk et al. (2004) state how the two-stage procedure used to this end typically implies the loss of a large amount of information and degrees of freedom. Furthermore, Battese and Coelli (1995) explain how even if a second stage regression can be performed, it is in contradiction with the identically distributed inefficiency assumption (first stage).

3.4 Estimation results

In this section, the estimation results are presented. First, the results from the first stage of stochastic frontier model (equation 3.12) are shown and subsequently the results from the second stage are given, i.e., the estimation of the panel regression for the estimated technical efficiency coefficients (equation 3.13) from the first step. Additionally, the results from the estimation of the basic-form transformed panel stochastic frontier model are also provided in this section.

3.4.1 Stochastic frontier estimation

For the estimation of a stochastic frontier, we have used the time-varying decay model (Battese and Coelli, 1995). As described in the previous section, this means that the inefficiency term is modelled as a truncated-normal random variable multiplied by a specific function of time; the idiosyncratic error term is assumed to have normal distribution, while the random inefficiency term constitutes the only panel-specific effect. Additionally, in order to control for the sizeable seasonality typically contained in these variables (see Figure 3.5) it is desirable to include month and year specific dummy variables as regressors in the model. Therefore, estimations include monthly dummies to control for the differentiated vacancies and job-seekers arrival rates throughout each year, and year dummies for the period when the reporting of vacancies at CES was still in effect, i.e., for the years 2000-2003. In addition, in the existing empirical work, variables are usually normalized (by the size of the labour force) in order to control for heteroscedasticity (Dur, 1999; Munich and Svejnar, 2009). However, since the size of the labour force in Croatia varied substantially during the observed period and being that the data about labour force on a regional level are not available,[84] in this paper we do not normalize the data by the size of the workforce because it could negatively affect the statistical properties of the model. Besides, in the analysis estimating the determinants of matching efficiency – the variable indicating population density is included in order to control for the 'size' of the respective labour market. Finally, as explained previously, the estimations include both stocks and flows of unemployed and only flows of vacancies. Results from the stochastic frontier estimation are

[84] For instance, until 2002, data on the persons employed in entities with less than ten employees were not included in total employment data at county level, while up to 2004, data on the persons employed in the police and defence were not included in total employment data at county level. What's more, data on the size of the labour force on a regional level are published only once a year, indicating the situation on 31 March (see Figure B.1 in Appendix B).

reported in Table 3.1, for both the unrestricted estimation and restricted estimation indicating constant returns to scale).[85] Since the variables are in logarithms, the estimations actually represent elasticities.

As is evident from Table 3.1, there is a larger weight of job-seekers in the matching process than is that of the posted vacancies. This result is not unusual, since in most of the empirical works the number of unemployed tends to affect hiring more than the number of posted vacancies (for instance, Fahr and Sunde, 2006; Ibourk et al., 2004; Jeruzalski and Tyrowicz, 2009).[86] What is more, only the stock of the unemployed positively affects the process of matching, while the newly registered unemployed decrease the matching capacity. This is in congruence with some other empirical results (Jeruzalski and Tyrowicz, 2009). Nonetheless, in this case adding the flow variable in the model actually increases the impact of the stock variable. Additionally, in the case of summing the two variables for the unemployed, the coefficient for the number of vacancies slightly increases while the result for the total number of unemployed (*u + u_new*) is as expected.

Furthermore, in order to test for the (in)existence of the constant returns to scale in the model, the Wald test of coefficient restrictions was conducted, where null hypothesis is equal to $\beta_u + \beta_v = 1$; $\beta_u + \beta_v + \beta_{u\_new} = 1$; and $\beta_{u\_sum} + \beta_v = 1$. The results are provided in Table 3.1 based on the obtained test statistics. Specifications with only stocks of the unemployed and with both stocks and flows in Table 3.1 indicate that the model exhibits constant returns to scale. Therefore, in the right part of Table 3.1 the results from the restricted estimation (where $\beta_u + \beta_v = 1$; $\beta_u + \beta_v + \beta_{u\_new} = 1$ and $\beta_{u\_sum} + \beta_v = 1$) are presented. As expected, there is no significant difference between these estimations and those for the unrestricted estimation.[87]

However, the main aim of this estimation was to establish the degree of (in)efficiency of the matching process. Interestingly, adding the newly registered unemployed to the model specification diminishes matching efficiency. Mean values from Table 3.1 suggest that the matching (hiring) process is on average 25-30% inefficient given the inputs (the unemployed and vacancies). Nevertheless, there are great variations across regions/regional offices (Figure 3.6 and Figure B.12 in Appendix B). This variability of estimated technical efficiency coefficients across regions guarantees sufficient variation to perform the second stage analysis (Jeruzalski and Tyrowicz, 2009).

[85] Additionally, the analysis is also conducted on the sample excluding the biggest region (which belongs to Zagreb regional office) – the results are presented in Table B.3 in Appendix B. As argued in Jeruzalski and Tyrowicz (2009), larger labour markets are usually characterised by larger flows, including outflows to employment without any support from the public employment services. However, the results excluding Zagreb regional office are not much different from the ones that include the whole sample.

[86] Petrongolo and Pissarides (2001) indicate how the regression that omits on-the-job search will give too low an estimate of the effect of vacancies on matchings (too high of unemployment). Soininen (2007) argues that when unemployment outflow is the used match measure the unemployment coefficient is generally larger than the vacancy coefficient. The opposite is true when vacancy outflow is used as the match measure.

[87] The same goes with the results excluding Zagreb region (Table B.3 in Appendix B).

Nevertheless, all regional offices show a rise in the matching efficiency in the period 2000-2011 (Figure 3.6 and Figures B.10 and B.12 in Appendix B).[88] Even though this result goes hand-in-hand with some other empirical results (for instance, Šergo, Poropat and Gržinić, 2009) this outcome is somewhat puzzling. Fahr and Sunde (2002), for instance, explain that increasing efficiency over time may be interpreted as the agents in the market learning how to find appropriate partners in order to form matches. Šergo et al. (2009) clarify their finding in a similar way, explaining how rising efficiency in Croatian labour market since the war and the de-industrialization shocks in the 1990-ies is connected with the capitalist framework of private employers. Namely, they describe how the responsiveness of the labour market depends not only on the willingness of the unemployed to fill jobs but also on the responsiveness of employers to fill vacancies with workers. Since our model refers to a somewhat later period (2000-2011), this can only serve as partial explanation. However, one has to remember that as of 2002 only a fraction of vacancies is posted at the CES while the number of the unemployed was constantly declining up to 2009 (start of the recession), which also had influence on the increasing matching efficiency. Other factors will be explained in the following section.

[88] On top of that, if we exclude Zagreb region, the efficiency coefficient estimates stay almost the same.

Table 3.1. Stochastic frontier estimation

	Unrestricted estimation				Restricted estimation		
Variables	**Stocks of u**	**Flows of u**	**Both**	**Sum**	**Stocks of u**	**Both**	**Sum**
u	0.761***		0.911***		0.759***	0.928***	
	(0.023)		(0.028)		(0.010)	(0.022)	
v	0.241***	0.262***	0.233***	0.248***	0.241***	0.235***	0.249***
	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
u_new		0.026	-0.166***			-0.163***	
		(0.021)	(0.019)			(0.019)	
u_sum				0.741***			0.751***
				(0.020)			(0.010)
Returns to scale	CRS	DRS	CRS	CRS	---	---	---
Constant	-2.598***	4.952***	-2.713***	-2.564***	-2.577***	-2.890***	-2.664***
	(0.191)	(0.217)	(0.192)	(0.171)	(0.037)	(0.054)	(0.037)
Mean technical efficiency	**0.762**	**0.384**	**0.691**	**0.805**	**0.763**	**0.685**	**0.801**
	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Wald χ^2	7470.74***	4625.79***	7548.41***	7779.14***	9057.41***	9259.30***	9024.01***
γ	0.104	0.762	0.150	0.075	0.102	0.158	0.080
	(0.038)	(0.065)	(0.045)	(0.030)	(0.036)	(0.047)	(0.031)
η	0.005***	0.0004***	0.005***	0.007***	0.006***	0.005***	0.006***
	(0.001)	(0.0002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log likelihood	76.710	-263.551	114.912	42.030	76.704	114.464	41.855
No. of observations	3168	3168	3168	3168	3168	3168	3168

Notes. Dependent variable: log of monthly flows to employment out of unemployment (m). γ represents the share of total variance accounted for by the variance of the inefficiency effect ($\gamma \equiv \sigma_u^2 / \sigma_S^2$) while η comes from the time-varying decay model ($u_{it} = \exp^{-\eta(t-T_i)} u_i$), where the non-negative effects u_i decrease, remain constant, or increase over time, if η>0, η=0 or η<0, respectively. Monthly and annual dummies are statistically significant, detailed results available upon request. Variables are in logarithms, lagged when necessary. CRS – test-statistics of Wald test of coefficient restrictions, where null hypothesis is equal to α+β=1, indicates that the matching function exhibits constant returns to scale.
Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculation based on CES data.

3.4.2 Covariates of technical efficiency

Following Jeruzalski and Tyrowicz (2009), in this section we present the estimation results for the covariates of technical efficiency scores.[89] In this way, the characteristics of a local labour market are approached by the means of proxies. Namely, some local markets may be more dynamic than others, while some may be populated by the more difficult groups of the unemployed. To account for this differentiation, following Destefanis and Fonseca (2007), Ibourk et al. (2004), and Jeruzalski and Tyrowicz (2009), we have used the following measures:

- Labour market structure (Figure B.9 in Appendix B):
    - vacancy ratio (v/u): measure of labour market tightness
    - regional unemployment rate (reg_unrate)
    - ratio of employed to delisted (m/delisted)
    - share of females in total unemployment (u_female) and in total flows to employment (m_female)
    - share of the young (u_<24y) in the pool of the unemployed
    - share of the long-term unemployed in the pool of the unemployed (u_12m+)
    - share of workers without experience in the pool of the unemployed (u_w/o experience)
    - share of workers previously employed in the primary sector of economic activity in the pool of the unemployed (u_primary_sector)
    - share of unemployed persons receiving unemployment benefits in the pool of the unemployed (u_benefits)
    - share of the no or low-skilled unemployed among the jobless (u_low skilled)
    - share of the high-skilled unemployed among the jobless (u_high skilled)
- ALMPs coverage rate (u_almp_coverage)
- Number of the highly skilled employed at the respective CES regional office per one unemployed (CES_high skilled)
- Net income *per capita* in a specific region/county (net income_pc)
- Size of the labour market measured by the population density (pop_density).

In addition, linear and quadratic trends are included to control for the country-wide labour market fluctuations, while monthly and annual dummies are introduced in order to control for large seasonal fluctuations.

Different variables included in 'labour market structure' may reflect different search intensities, willingness to accept received job offers and/or firms' attitudes (Ibourk et al., 2004). For

[89] Jeruzalski and Tyrowicz (2009) explain that although the regression construct specifies causality direction from the RHS variables to the LHS one - they are only trying to establish if there is a link between some control factors and the individual efficiency scores.
In addition, it can be argued that both the unemployment and the vacancies affect the value of (in)efficiency, and that variables that serve as determinants of the (in)efficiency may directly affect the matching process. However, following the standard procedure from the literature (Batesse and Coelli, 1995; Destefanis and Fonseca, 2007; Fahr and Sunde, 2002, 2006; Ibourk et al., 2004; Jeruzalski and Tyrowicz, 2009; or Warren, 1991) it is assumed that the variables that affect matching (in)efficiency do not directly impact the matching process. Possible endogeneity of vacancies and unemployment will be discussed later on in the paper.

instance, labour market tightness represents the search intensity of firms and competition among firms for applicants (Fahr and Sunde, 2006), but it can also be a good measure of the cycle (Petrongolo and Pissarides, 2001). Level of local unemployment (regional unemployment rate), on the other hand, can be a good measure of the search intensity and competition among job-seekers. The share of females in both unemployment and in total flows to employment, corresponds to the diversity of job creation and destruction in particular labour markets; youth usually demonstrates higher adaptability (search intensity), while the low-skilled unemployed typically represent lower value to the employers, which may constitute an obstacle in smooth unemployment-to-employment transitions (Jeruzalski and Tyrowicz, 2009). Additionally, share of the long-term unemployed may capture both business cycle effects and more structural difficulties (such as skills mismatch) (Ibourk et al., 2004) while share of the unemployed receiving unemployment benefits should affect the willingness to accept the job (via reservation wage). Furthermore, share of females in total unemployment as well as the share of long-term unemployed may indicate ranking effects while the share of unemployed in agriculture (primary sector) may indicate some firm effects (Destefanis and Fonseca, 2007).

As discussed earlier, ALMPs coverage rate (u_almp_coverage) is constructed as the number of individuals in any treatment over the pool of the unemployed in a respective region at the year-end. This variable is important because it should affect different search intensities and thus influence the matching efficiency. Moreover, the number of the highly skilled employed at the respective CES regional office per one unemployed (CES_high skilled) should serve as a proxy of regional labour office capacity. Even though the number of job counsellors or even job brokers (Jeruzalski and Tyrowicz, 2009) would be a better measure, due to unavailability of the data (see Figure B.3 in Appendix B), the number of highly skilled CES employees per one unemployed will serve this purpose. In order to somehow control for the demand fluctuations, net income *per capita* on a regional level is used here. Some other variables, like investments or consumption, could probably serve a better purpose in this respect, but due to data unavailability on a region/county level we stick to net income *per capita*.[90]

As argued by Ibourk et al. (2004) as well as Munich and Svejnar (2009) the size of the respective labour market is important for a number of reasons. Ibourk et al. (2004), for instance, use population density which is meant to capture effects coming from the density of economic activities and the probability that a contact is established between the right employer and employee, i.e., population density serves as a proxy for the size of social networks and the transmission of information. Munich and Svejnar (2009), on the other hand, indicate that not controlling for the district size may lead to biased coefficients unless the function exhibits constant returns to scale (omitted variable problem) which leads to the spurious scale effect. In our specification, we follow Ibourk et al. (2004) and use population density as covariate of technical efficiency.

[90] For instance, Mian and Sufi (2012) explain how negative demand shocks affected employment levels during the recent recession in the U.S. and use household balance sheets, i.e., debt-to-income ratio of the households, in this respect. They conclude that 65% of the lost jobs in the 2007-2009 time period is due to the decline in aggregate demand driven by household balance sheet shocks.

Results of these estimations are reported in Table 3.2. There are five different model specifications. First, only the 'labour market structure' variables (Figure B.9 in Appendix B) are used. Then, ALMPs coverage rate variable is added to the model specification, while in the third specification the number of highly skilled CES employees per one unemployed (proxy of CES regional office capacity) is included. Specification four adds a measure of 'demand fluctuation', i.e., net income *per capita*, while specification five additionally includes time trend, measure of the region's size (population density), and monthly and annual dummies.[91]

The capacity of the public employment services to match employers with the job-seekers may be negatively affected by some structural characteristics, but it is supposed to be positively affected by some policy variables, like number of PES employees (per number of the unemployed) or ALMPs coverage (Jeruzalski and Tyrowicz, 2009). The estimated coefficients in Table 3.2 only partially confirm these expectations. Namely, some of the covariates are not significant and for some that are significant, the sign of the relationship is not clear. However, as explained earlier, we are only trying to establish if there is a link between some control factors and the individual efficiency scores, not their causality.

As far as structural variables are concerned, none of the estimated coefficients seems to be large enough to explain variations in the technical efficiency coefficient. Vacancy ratio as well as the share of the long-term unemployed proved to be insignificant in almost all of the model specifications[92] while the share of those receiving unemployment benefits and share of the young is significant in some specifications while in others is insignificant. Besides that, depending on the model specification, some of the covariates change their sign, which suggests that the relationship between them and the matching efficiency is spurious.

Taking all this into account, we can see that only regional unemployment rate,[93] share of workers without experience, and share of low-skilled workers have unvarying negative and significant impact on technical efficiency, while the share of workers previously employed in the primary sector and share of high-skilled workers have significant and positive effect[94] on the coefficient of technical efficiency. These results, except perhaps for the share of agricultural workers, are quite intuitive and expected.

[91] Figure B.11 in Appendix B shows correlations between the efficiency coefficient and a set of explanatory variables.
[92] This is somehow surprising being that in some other empirical explorations (such as Fahr and Sunde, 2006) these variables proved to be important in explaining technical (in)efficiency of the matching process on a regional level.
[93] Except in the fourth model specification.
[94] Except in the last model specification for high-skilled workers.

Table 3.2. Determinants of technical efficiency

Variables	(1)	(2)	(3)	(4)	(5)
v/u	0.0001	0.00003	-0.00004	-0.0006***	0.0001
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
reg_unrate	-0.0197***	-0.0249***	-0.0166***	0.0041*	-0.0457***
	(0.0018)	(0.0021)	(0.0020)	(0.0023)	(0.0038)
m/delisted	-0.0006***	-0.0008***	-0.0008***	-0.0006***	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
m_female	-0.0009**	-0.0011**	-0.0011**	-0.0014***	0.0009*
	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
u_female	0.0331***	0.0374***	0.0301***	0.0402	-0.0191***
	(0.0064)	(0.0076)	(0.0071)	(0.0069)	(0.0068)
u_<24y	-0.0027	-0.0024	0.0107***	0.0134***	0.0349***
	(0.0023)	(0.0026)	(0.0027)	(0.0026)	(0.0029)
u_12m+	0.0018	0.0008	-0.0051*	-0.0011	0.0029
	(0.0027)	(0.0032)	(0.0031)	(0.0030)	(0.0029)
u_w/o_experience	-0.0313***	-0.0367***	-0.0397***	-0.0333***	-0.0368***
	(0.0022)	(0.0026)	(0.0024)	(0.0025)	(0.0028)
u_primary_sector	0.0020**	0.0041***	0.0057***	0.0056**	0.0105***
	(0.0010)	(0.0012)	(0.0011)	(0.0008)	(0.0010)
u_benefits	0.0009	0.0017	0.0027*	0.0013	0.0086***
	(0.0014)	(0.0017)	(0.0016)	(0.0016)	(0.0015)
u_low skilled	-0.0395***	-0.0412***	-0.0373***	-0.0371***	-0.0063**
	(0.0030)	(0.0035)	(0.0034)	(0.0033)	(0.0032)
u_high skilled	0.0121***	0.0137***	0.0113***	0.0092***	0.0019
	(0.0014)	(0.0016)	(0.0015)	(0.0015)	(0.0017)
u_almp coverage		0.0008**	0.0006**	0.0005*	0.0023***
		(0.0003)	(0.0003)	(0.0003)	(0.0006)
CES_high skilled			0.0316***	0.0297***	0.0301***
			(0.0021)	(0.0020)	(0.0020)
net income_pc				0.0638***	0.0359***
				(0.0037)	(0.0079)
Time trend					0.0012***
					(0.0001)
Squared time trend					-2.79e $^{-06}$***
					(4.73e $^{-07}$)
pop_density					0.0311***
					(0.0019)
Monthly dummies					YES
Annual dummies					YES
Constant	0.5983***	0.6038***	0.8179***	0.2256***	0.2933***
	(0.0108)	(0.0127)	(0.0186)	(0.0399)	(0.0769)
Wald χ^2	1098.45***	1350.13***	1598.98***	2290.03***	8095.08***
No. of observations	3168	3168	3168	3168	3168

Notes. Dependent variable: estimates of the technical efficiency from the stochastic frontier as reported in Table 3.1 (column 6). Monthly and annual dummies are statistically significant, detailed results available upon request (included only in the last model specification). Hausman specification test suggests the use of fixed-effects estimator. However, after the models are checked for heteroscedasticity and autocorrelation, they are corrected by using cross-sectional time-series FGLS regression estimation. Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculation based on CES data.

Unexpected results come (where significant) from the share of females in both the unemployed and the outflows from unemployment. Namely, larger percentage of females in the pool of the unemployed should signify less diversified labour markets, i.e., lower capacity for matching, while higher share of female outflows should signify exactly the opposite. However, in our case (in most of the specifications) a higher share of females among the unemployed positively affects efficiency estimates while female share in outflows from unemployment has a negative effect. Still, in the last model specification, where all the variables are included, these two covariates have an 'appropriate' sign. Another 'inconsistency' comes with the young (<24) job-seekers where in the first two model specifications the sign for this covariate is negative (although insignificant), while later it becomes positive (as expected).

Relationship between the share of persons receiving unemployment benefits and technical efficiency coefficient is another unexpected result. Namely, this variable positively affects matching efficiency (although is mostly insignificant). Being that it should affect the willingness to accept a job via increase in the reservation wage of the job-seeker, one would expect that the higher the share of unemployment benefit receivers, the lower the matching efficiency in a respective market. However, since the amount of the benefits on a monthly basis is on average pretty low (Chapter 2; Rutkowski, 2003) it does not have a great impact on the reservation wage increase, i.e., on lowering the matching efficiency. Positive effect probably comes from the fact that these people represent the recently unemployed (period of receiving benefits is also limited) with a higher search intensity.[95]

The ALMPs coverage rate has a positive and significant effect on the matching efficiency.[96] This suggests that programmes are effectively targeted on the unemployed workers with below average matching efficiencies (Ibourk et al., 2004).[97] However, the value of the estimated coefficient is too small to have any real impact on the matching efficiency. The number of highly skilled CES employees per one unemployed, on the other hand, is positive and somewhat larger, suggesting that the regional employment office capacity positively affects matching efficiency.

Since one should expect that units react differently to countrywide shocks, the response in the labour market may owe a lot to the local response to shock, apart from the efficiency of a local labour office. Thus, in the last two model specifications net income *per capita* in a respective county is added into the estimation. As expected, this coefficient is significant and positive indicating that 'demand fluctuations' have an impact on the matching efficiency as well. Time trend has a positive impact (visible in Figure 3.6 and Figure B.10 in Appendix B), as well as population density (last model specification). As Jeruzalski and Tyrowicz (2009) argue, a large part of the observed heterogeneity will be an interaction of time and unit characteristics.

[95] Additionally, Marimon and Zilliboti (1999) stress the fact that higher unemployment benefits may affect the extension of time devoted to search for employment in order to find a better 'match' which actually increases the efficiency of the matching process.
[96] Via their effect on the composition of the stock of job-seekers.
[97] Additionally, this variable should also indicate the quality of the allocation of resources as well as staff quality of regional employment offices being that they are responsible for the selection of unemployed persons who participate in the programme.

3.4.2.1 Exploring the implications of the crisis

As mentioned previously, in the second half of 2008 the Croatian economy entered a recession, which has had a huge impact on the labour market. This is reflected not only in the large increase in the number of unemployed, but also in the change of the structure and the number of participants in active labour market programmes (Figure 3.3 and Figure B.4). However, not only did the structural characteristics of local labour markets and additional policy variables possibly have an influence on the matching efficiency, but search intensities of the unemployed probably also drastically changed after 2008. This is not only reflected in the increased regional unemployment rate (Figure B.1 in Appendix B), but could also be a consequence of different psychological factors influencing search decisions in the labour market.

Hence, in order to establish whether there are any important implications of the crisis for the efficiency of the matching process on a regional level in Croatia, we estimated the model separately for two sub-periods: pre-crisis (2000-2007) and crisis (2008-2011). Table 3.3 presents the estimates of the technical efficiency determinants in the period before the crisis and after the start of the crisis.[98] Indeed, there are some important differences between the two sub-periods and in comparison with the results in Table 3.2.

For instance, labour market tightness proved to be positive and significant in the crisis period indicating that competition among firms for applicants intensified in the crisis. The share of females in both the unemployed and in the outflows from unemployment exhibits different (opposite) effects in the two sub-periods. While a higher share of females in outflows from unemployment positively affects efficiency estimates in the crisis period, the opposite is true for the pre-crisis period. Similar goes for the female share in the unemployed, which has a negative effect on technical efficiency in the crisis period, while the opposite holds for the pre-crisis period. Furthermore, the share of long-term unemployed has a negative effect on the efficiency in the crisis, while it positively affects efficiency in the pre-crisis period in most of the model specifications. These results suggest that theoretical predictions of the effects of different structural characteristics of the Croatian local labour markets are closer to the real situation in the period after the start of the economic and financial crisis in 2008.

Unexpected results occur for the share of high-skilled unemployed in the total pool of unemployment as well as for the ALMPs coverage rate, which in most of the model specifications for the pre-crisis period show a negative impact on the matching efficiency. However, probably the most unexpected result is the negative impact of the regional income *per capita* in the crisis. This result indicates that the demand had a negative impact on the matching efficiency after the start of the crisis. Additionally, time trend also proved to have a negative impact on the matching efficiency in the crisis period, while the opposite is true for the squared time trend.

[98] Stochastic frontier estimation results for the two sub-periods are given in Appendix B – Tables B.4 and B.5. The main results indicate higher mean technical efficiency coefficients in the crisis period (2008-2011), but still lower than when the entire sample (2000-2011) is taken into account.

Table 3.3. Determinants of technical efficiency – pre-crisis & crisis period

	pre-crisis (2000-2007)					crisis (2008-2011)				
Variables	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
v/u	0.0001	0.0001	-0.00002	-0.0006**	0.0002	0.0007**	0.0004*	0.0003	0.0005**	0.0005*
	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
reg_unrate	-0.0441***	-0.0531***	-0.0475***	-0.0218***	-0.0484***	-0.0485***	-0.0502***	-0.0296***	-0.0424***	-0.0902***
	(0.0032)	(0.0036)	(0.0036)	(0.0045)	(0.0044)	(0.0038)	(0.0035)	(0.0029)	(0.0033)	(0.0071)
m/delisted	-0.0006**	-0.0006**	-0.0005*	-0.0004*	-0.0001	-0.0019**	-0.0018**	-0.0022***	-0.0026***	-0.0004
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0008)	(0.0007)	(0.0005)	(0.0006)	(0.0009)
m_female	-0.0030***	-0.0030***	-0.0032***	-0.0036***	0.0009*	0.0024*	0.0022*	0.0019**	0.0019**	-0.0002
	(0.0007)	(0.0007)	(0.0007)	(0.0008)	(0.0005)	(0.0013)	(0.0011)	(0.0009)	(0.0009)	(0.0012)
u_female	0.1497***	0.1521***	0.1536***	0.1746***	-0.0092	-0.0586***	-0.0574***	-0.0560***	-0.0584***	-0.0223
	(0.0105)	(0.0105)	(0.0107)	(0.0112)	(0.0083)	(0.0130)	(0.0119)	(0.0095)	(0.0094)	(0.0138)
u_<24y	-0.0108***	-0.0111***	0.0052	0.0104**	0.0420***	0.0220***	0.0167***	0.0178***	0.0147***	0.0271***
	(0.0036)	(0.0036)	(0.0039)	(0.0041)	(0.0031)	(0.0062)	(0.0056)	(0.0043)	(0.0044)	(0.0065)
u_12m+	0.0115***	0.0129***	0.0081*	0.0117***	0.0035	0.0137*	0.0058	-0.0096*	-0.0092*	-0.0150*
	(0.0041)	(0.0041)	(0.0042)	(0.0045)	(0.0032)	(0.0078)	(0.0072)	(0.0055)	(0.0054)	(0.0078)
u_w/o_experience	-0.0223***	-0.0218***	-0.0278***	-0.0252***	-0.0414***	-0.0352***	-0.0271***	-0.0223***	-0.0300***	-0.0722***
	(0.0037)	(0.0038)	(0.0037)	(0.0039)	(0.0031)	(0.0054)	(0.0049)	(0.0039)	(0.0041)	(0.0059)
u_primary_sector	0.0055***	0.0052***	0.0086***	0.0123***	0.0140***	0.0076***	0.0094***	0.0049***	0.0035***	0.0098***
	(0.0016)	(0.0016)	(0.0016)	(0.0017)	(0.0010)	(0.0021)	(0.0018)	(0.0014)	(0.0013)	(0.0019)
u_benefits	0.0089***	0.0088***	0.0117***	0.0136***	0.0123***	0.0155***	0.0118***	0.0057***	0.0074***	0.0139***
	(0.0026)	(0.0026)	(0.0027)	(0.0028)	(0.0019)	(0.0031)	(0.0029)	(0.0021)	(0.0021)	(0.0032)
u_low skilled	-0.0405***	-0.0416***	-0.0425***	-0.0470***	-0.0084***	-0.0223***	-0.0048	-0.0047	-0.0255***	-0.0674***
	(0.0044)	(0.0045)	(0.0045)	(0.0046)	(0.0031)	(0.0084)	(0.0073)	(0.0057)	(0.0062)	(0.0089)
u_high skilled	0.0003	-0.0007	-0.0037	-0.0072***	0.0018	0.0105***	0.0067**	0.0035*	0.0055**	0.0042
	(0.0023)	(0.0023)	(0.0023)	(0.0024)	(0.0019)	(0.0031)	(0.0028)	(0.0021)	(0.0022)	(0.0038)
u_almp coverage		-0.0023***	-0.0028***	-0.0019***	0.0026***		0.0029***	0.0019***	0.0041***	0.0017
		(0.0005)	(0.0005)	(0.0005)	(0.0006)		(0.0007)	(0.0005)	(0.0006)	(0.0014)
CES_high skilled			0.0421***	0.0459***	0.0339***			0.0278***	0.0303***	0.0455***
			(0.0033)	(0.0034)	(0.0023)			(0.0027)	(0.0027)	(0.0041)
net income_pc				0.0668***	0.0167*				-0.0944***	-0.2834***
				(0.0059)	(0.0085)				(0.0103)	(0.0141)
Time trend					0.0028***					-0.0018*
					(0.0001)					(0.0010)
Squared time trend					-7.51e $^{-06}$***					0.00001***
					(8.30e $^{-07}$)					(3.91e $^{-06}$)

(table continues)

(continued)

pop_density					0.0243*** (0.0019)					0.0014 (0.0032)
Monthly dummies					YES					YES
Annual dummies					YES					YES
Constant	0.5180*** (0.0181)	0.4967*** (0.0187)	0.7811*** (0.0289)	0.2242*** (0.0613)	0.4098*** (0.0836)	0.5441*** (0.0250)	0.5732*** (0.0222)	0.7326*** (0.0231)	1.6338*** (0.0958)	3.5226*** (0.1348)
Wald χ^2	847.55***	913.89***	1257.44***	1736.02***	15422.89***	551.05***	488.32***	454.75***	679.29***	2270.95***
No. of observations	2112	2112	2112	2112	2112	1056	1056	1056	1056	1056

Notes. Dependent variable: estimates of the technical efficiency from the stochastic frontier as reported in Table B.5 in Appendix B (columns 2 and 5). Monthly and annual dummies are statistically significant, detailed results available upon request (included only in the last model specification). Hausman specification test suggests the use of fixed-effects estimator. However, after the models are checked for heteroscedasticity and autocorrelation, they are corrected by using cross-sectional time-series FGLS regression estimation. Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculation based on CES data.

3.4.2.2 Stochastic frontier estimation by model transformation

Table 3.4 contains estimation results from the transformed panel stochastic frontier model as suggested in Wang and Ho (2010). At this point, only the basic-form of the model is estimated - using a few variables that represent labour market structure,[99] a policy variable (u_almp coverage), as well as an additional variable that should stand as a proxy for demand fluctuation (net income_pc) as constraints for the technical efficiency. Furthermore, time trend and population density variable are also included in the analysis.[100]

As the results indicate, model transformation did not significantly change the estimations of the coefficients for the stock and flow of the unemployed (u and u_new) and the flow of vacancies (v) in comparison with the 'regular' stochastic frontier estimation (Table 3.1), except in the case where we have only flows of the unemployed. However, efficiency covariates are somewhat changed from the ones in earlier estimations (Tables 3.2 and 3.3).

Namely, variables representing labour market structure (labour market tightness, regional unemployment rate and shares of low and high-skilled workers) are mainly insignificant and of the sign opposite than the one expected in most of the model specifications. However, the variable representing demand fluctuations - regional net income *per capita* – is mainly significant, except in the model specification with only flows of the unemployed, and has a strong positive impact on the matching efficiency. This suggests that the efficiency of the matching process on a regional level in Croatia is predominantly demand-driven.

Population density is insignificant in all model specifications while linear time trend, where significant, has a negative impact on the matching efficiency (as in the case after the start of the crisis). This result indicates lowering efficiency over time, which was also the case in Jeruzalski and Tyrowicz's (2009) first-difference estimation of the matching function. However, when looking at the estimated technical efficiency coefficients over the years (Figure 3.6) one can observe the rise in the mean technical efficiency coefficient over time. Still, this is only the basic-form model, while for stronger conclusions other variables (potentially) affecting the efficiency need to be included in the estimation.

[99] Two variables that should affect the efficiency positively (labour market tightness and the share of high-skilled workers) and two that should have a negative impact on the efficiency (regional unemployment rate and the share of low-skilled workers).

[100] The model, by its construction, does not allow the inclusion of the constant as well as individual-specific and time-invariant, i.e., dummy variables, into the equation.

Table 3.4. Stochastic frontier estimation by model transformation

	Stocks of u	Flows of u	Both	Sum
Frontier				
u_tr	0.797***		0.987***	
	(0.052)		(0.058)	
v_tr	0.378***	0.966***	0.252***	0.398***
	(0.017)	(0.064)	(0.030)	(0.016)
u_new_tr		-0.379***	-0.378***	
		(0.020)	(0.020)	
u_sum_tr				0.627***
				(0.054)
Constraints				
v/u	-0.043	0.009	-0.212***	-0.005
	(0.070)	(0.019)	(0.064)	(0.082)
reg_unrate	1.483***	-0.001	0.298	1.670***
	(0.294)	(0.003)	(0.293)	(0.349)
u_low skilled	0.011	0.005	0.304	0.152
	(0.380)	(0.011)	(0.261)	(0.494)
u_high skilled	-0.047	0.003	-0.140	-0.017
	(0.199)	(0.007)	(0.154)	(0.242)
u_almp coverage	0.008	-0.001	-0.054**	-0.028
	(0.052)	(0.001)	(0.027)	(0.068)
net income_pc	1.597***	0.008	1.274**	1.542***
	(0.496)	(0.017)	(0.501)	(0.468)
time trend	-0.024***	-0.0001	-0.015***	-0.027***
	(0.005)	(0.0002)	(0.004)	(0.005)
pop_density	0.046	0.009	-0.076	0.056
	(0.099)	(0.021)	(0.132)	(0.124)
c_{υ}	-2.191***	-2.301***	-2.309***	-2.163***
	(0.025)	(0.025)	(0.025)	(0.025)
c_u	-32.393***	4.072	-28.026***	-30.297***
	(10.298)	(4.421)	(10.060)	(9.602)
Mean technical efficiency $\left[E(\exp(-u_{it}) \mid \Theta)\right]$	**0.852**	**3.14e^{-23}**	**0.711**	**0.890**
	(0.129)	(8.07e^{-23})	(0.130)	(0.117)
χ^2				
Wald	837.91***	596.74***	925.09***	795.25***
Log likelihood	-1022.77	-857.09	-846.19	-1068.92
No. of observations	3168	3168	3168	3168

Notes. Dependent variable: within-transformed log of monthly flows to employment out of unemployment (m_tr). $\Theta = \Delta\widetilde{\varepsilon}_i$; $c_{\upsilon} = \ln(\sigma_{\upsilon}^2)$; $c_u = \ln(\sigma_u^2)$. Variables are in logarithms, lagged when necessary. Standard errors (except for technical efficiency where standard deviation is reported) reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculation based on CES data.

Figure 3.6 shows the efficiency estimates across regional offices and over the years from three different specifications: (i) stochastic frontier estimation (Table 3.1); (ii) determinants of technical efficiency (Table 3.2); and (iii) the transformed panel stochastic frontier model (Table 3.4). All three model specifications show a rise in the estimated technical efficiency coefficient over the years, with considerable regional variation.

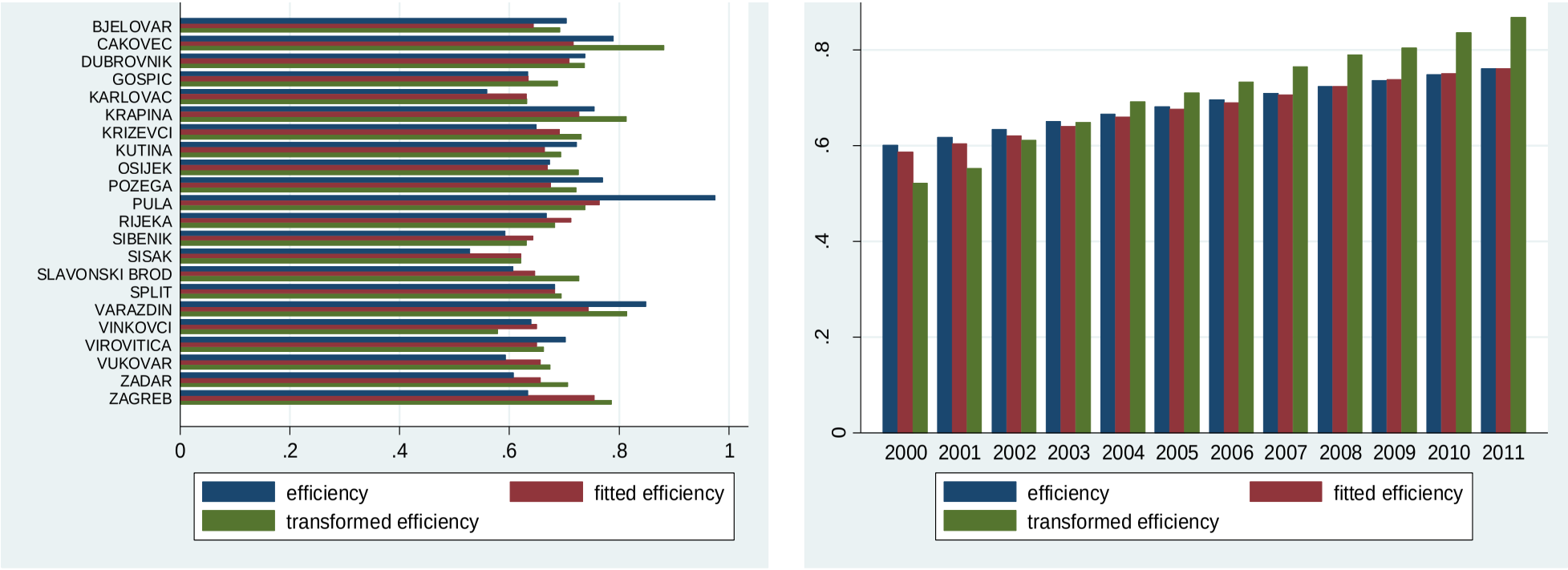
In general, a transformed model gives somewhat higher efficiency coefficients in comparison with the original panel stochastic frontier estimation. However, this is not the case in all the regions or in all years for that matter. Fitted values, on the other hand, largely resemble the coefficients from the original estimation when one looks at the mean values over the years, while values across regions (regional offices) show more dissimilarity. Still, the ranking of the regions (from least to most efficient) stays the same for the most part.

For instance, original stochastic frontier estimation shows that regional office Pula exhibits almost 100% efficiency,[101] while regional office Sisak is approximately 50% efficient in matching unemployed workers with available jobs. On the other hand, fitted values still put Pula at the top (76% efficiency), with Zagreb (76%) very close to that, and Sisak in the last place (62%), with Karlovac (63%) right behind.[102] What is more, fitted efficiency values are much closer to each other (the difference between the most and the least efficient regional office is only 14 percentage points) than was the case with the original estimation (a difference of 45 percentage points). Overall, fitted values show that regional differences in technical efficiency scores are well explained by the covariates presented in Table 3.2. The transformed model gives somewhat different results, with the difference between mean efficiency estimates for the most efficient regional office (Cakovec, followed by Varazdin) and the least efficient regional office (Vinkovci, followed by Sisak) amounting to 30 percentage points. However, one has to remember that covariates for the technical efficiency in this case are somewhat limited due to model construction.

[101] This result seems a bit unusual, but it only indicates that in Istria (covered by the Pula regional office) almost all available vacancies are filled from the category of registered unemployed in a respective month. This result also points to a highly dynamic labour market in the county of Istria. This is also confirmed by the low unemployment rates (see Figure 3.1 and Figure B.1 in Appendix B) in this county.

[102] These results are in congruence with some works that test for the poverty on a regional level in Croatia. For instance, Rubil (2013) shows that in 2010 the county with the least poverty was Istria (Pula regional office), while the poorest county was Karlovac, followed by Sisak-Moslavina.

Figure 3.6. Mean technical efficiency across regional offices (left) and over the years (right) – different efficiency estimates



Notes. Efficiency estimates from the (restricted) specification with both stocks and flows of the unemployed (column 6 in Table 3.1) are presented in the first case.
The second case presents fitted values after the estimation of the covariates for the first case (column 5 in Table 3.2).
The third case presents efficiency estimates from the transformed panel-stochastic frontier model (column 3 in Table 3.4).

Source: Author's calculations based on CES data.

3.5 Conclusions

This paper explores the efficiency in the labour market by estimating the matching function on a regional level in Croatia. Since there are huge regional differences in both employment and unemployment levels among Croatian regions (counties), the main objective of the paper is to evaluate the efficiency levels as well as changes that may have taken place both over time and across regions. Furthermore, the role of regional employment offices is taken into account. Thus, the empirical analysis is conducted on a regional level using the regional office-level data obtained from the Croatian Employment Service on a monthly basis in the period 2000-2011. To take into account the effect of the crisis, the estimation is also conducted for two different sub-periods: pre-crisis (2000-2007) and crisis (2008-2011). In order to perform the estimation, the panel stochastic frontier model is used, as well as its modified version – the transformed panel stochastic frontier model.

The main results point to a larger weight of job-seekers in the matching process in comparison to posted vacancies which is not unusual, especially taking into account the fact that vacancies posted at the CES offices are not all the available vacancies in the economy. Model specification that includes both stocks (at the end of the previous month) and flows (newly registered) of the unemployed, as well as the one that includes only stocks, points to the existence of constant returns to scale, while model specification with only flows of the unemployed suggests that the model exhibits decreasing returns to scale. In addition, flows of the unemployed included in the model, unlike in some other empirical analyses, increase the positive impact of stocks.

The main focus of the analysis – the efficiency of the matching process – proved to be rising over time with significant regional variations. On average, the technical efficiency of the matching process is 70% to 75%, ranging from about 50% in the Sisak region to almost 100% in Istria (Pula regional office). However, adding the newly registered unemployed to the model specification diminishes matching efficiency. The variations of estimated technical efficiency coefficients across regions suggest the need for evaluation of the second stage analysis – i.e., the regression of technical efficiency coefficients and a set of covariates that should affect it. Namely, it is assumed that the policy relevant variables can be introduced into the original model if the assumption about the homogeneity of the unemployed is relaxed by varying the individual search intensities. Different search intensities emerge either due to the structural characteristics of the respective labour market (e.g., age, education) or due to policy variables like active labour market programmes or employment service staff capacity.

As far as the labour market structure variables are concerned, the obtained results suggest that the regional unemployment rates and the shares of workers without experience and low-skilled workers in the pool of the unemployed have the highest negative impact on the matching efficiency. The shares of primary sector and high-skilled workers in the pool of total unemployed, on the other hand, have the highest positive impact in the respective regional labour market.

Policy variables have mostly positive impact on the matching efficiency. Nevertheless, the CES was reluctant to provide the data on financial resources devoted to each of its regional offices (or any financial data for that matter), as well as more detailed data about its staff, equipment and similar, which would be very helpful in determining the quality of services provided by the regional employment offices. Hence, the quality of the regional employment offices' services is proxied by the number of highly skilled employed at the respective CES regional office per one unemployed as well as by the ALMP coverage rate which should indicate the quality of the allocation of resources as well as staff quality (they determine who participates in the programme) - both of which have a positive impact on the efficiency of the matching process.

The results suggest that the ALMP coverage rate has a positive impact on the efficiency of the matching process, but the size of the estimated coefficient is too small for us to come to any strong conclusions. However, the number of highly skilled CES employees per one unemployed indicates a stronger significant positive impact in all the model specifications. This suggests that the CES regional office staff caseload is important for the explanation of the variation in the matching efficiency. Yet, one has to bear in mind that the CES office staff capacity variable depends not only on the number of employees per one office, but even more on the number of unemployed persons in a respective region. Overall, fitted values for the technical efficiency coefficient estimates show less dispersion between regional offices, with efficiency estimates ranging from 62% (Sisak) to 76% (Pula). Still, the ranking of the regions (from least to most efficient) stays more or less the same.

Net income *per capita*, as an indicator of the demand fluctuations, also proved to have a positive impact on the matching efficiency. Thus, it seems that demand fluctuations remain one of the main causes of matching (in)efficiency in Croatia. As it is nicely explained by Kuddo (2009, p. 65): "Active labour market services, in and of themselves, do not create jobs. In general, a favourable investment and business climate, and rapid economic development are key to job creation. ALMPs can only contribute to less inequality in the labour market, a reduction in long-term unemployment, and an easier filling of the existing vacancies." Nonetheless, it seems that the allocation of funds to regional employment offices is driven by the absorption capacity of the respective office, based on historical records while local needs serve only as a secondary factor. And this is something that should be definitely taken into account when implementing new policies and allocating funds to CES regional offices. However, due to data limitation, this could not be further explored in this paper.

Additionally, in order to establish whether there are any important implications of the crisis for the efficiency of the matching process on a regional level in Croatia, the model is also estimated separately for two sub-periods: pre-crisis and crisis. The results show there are some important differences between the two sub-periods and in comparison with the original estimates. Estimation results produced in the period of the crisis (2008-2011) are more consistent with theoretical predictions. Furthermore, given that the classic panel stochastic frontier estimation of the matching function has some problems, including possible endogeneity of independent variables, in order to get more consistent estimates, transformation of the original panel stochastic frontier model is applied. Nevertheless, preliminary results from the basic-form

transformation model show that there is no significant difference in estimated mean technical efficiency coefficients in comparison to the original panel stochastic frontier model, while the opposite is true for the covariates of technical efficiency. Still, these results should be taken with caution since the model included only a few variables possibly affecting matching efficiency.

On the whole, this work shows that there are differences in the efficiency of the matching process on a regional level in Croatia. While the structure of the specific labour market as well as the role of (regional) employment offices explains a part of this regional efficiency differentiation, demand deficiency still stands as one of the most important factors of matching unemployed persons with available vacancies in the Croatian labour market.

4 STRUCTURAL UNEMPLOYMENT IN CROATIA – HOW IMPORTANT IS THE OCCUPATIONAL MISMATCH?[103]

4.1 Introduction

Croatia is among those countries that have experienced tremendous changes in their labour markets after the collapse of the former socialist system and the transformation to a market economy. In the former system, most of the Central and East European (CEE) economies were based on a large industrial sector, while the service sector was relatively underdeveloped. When the transition process started, the service sector was emerging but it faced insufficiently skilled labour supply. Kucel, Vilalta-Bufi, and Robert (2011) explain how this situation led to a large unemployment of skilled labour from the industrial sector and increased employment of often under-educated workers in the service sector. Namely, this period of rapid structural change in all areas of the economy was characterized by the slow adjustment of the skills structure of the workforce.[104] Yet, this happened in the period of huge educational expansion in almost all CEE countries (Kucel et al., 2011).[105] Tomić and Tyrowicz (2010), for instance, argue that the educational boom observed in Croatia since the beginning of the 1990-ies was related to the high and intensifying demand for skills from the employers. However, this soon became a problem given that an excess of skilled labour in the labour markets inflated the entry qualifications to skilled jobs and produced over-education in the market. These two processes led to a sizable increase of both under-education in the early phase of transition, and over-education in the later, more matured phase of transition (Kucel, et al., 2011, p. 6).

Schioppa (1991), on the other hand, states how many studies show that those countries that are least flexible in matching their unemployed with available vacancies are actually those that have persistently high unemployment rates. According to him, labour market mismatch is usually the consequence of inadequate education and training or insufficient geographical and occupational labour mobility (Schioppa, 1991). Even in the transition economies it was expected that after the initial fall in the employment rate, the emergence of new (private) firms would reverse the process. However, this was for the large part halted by the extremely low mobility of workers across different occupations, industries, and locations (Boeri, 2000). Brixiova, Li, and Yousef (2009) further emphasize that skill shortages in CEE serve as the most important obstacle to faster labour reallocation and convergence to the EU-15 employment structures. Evidently, the current supply of labour has difficulties in adapting to a varying demand for labour that is associated with increasing competition and technological changes in the global market, which indicates the existence of structural unemployment.

[103] Earlier version was presented at the 24th annual EALE (European Association of Labour Economists) conference.

[104] For instance, Rutkowski (1996) argues how in Poland skills acquired under the old system lost their value in comparison with new, white-collar, skills.

[105] For example, in the period between 1990 and 2007, the number of persons in tertiary education in Croatia increased by 95% (Matković, 2009). Additionally, the Polish example shows that even in the first years of market-oriented reforms, there was a huge rise in the wage premium for white-collar workers, and a significant jump in the returns to education, which indicates that privatization strengthened the incentive for human capital investment (Rutkowski, 1996).

Therefore, this paper starts from the premise that the reason for high and persistent unemployment in Croatia is the shortage of adequate skills in the labour market, i.e., skills and knowledge of the labour force supply do not match the skills and knowledge that employers seek (demand). This means that the highest portion of the unemployment in Croatia is structural unemployment. The main research question is, thus, to what extent can the existing level of unemployment be attributed to structural (occupational) mismatch or by how much would unemployment fall were structural balance to be achieved?

In order to investigate this, the matching function approach is used by adopting a model first introduced in Dur (1999). The model estimates the matching function that explicitly incorporates the effect of mismatch instead of adding an arbitrary mismatch index into the matching function. However, in this paper the matching process is assumed not to be the same across submarkets. One of the limitations of the educational mismatch study by Dur (1999) is that it estimates only the aggregate matching function that covers the entire labour market.[106] This study estimates, besides the aggregate function, also the disaggregated matching functions based on the grouping of (similar) occupations and estimating the matching functions that explicitly incorporate the mismatch index for different submarkets. Also, the study uses occupations as a proxy for skills instead of the educational levels used in Dur (1999). This is justified on the grounds that occupations typically define the skill requirements of vacancy and they characterize the skills of a job-seeker much better than the level of education.

Furthermore, this is one of the first studies that tries to estimate the existence of the occupational (skills) mismatch in the Croatian labour market and thus should provide valuable policy information. Namely, the assumption that the main source of high and persistent unemployment in Croatia is incongruity between the supply and the demand in the labour market is not new; it is something used on a daily basis for political purposes. However, rigorous empirical testing is missing.[107] The results of this study could also be important for other transition economies since the attributes inherited from the previous system as well as the roads of transition and joining the EU were, to some extent, similar for all CEE countries.

This chapter is organized as follows. Section 4.2 gives the definition and importance of structural unemployment with emphasis on transition countries by reviewing the relevant literature. Section 4.3 provides the background of the Croatian labour market and gives the description of the data used in the analysis. In section 4.4, a short description of the model adopted from Dur (1999) is given while section 4.5 provides estimation results together with the relative importance of occupational mismatch for Croatian unemployment in the period 2004-2011. Section 4.6 concludes.

[106]Fahr and Sunde (2004) argue that the results on the aggregate level are of little help when trying to target certain labour market interventions to certain groups of workers or firms in order to maximize their impact.

[107]The only attempt to estimate some kind of skills mismatch up to now was done in a paper by Obadić (2004) where she estimated disaggregated matching functions according to qualification level and economic activity for Croatia in the period 1992(98)-2002. Recently, Matković (2011, 2012) contributed to the analysis of the so-called horizontal mismatch in the Croatian labour market between field of education and acquired job.

4.2 Related literature

Simultaneous (co)existence of unemployment and vacancies in the labour market is a well-known fact (Dur, 1999; Petrongolo and Pissarides, 2001; van Ours, 1991). One of the main reasons for this phenomenon is that the pairing or matching between vacancies and the unemployed is a process that requires some time, and whose efficiency depends on the behaviour of both employers and unemployed people in the process of seeking employment (Dur, 1999). This type of unemployment in the labour market is usually called *frictional unemployment*. Another reason for simultaneous existence of unemployment and vacancies in the labour market is that the characteristics of the unemployed are different from those which are necessary for the vacant positions, or because there is a mismatch between supply and demand in the labour market. This type of unemployment in the labour market is called *structural unemployment*. It follows that both the efficiency of the matching process and mismatch may be important determinants of the level of unemployment, with a given number of vacancies (Dur, 1999).[108]

The structural imbalance or mismatch thus entails a situation in which the characteristics of unemployed workers, particularly in terms of skills, work experience or location, differ from those of the jobs that are available (Jackman and Roper, 1987, p. 10). In other words, there is a mismatch between vacant jobs and unemployed workers such that if the latter were available with different skills and/or in different places the level of unemployment would fall (Turvey, 1977, p. 210). Obadić (2004), for instance, claims that mismatch can be a consequence of imperfect information, inefficient functioning of the labour market, as well as individual preferences and social values.[109]

Skills mismatch can be vertical and horizontal. Vertical mismatch is defined as a situation where the level of education or skills is above or below the required level of education or skills, while horizontal mismatch is defined as a situation where the level of education or skills is suited for the job, but the type of education or skills is inadequate to perform the job (CEDEFOP, 2010, p. 13). This latter type of mismatch is sometimes called education-occupation mismatch. However, most of the literature on mismatch has focused on the first type, i.e., differences between the job-seeker's achieved level of schooling and the level of education required for the job he/she applies for (see for instance, Hersch, 1991; or Sloane, Battu, and Seaman, 1999).

In addition, there is also the problem of 'inefficient' educational system that leads to over- or under-supply of specific skills in the labour market.[110] Sattinger (1993), for instance, shows that the quality of a job match determines the productivity level and earnings in a job. Barcena-Martin, Budria and Moro-Egido (2012), on a sample of European university graduates, further show that the mismatched earn on average 11.7% less than their well-matched counterparts.

[108] In addition to the above, unemployment may be the result of a low level of the overall demand for labour (*cyclical unemployment*), which has actually been happening in Croatia since the second half of 2008 when the financial and economic crisis emerged, and has further deepened the existing problems in the Croatian labour market.

[109] A comprehensive overview of the literature regarding skills mismatch is given in Quintini (2011).

[110] More about this problem in Croatia is explained in Matković (2011).

However, in order to utilize the stock of human capital in the population completely, it is essential to match individuals' education-specific skills with the occupational job characteristics (Nordin, Persson and Rooth, 2010), or to achieve optimal allocation every worker must be matched to a job that he or she performs better than all other workers. Hence, skills (mis)match points to the actual ability of employees to perform the tasks set before them effectively and efficiently, thus affecting the productivity and performance of the organizations in which they are employed (Položki Vokić, Tomić and Zrnc, 2011). Evidently, mismatch of skills, whether vertical or horizontal, can be a source of unemployment in the labour market. This is confirmed in several empirical studies, predominantly for the US labour market.

For example, Barlevy (2011) shows that mismatch of skills in the labour market is responsible for 2 out of 5 percentage point increase in unemployment due to the recent economic and financial crisis in the US. This is also confirmed by Estevao and Tsounta (2011) who show that mismatch between demand and supply of skills in the labour market in the US rose during the crisis and that in the circumstances of increased skills mismatch and the worsening conditions in the real estate market, unemployment is also increasing. According to their findings, structural unemployment in the US in 2010 was about 1.75 percentage points higher than before the collapse of the real estate market at the end of 2006. A similar finding is provided in Sahin, Song, Topa, and Violante (2012) where the authors show that mismatch across industries and occupations explains about one third of the total observed (recent) increase in the US unemployment rate (i.e., 0.6 to 1.7 percentage points of the total rise by about 5 percentage points), whereas geographical mismatch plays no apparent role. Cotti and Drewianka (2012), on the other hand, investigate the so-called 'jobless recovery' in the US and argue that the decrease in labour market efficiency is not simply due to the number of workers and employers looking to match, but also to the imbalances between workers' skills and employers' needs.[111]

Increased presence of mismatch in transition countries is the result of significant changes during the 1990-ies in the structure of product markets, which have led to changes in the structure of labour demand, that were not aligned with the labour supply (Obadić, 2004).[112] Furthermore, the persistence of structural unemployment could be caused by factors such as deterioration of human capital of the unemployed (skills out of date) or a negative perception of the unemployed on the part of the potential employers (Šergo et al., 2009). Yet, although important, studies on skill, educational or occupational mismatch in former transition countries are scarce. This is primarily a result of the lack of adequate data (Kucel et al., 2011). In addition, most of the studies that exist in this area usually cover school-to-work transition, sometimes differentiating between vertical and horizontal mismatch (see, for instance, Farčnik and Domadenik, 2012; Kogan and Unt, 2005; or Roberts, 1998). However, several recent studies on the transition from

[111] Faberman and Mazumder (2012) argue that skills mismatch in the US labour market is most significant for the group of workers in occupations that require a moderate amount of skills. Furthermore, Jaimovich and Siu (2012) explain how jobless recoveries in general are due to jobless recoveries in the middle-skill occupations that are disappearing due to the so-called job-polarization, i.e., disappearance of employment in occupations in the middle of the skill distribution.

[112] Bean and Pissarides (1991) show how in Britain in the 1970-ies and 1980-ies any shift in the pattern of demand for different types of labour was associated more with the shifts in the structure of product demand. According to them, mismatch is caused by the qualification, sectoral and regional incongruities.

centrally planned economy towards market economy shed important insights on how the mismatch could have developed in some of these countries (Bartlett, 2012; Jeong, Kejak and Vinogradov, 2008; Kucel et al., 2011; Lamo and Messina, 2010).

For instance, Jeong et al. (2008) explore the reallocation of labour in selected transition economies along educational and occupational dimensions, focusing on the composition instead on the level of human capital. They show that in the Czech Republic and Poland, there has been a major shift in both education and occupations from technical to business fields since 1990, while they do not find the same pattern in Hungary, attributed to the earlier timing of its transition. In the paper, they model the labour reallocation as a response to the changing demand structure which, when calibrated with the Czech and Polish data, generates a large movement of workers with technical education and experience into business occupations in the early transition. Based on this, they estimate that the discounted sum of output loss due to the human capital mismatch amounts to between 8% and 40% of the 1990 aggregate output. Lamo and Messina (2010), on the other hand, examine incidence and consequences of educational mismatch in Estonia in the period 1997-2003. They show that the incidence of over-education in Estonia during the observed period is rather high - more than 12% of workers are formally overeducated for their jobs. They also analyse the wage penalties of being mismatched and find significant penalties to over-education, as wages were lower on average by 24%.

Kucel et al. (2011) investigate the determinants of education-job mismatches in the Central and East European countries in the second half of the 2000-s, distinguishing between two types of labour markets: the occupational (Czech Republic, Poland and Slovenia) and the internal labour market (Estonia, Lithuania, and Hungary). They find that the first group of countries experiences fewer (vertical, horizontal and skill) mismatches than the second one due to their better connection between education and the labour market. In addition, they find that, although similar, labour mismatches in these countries differ from those in the Western economies in two main aspects: (i) the transition in the CEE countries created a larger pool of under-educated individuals; and (ii) fields of study such as social science and sciences, which tend to increase mismatch in Western countries, are found to improve vertical mismatch in the 'occupational labour market' group of CEE countries.

Bartlett (2012) discusses high structural unemployment in the countries of Western Balkan and further investigates the use of various skills anticipation methods to inform education and training policy in the region. He argues that structural mismatch is a persistent phenomenon in transition economies, in contrast to more developed economies where such skill mismatches tend to decline over time. According to him, this is especially visible in the Western Balkan countries, for which he mainly blames the unadjusted educational system in these countries. The author (Bartlett, 2012) concludes that, instead of a supply-led approach to education and training provision in the region it might be more appropriate to adopt a more decentralized demand-led approach to resolving skill mismatch and skill gaps.

The problem of structural unemployment in Croatia is tackled by, for example, Obadić (2006a, b), where via calculation of regional mismatch she indicates the existence of structural unemployment due to mismatch between the demand in the labour market and the location of workers seeking employment. Botrić (2011), on the other hand, tries to explain the basic determinants of structural unemployment in the countries of Southeast Europe, and suggests that a high fiscal burden (high taxes), the overall restructuring of the economy, and remittances (from overseas) are primary determinants of high structural unemployment in the region.

However, the only paper, up to recently, that tried to estimate some kind of skills mismatch for Croatia is the one by Obadić (2004). Based on research carried out for transition countries, she concludes that the existence of constant or diminishing returns in the matching function implies the existence of an inefficient labour market in the period of the relocation process during the transition. In the paper, she estimates disaggregated matching functions according to qualification level and economic activity for Croatia in the period 1992(98)-2002. On the basis of the estimated coefficients of (partial) elasticity she concludes that the most efficient in new hirings are the following qualifications: skilled and highly-skilled, secondary-school level and university level (because of the increasing returns to scale). Furthermore, she shows that in qualifications such as skilled and highly-skilled, secondary-school level and non-university (higher education) level, there is excess of both supply and demand for labour, i.e., a mismatch (high coefficient of elasticity for unemployed and low (negative) coefficient of elasticity for vacancies). As far as economic activities are concerned, the most efficient ones are the manufacturing industry, wholesale and retail trade, and other social and personal service activities (increasing returns to scale) where there is also excess of both supply and demand (size of the coefficients), i.e., a mismatch. In sectors such as hotels and restaurants and transportation, storage and communication, there is shortage of supply. Matković (2011, 2012), in his recent works, indicates that there exists horizontal mismatch in the Croatian labour market between field of education and acquired job (occupation).

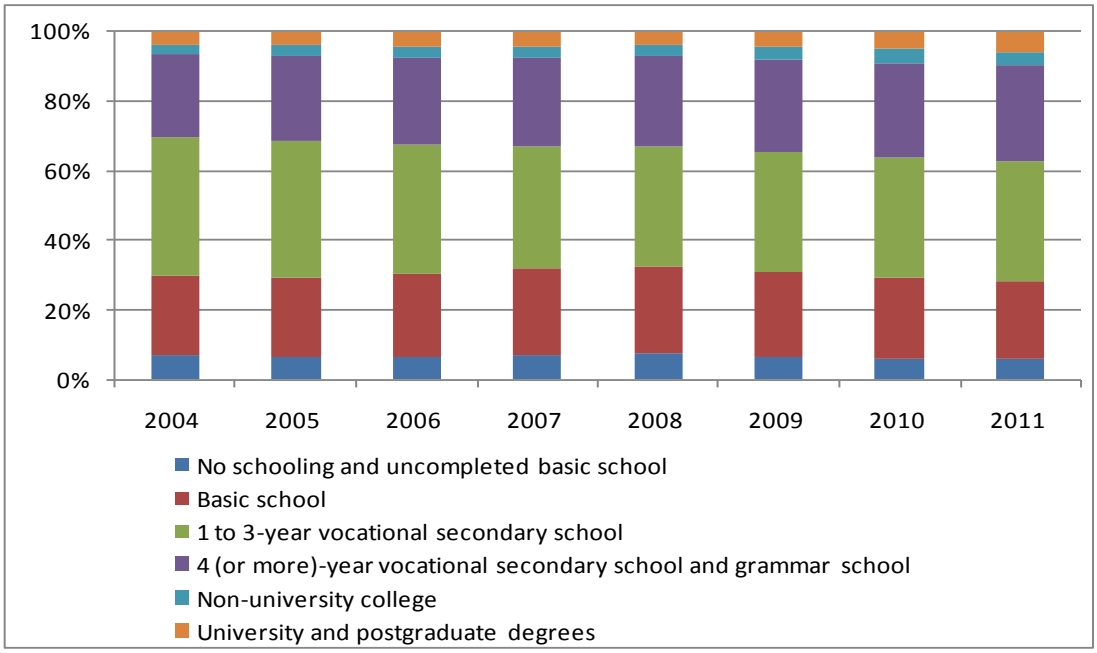
Furthermore, analysing the size and composition of the middle class in Croatia and Poland in the period 1995-2008, Tomić and Tyrowicz (2010) show that, based on occupations or professions, the middle class in Croatia is the skilled class. Additionally, they show that as the share of skilled workers has increased in the working population, highly skilled workers have moved above the median income, thus reducing their representation in the middle class. The middle class is mostly composed of those with high school and vocational education, educational groups that interchanged their shares during the observed period. In other words, the group with vocational secondary education increased its share in both the working population as well as in the middle class. The share of both those with elementary and higher education within the middle class is relatively small (Tomić and Tyrowicz, 2010).

4.3 Setting and data description

Currently, the labour market in Croatia is characterized by low activity, low employment, and high unemployment rates. This indicates a lack of flexibility in the Croatian labour market, but also internal structural problems. This situation is not only the consequence of the ongoing

economic and financial crisis; it is a constant process ever since the collapse of the socialist system at the beginning of the 1990-ies. Nevertheless, there is much heterogeneity among the participants in the labour market in Croatia. Employment and unemployment by region (NUTS2) reveals that there are significant regional differences (Chapter 3). The same holds for differences in skills, occupations or sectors of economic activity. It is familiar that unemployment is much higher among lower-educated workers than among higher-educated workers.[113] Figure 4.1 shows the composition of the unemployed in Croatia by education level in the period 2004-2011.

Figure 4.1. Share of the average number of unemployed by education level in total unemployment (2004-2011)



Source: CES.

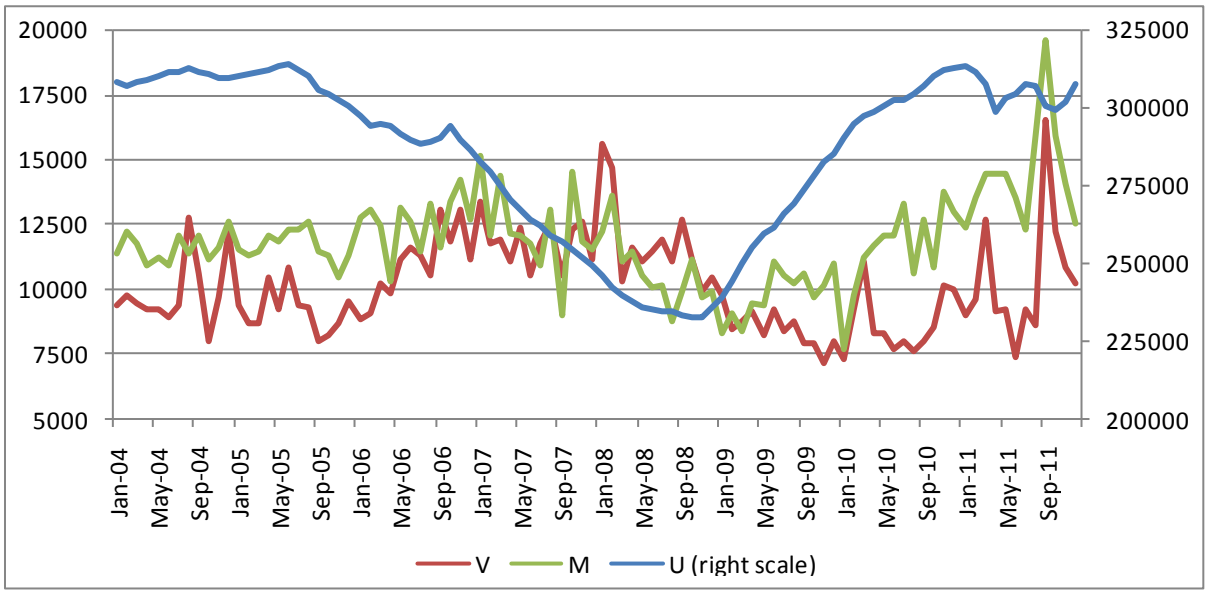
It is evident that in Croatia the bulk of unemployment is composed of people with 1 to 3-year vocational secondary school, followed by people with 4-year vocational secondary and grammar school and those with only elementary school. The share of those without completed elementary school is decreasing, whilst the share of those with higher education is increasing, especially after the beginning of the crisis in the second half of 2008. The structure of employment in Croatia by industry and occupation in comparison with EU countries shows a similar situation. For instance, there is a significantly higher proportion of people employed in agriculture in Croatia (by almost 10 percentage points above the EU-27), while the proportion of those employed in services is smaller by 3-8 percentage points in comparison with the EU-27. On the other hand, Croatia has the largest share of employed skilled manual workers (by 9 percentage

[113] In their work, Jackman, Layard and Savouri (1991) state that in all the countries unskilled people have much higher unemployment rates than skilled people, and they give the example of the US and Great Britain with the unemployment rate of semi-skilled and unskilled workers over four times that of professional and managerial workers.

points higher than the EU-27), while the share of skilled non-manual workers is smaller by 8 percentage points in comparison to the EU-27. It is interesting to notice that the proportion of those with elementary occupations is the lowest in Croatia. This difference in the educational structure of the employed and unemployed population could represent an indicator of skills mismatch between supply and demand in the labour market (Bićanić and Babić, 2008). However, in order to confirm this, we should wait for the results of the empirical analysis provided in section 4.5.

The data used in this paper are monthly data from the Croatian Employment Service (CES) on: (1) the number of registered unemployed persons (*U*), (2) the number of reported vacancies (*V*), and (3) the number of employed persons from the Service registry (*M*) in the period from January 2004 until December 2011. Figure 4.2 shows the movement of these variables in a given period based on seasonally adjusted data.

Figure 4.2. Monthly trends in aggregate unemployment, employed from the CES registry and the reported vacancies, seasonally adjusted data (2004-2011)



Notes. Seasonally adjusted by X-12 ARIMA (US Census Bureau).
U = unemployment; V = vacancies; M = matchings.

Source for original data: CES.

Apart from the exceptionally large number of the unemployed, the figure shows that the employment records from the Service are generally slightly higher than the reported vacancies in the same month. However, this picture is expected given that since 2002 the employers were no longer legally obliged to report vacancies to the Croatian Employment Service. CES states that after 2004 all the transitional effects of changes in legal obligations on reporting vacancies were

no longer visible (CNB, 2010). Nevertheless, vacancy series in this paper are based only on vacancies posted at the Croatian Employment Service during the respective month.[114]

To be able to detect the existence of mismatch in the labour market, all variables are divided according to the nine broad occupational groups:[115]

1. Legislators, senior officials and managers;
2. Professionals;
3. Technicians and associate professionals;
4. Clerks;
5. Service workers and shop and market sales workers;
6. Skilled agricultural and fishery workers;
7. Craft and related trades workers;
8. Plant and machine operators and assemblers;
9. Elementary occupations.

Even though skills mismatch is usually examined via the educational groups (for instance, Dur, 1999), due to unavailability of that kind of data for vacancies and number of hires (matches), we decided to analyse structural unemployment in Croatia via occupational mismatch. In the context of the Croatian labour market, as well as its economic and educational structure, we believe that occupational (mis)match may provide even better information.

For instance, Fahr and Sunde (2001) argue how separating labour markets by occupations (as an alternative to industries or regions) allows looking at the relevant comparable measures for flows and stocks, supporting their argument with evidences which suggest that virtually all job-seekers stay within their profession (occupation) which is not true with the industry or region. In addition, the same authors explain how occupation usually defines the skill requirements of vacancy and characterizes the skill of a person, which may point to better matching quality in searching for a job (Fahr and Sunde, 2002). Additionally, the level of education is usually the same in a specific occupational group (Table C.4 in Appendix C), which means that the use of occupation categories as a proxy for skills is justifiable in this case. Evidently, information on job openings by occupation is not important only for those looking for jobs, but also for those considering education and training options and for policy makers in employment services, education and training (Shah and Burke, 2001).

[114] I.e., they represent the flow (as opposed to stock) variable. According to the Employers' Survey (CES, 2011), 54.0% of employers said they were using CES services in the process of searching and hiring workers in 2010. Earlier surveys (CES, 2008, 2009, 2010) show similar trends: 58.4% of employers said they were using CES services in searching and hiring workers in 2009; 67.2% of them in 2008; and 75% of them in 2007. Evidently, when hiring new workers, firms, in addition to the CES services, are increasingly using other means of advertising vacancies.

[115] Based on the International Standard Classification of Occupations (ISCO). Military occupations are left out of the analysis since in some of the periods (months) there were no registered unemployed or vacancies in this group.
Perhaps a more detailed categorization of occupations would bring more information. However, due to its specific construction, the next level of categorization provides too detailed grouping of occupations, which means that many of these groups do not have any open vacancies or even any unemployed in most of the months studied in the paper and thus they could not be used in the empirical estimation. Similarly, Dur (1999) in his analysis used only four broad educational groups.

The assumption here is that each of the occupations represents a separate submarket in the overall labour market. Namely, this assumption implies that jobs within each submarket are reasonably homogeneous but across submarkets differ significantly,[116] so that job-seekers in one specific submarket (occupation) never apply for a job in any other submarket (occupation), and vice versa. Even in the absence of structural imbalance, the unemployment rate is usually not equal to the vacancy rate in aggregate or in any particular submarket[117] so we measure occupational imbalance (mismatch) relative to the existing aggregate levels of unemployment and vacancies in the economy. The next figure (Figure 4.3) shows exactly this - shares of the unemployed in the segment (submarket) *i* in total unemployment (U_i/U) and shares of vacancies in the submarket *i* in the total number of vacancies (V_i/V) for each of the submarkets (occupations).

Figure 4.3 indicates that in the case of low-skilled workers (elementary occupations), the share of the unemployed in total unemployment is higher than the proportion of vacancies in this occupation in relation to the total vacancies. On the other hand, in the case of highly skilled workers (professionals), the share of vacancies is higher than the proportion of the unemployed. In some other professions (such as, for example, technicians and associate professionals), these shares are actually very similar. Another important thing observable from the figure is that there are no major shifts in the share of the different submarkets (occupations) over time, and these differences remain almost the same even after the expiration of several years. Clearly, based only on this figure one could say that there exists a mismatch between supply (the unemployed) and demand (vacancies) in some of the submarkets, while in others there is no visible mismatch.

However, as observable in Figure 4.3, the share of some submarkets (occupations) in the total number of both vacancies and unemployment is too small[118] to be able to bring any strong conclusions. In addition, some of these occupations are too distinct from each other and the labour (sub)market probably functions in a completely different way. Therefore, we have grouped these nine occupations into two main categories[119] (that will also be used in subsequent empirical analysis):

1. *white-collar occupations* that include legislators, senior officials and managers; professionals; technicians and associate professionals; and clerks, and
2. *blue-collar occupations* that include service workers and shop and market sales workers; skilled agricultural and fishery workers; craft and related trades workers; plant and machine operators and assemblers; and elementary occupations.

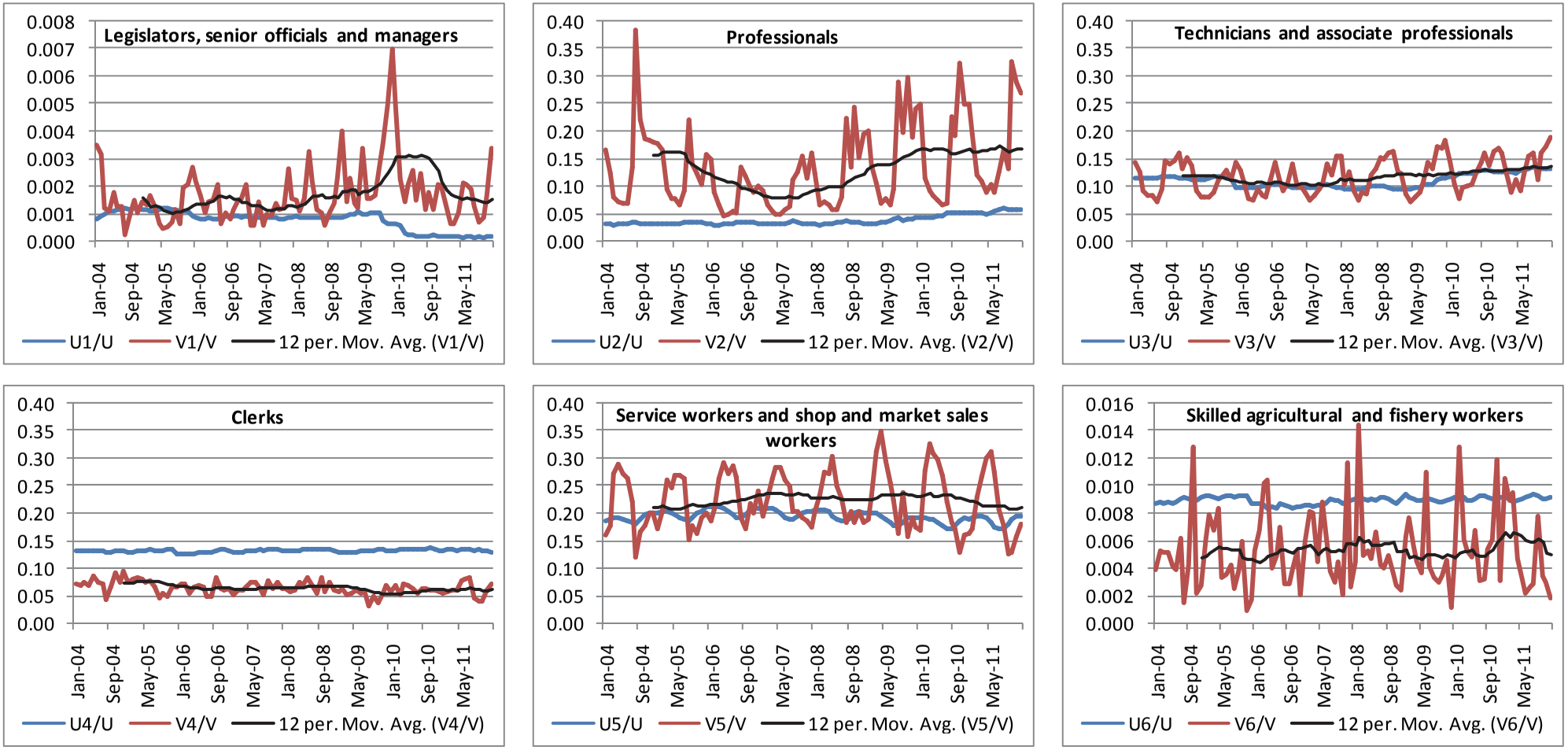
[116]Of course, it is possible that in reality there is a violation of this assumption. However, because of the need for simplification for further analysis, complete 'separability' of the submarkets is assumed.

[117] Because, for instance, the average durations of unemployment and vacancies is not the same (*frictional unemployment*); the labour market does not clear if wages are held too high; or there is an impact of the fluctuations in aggregate demand (Jackman and Roper, 1987).

[118]Legislators, senior officials and managers; skilled agricultural and fishery workers; and plant and machine operators and assemblers, with shares in total employment and vacancies of less than 10%.

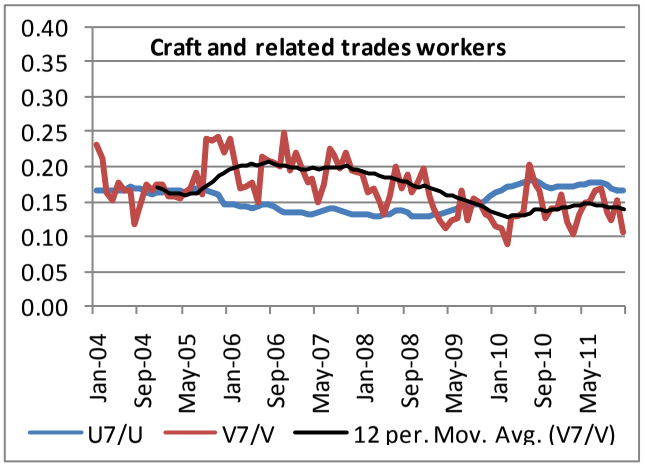
[119] Similarly as in Chapter 2.

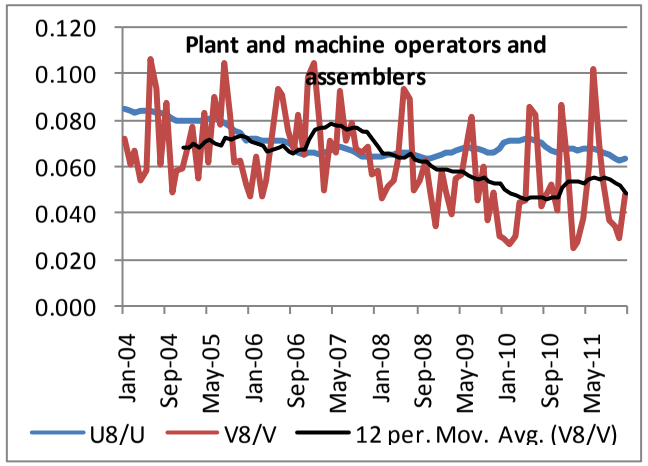
Figure 4.3. Share of unemployment and vacancies in total unemployment (vacancies) by occupations

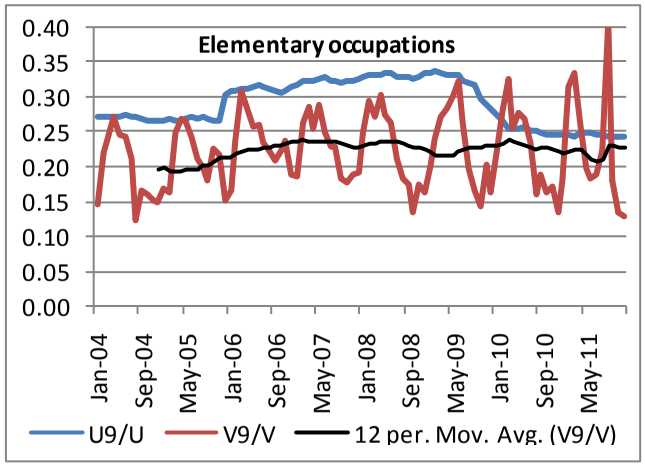


(figure continues)

(continued)





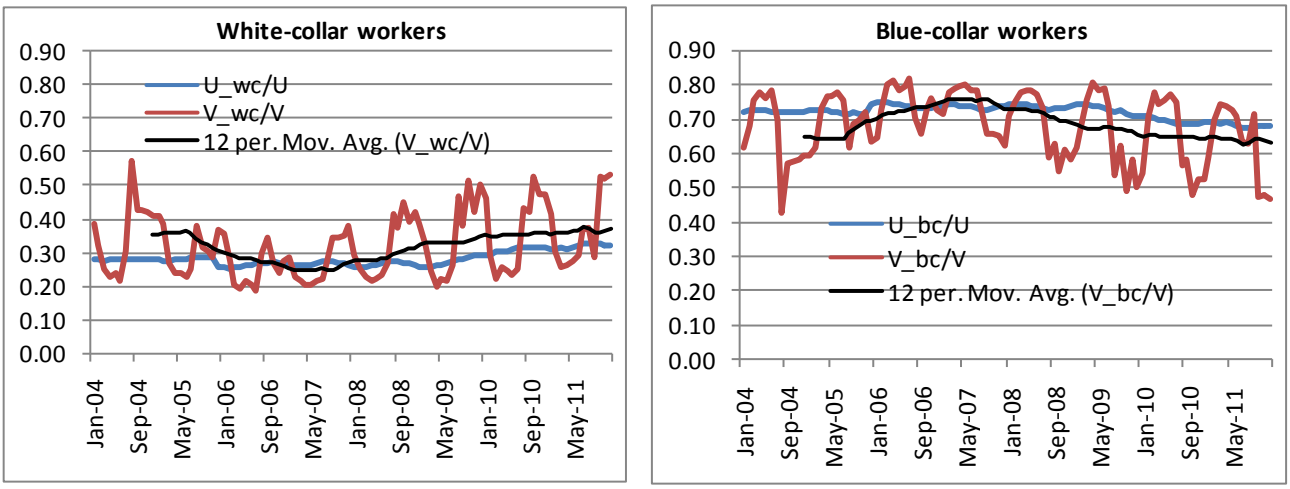


Notes. *Ui/U* = the share of unemployed in the segment (submarket) *i* in total unemployment; *Vi/V* = the proportion of vacancies in the submarket *i* in the total number of vacancies; *i=1,...,9*, where 1 represents legislators, senior officials and managers and 9 represents elementary occupations.

Source: Author's calculation based on CES data.

Figure 4.4 shows the shares of unemployment and vacancies for these two groups (white- and blue-collars) in total number of the unemployed and vacancies. Blue-collars evidently have a much higher share in unemployment, while for vacancies the difference is not so obvious. Still, as is evident from Figure 4.4, there is also no visible mismatch in these two broad groups of occupations. Nevertheless, the empirical analysis will be conducted for these two submarkets separately in order to account for possible differences in the functioning of the labour market (including the matching process) for different (more similar) groups of occupations.

Figure 4.4. Share of unemployment and vacancies in total unemployment (vacancies) by white- and blue-collar classification



Notes. *U_wc/U* = the share of unemployed in the white-collar segment (submarket) in total unemployment; *V_wc/V* = the proportion of vacancies in the white-collar submarket in the total number of vacancies; *U_bc/U* = the share of unemployed in the blue-collar submarket in total unemployment; *V_bc/V* = the share of vacancies in the blue-collar submarket in the total number of vacancies.

Source: Author's calculation based on CES data.

4.4 Empirical strategy

The model in this paper is based on the procedure introduced in Dur (1999) which actually stems from the paper by Jackman and Roper (1987).

It all starts with the concept of the matching function. The main goal is to model the interrelationship between workers looking for jobs, firms looking for workers and a number of other variables, the results of which give the number of new jobs at any time. Hujer et al. (2002) explain how the matching process actually serves as a proxy for the differences in the geographic and skill characteristics between the vacant jobs and the job-seekers. According to the relevant literature (Dur, 1999; van Ours, 1991), the matching function describes the relationship between the flow of filled vacancies in some period and the stock of the unemployed and job vacancies at the beginning of the period:

$$M_i = f(U_i, V_i), \tag{4.1}$$

where *M* denotes the number of successful matches, *U* represents the number of unemployed, *V* is the number of vacancies, while the coefficient *i* indicates the occupation in this case.

One of the main drawbacks of the matching function defined in this way is that it does not take into account the employed workers who change jobs; instead, the assumption is that hiring (matching) comes exclusively from the category of unemployed. However, this is a standard assumption in the literature that uses the matching function for the purpose of examining the functioning of the labour market.

The above expression is often written in the form of a Cobb-Douglas function:

$$M_i = kU_i^{\alpha}V_i^{\beta}, \tag{4.2}$$

where *k* indicates the efficiency of labour markets, and α and β are the coefficients of (partial) elasticities that indicate the relative importance of supply (*U*) and demand (*V*) in the labour market. Factors affecting matching efficiency include, for example, the introduction of labour market intermediaries, introduction of social insurance, unionization, and changes in the mobility of labour (Nickell et al., 2003). Basically, as noted above, the efficiency of the matching process mostly depends on the search behaviour of both employers and job seekers during the process of seeking employment.[120]

Dur (1999) lists two variables that could help in explaining the search behaviour of the employers and the unemployed: the level of unemployment benefits in relation to wages (*replacement rate*) and the share of long-term unemployed in total unemployment. The level of unemployment benefits (relative to the level of wages) affects search behaviour in two ways. If the level of benefits is higher, it may reduce the search intensity of the unemployed because the net income gain of finding a job reduces. Additionally, the unemployed may become less willing to accept a job at a given wage. Both ways, fewer vacancies will be filled, i.e., the flow of matches is lower, given the stock of the unemployed and vacancies.[121] On the other hand, the share of long-term unemployed in total unemployment may have a negative effect on the number of filled vacancies if employers stigmatize or if the long-term unemployed become discouraged. Yet, the benefit level is usually lower (or non-existent) for long-term unemployed than for short-term unemployed. A higher share of long-term unemployed in total unemployment thus should reduce the average replacement ratio, leading to lower reservation wages, and thus more filled vacancies.[122] Hence, the effect of the share of long-term unemployed on the number of matches is theoretically ambiguous (Dur, 1999).

[120] The more effective employers and job-seekers are in their search process, or the higher the probability that their contact results in a match, the higher the flow of matches is, given the stocks of the unemployed and vacancies (Dur, 1999).

[121] Marimon and Zilliboti (1999), however, point out that higher unemployment benefits may affect the extension of time devoted to search for employment in order to find a better 'match' which actually increases the efficiency of the matching process.

[122] In Croatia, the share of long-term unemployed in total unemployment is decreasing during the recession (as the number of total unemployed increases, the proportion of those unemployed for more than 12 months in total unemployment reduces), which means that this variable could partially control for the state of the economy.

As mentioned before, it is assumed that the aggregate labour market consists of a number of completely separable submarkets differentiated by the type of occupation. This means that job-seekers belonging to occupation *i* cannot (or do not) search for a job in any other occupation. The same goes for vacancies – a vacancy that belongs to occupation *i* is never filled by a job-seeker that belongs to some other occupation. Thus, the aggregate matching function is just the sum of the matching functions across the whole labour market:

$$M = \sum_i M_i = kU^{\alpha}V^{\beta}\sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}. \tag{4.3}$$

Expression 4.3 shows that the aggregate number of filled vacancies (matches) depends on the stocks of aggregate unemployment and vacancies, the efficiency parameter *k* and the distribution of unemployment and vacancies over submarkets (occupations).

The term $\sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}$ in expression 4.3 is equal to one if, for each submarket (occupation) *i*, the share of the unemployed that belongs to the submarket *i* in aggregate unemployment (U_i/U) is equal to the share of vacancies belonging to the submarket *i* in aggregate vacancies (V_i/V). If this term is actually equal to one, i.e., the labour market situation is equally favourable (depressed) in each submarket, it is called **perfect structural balance** (Dur, 1999, based on Jackman and Roper, 1987).[123] The difference between actual unemployment (U) and unemployment in perfect structural balance (U_S) represents an indicator of mismatch in the labour market. From expression 4.3 this difference equals to:

$$U - U_S = U \cdot \left(1 - \sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}\right) = U \cdot mm, \tag{4.4}$$

where *mm* represents the mismatch indicator that can be interpreted as the share of total unemployment that can be attributed to mismatch.[124] Obviously, the importance of mismatch on the overall level of unemployment depends on the distribution of both unemployment and vacancies over submarkets (occupations), but also on the size of the particular submarket. This means that if both U and V are high in one submarket and low in another, shifting the unemployed from the first submarket to the second one does not tremendously increase the number of matches, or that relatively high unemployment and low vacancies in a quite small submarket leads to only a moderately higher level of *mm* (Dur, 1999). Based on this expression (4.4), we can observe how expression 4.3 represents the matching function that incorporates the effect of occupational mismatch on the (aggregate) flow of filled vacancies.

[123] Please see Appendix C for details.
[124] For details about this result, please refer to the explanation in Appendix C.

In order to estimate how much of (total) unemployment can be attributed to occupational mismatch in the period January2004-December2011 we use the matching function derived in the expression 4.3. Its empirical counterpart looks like:[125]

$$\log M_t = const. + \sum_j \lambda_j \log k_{j,t-1} + \alpha \log U_{t-1} + \beta \log V_t + (1-\xi)\log \sum_i \left(\frac{U_{i,t-1}}{U_{t-1}}\right)^{\alpha} \left(\frac{V_{i,t}}{V_t}\right)^{\beta} + \varepsilon_t \qquad (4.5)$$

where index *t* is introduced in order to distinguish between different time periods (months).[126] The error term is assumed to have all the usual characteristics. Again, as is evident from expression 4.5, the mismatch indicator is incorporated explicitly into the matching function.

Parameter k_t in expression 4.5 represents a set of variables that might affect the search behaviour of both the unemployed and employers, i.e., the efficiency of the matching process. In this case, we use (linear) time trend to account for changes in search behaviour related to unobserved characteristics.[127] In addition, instead of the *replacement rate* and the share of long-term unemployed in total unemployment, we use the share of the number of users of unemployment benefits in total unemployment. The reason for this is twofold. First, there is a lack of data concerning the (minimal) amount of monetary benefits in each of the observed periods (months) for the calculation of the actual replacement rate.[128] Second, the share of the number of users of unemployment benefits in total unemployment and the share of long-term unemployed in total unemployment are highly correlated, and, thus, we use only this one variable.[129]

4.5 Estimation results

The model in this paper is estimated using non-linear least squares (NLS) estimation, but because of possible simultaneity, we also estimate the model using nonlinear two-stage least squares instrumental variable (TSLS IV) estimation, treating the unemployment, vacancies and the share of the number of users of unemployment benefits in total unemployment as endogenous. In addition to exogenous and lagged endogenous variables, as additional instruments we use logs of the index of construction works, the share of the average net in the

[125] For more details, please refer to Appendix C.

[126] As already mentioned, only the unemployment variable is in a 'stock' form while vacancies are a 'flow' variable (the so-called 'stock-flow matching'; see, for instance, Dmitrijeva and Hazans, 2007 or Jeruzalski and Tyrowicz 2009) and thus the unemployment variable is taken as reported at the end of the previous month while vacancies represent all vacancies reported at CES during the respective month.
Besides the log-linearization, in the literature (Dur, 1999; Munich, Svejnar, and Terrell, 1999) all the data are usually scaled (normalized) by the size of the labour force. However, since the size of the labour force in Croatia varied considerably during the observed period and it is not available on a monthly basis for different occupations from any official statistical source, in this paper we do not normalize the data by the size of the workforce because it could negatively affect the statistical properties of the model.

[127] Time trend is usually used to allow variations in the efficiency of the process of matching. If the coefficient for the time trend in expression 4.5 is less than zero, then the efficiency of the matching process decreases over time, and vice versa.

[128] Although we prove that unemployed persons receiving unemployment benefits (in monetary terms) are less likely to search for work (Chapter 2), we also point out that only one fifth of the unemployed (in the period 1996-2009) receives some sort of compensation and conclude that this factor has no greater effect on the search for (and finding) jobs.

[129] Correlation coefficient between these two variables in the observed period amounts to 0.73.

average gross wage and the spread between interest rates on short-term loans and interest rates on foreign currency deposits for enterprises (see Appendix C for details).[130]

Furthermore, since these are relatively high frequency data (see Figure 4.2), controlling for seasonal variation seems particularly important. Therefore, estimations include monthly dummies to control for differentiated vacancies and outflows (matchings) throughout each year. Given that we have data on the flow of filled vacancies by occupations, we estimate the matching function not only on the aggregate level, but also for each of the submarkets defined in the previous section - *white-collar and blue-collar occupations* – using the same approach as for the aggregate function.

4.5.1 NLS and TSNLS estimation results

Even though the model assumes constant returns to scale, we also estimate the unrestricted model (see Table C.5 in Appendix C).[131] Since in most of the cases the null hypothesis about constant returns to scale ($\alpha + \beta = 1$)[132] cannot be rejected, we present here only the restricted model specification (Table 4.1). First, let us discuss the results for the aggregate function.

At first glance, it seems that there are no major differences between NLS and IV estimation. For both the NLS and TSNLS IV estimation the coefficient of elasticity (α) for the unemployed is larger than the coefficient of elasticity for vacancies (β) which means that firms are less successful in finding workers than workers in finding jobs. The reason for this may be the limitation in labour supply, mismatch, the asymmetry of information, etc.[133] Additionally, for both the NLS and TSNLS IV estimation, the coefficient for the incorporated mismatch index (equation 4.5) seems to be insignificantly different from its theoretical value of one. Finally, the share of the users of unemployment benefits in total unemployment has a significant negative

[130]In Dur (1999), instruments used in the model are, besides lagged endogenous variables, the logs of capacity utilization, the tax wedge, consumer minus producer prices, the size of the working-age population and the capital stock. Unfortunately, data for most of these variables are not available in Croatia, especially on a monthly basis.

[131] Those estimations suggest that the mismatch index does not have a (statistically) significant impact on the process of matching. However, for both white- and blue-collar submarkets the results suggest a negative impact of occupational mismatch on the process of matching. Time trend, on the other hand, positively affects the matching process, while the share of the users of unemployment benefits in total unemployment has a negative effect on the matching process in all the (sub)markets. Additionally, in most of the cases the null hypothesis about constant returns to scale ($\alpha + \beta = 1$) cannot be rejected. However, estimation results for blue-collar occupations suggest that the function exhibits increasing returns to scale. The same is true for the TSNLS estimation for the aggregate labour market.

[132]For more information on returns to scale in different empirical estimations of the matching function, see Petrongolo and Pissarides (2001).

[133] However, this result is not unusual since in many empirical works the number of unemployed tends to affect hirings more than the number of posted vacancies (for instance, in Fahr and Sunde, 2006; Ibourk et al., 2004; or Jeruzalski and Tyrowicz, 2009, whereas, for example, in Dur, 1999 or van Ours, 1991 vacancies have larger weight). Petrongolo and Pissarides (2001) explain how not including on-the-job search usually leads to a higher coefficient for the unemployment variable in the matching function. Still, one needs to keep in mind that ever since 2002 firms in Croatia are not obliged to post vacancies at the Croatian Employment Service and, thus, the number of vacancies used in the estimation is not the total number of vacancies in the economy in a given month. Additionally, as of 2008, there has been a recession in Croatia that has caused low generation of new vacancies which might also generate some of the difference in elasticities between unemployment and vacancies.

impact on the matching process, while time trend significantly positively affects the matching process.[134]

Table 4.1. Estimation results for the restricted estimation

	aggregate function		**white-collars**		**blue-collars**	
	NLS	**TSNLS**	**NLS**	**TSNLS**	**NLS**	**TSNLS**
α	0.815***	0.849***	0.733***	0.611***	0.850***	0.926***
	(15.563)	(11.839)	(13.101)	(7.887)	(11.316)	(8.285)
β	0.185	0.151	0.267	0.389	0.150	0.074
	(---)	(---)	(---)	(---)	(---)	(---)
ξ	-1.180	-1.739	-1.307**	-1.733***	1.987	7.793
	(-1.418)	(-1.375)	(-2.362)	(-3.873)	(0.415)	(0.407)
time trend	0.003***	0.003***	0.005***	0.004***	0.002**	0.002***
	(5.958)	(5.197)	(7.704)	(6.801)	(3.063)	(2.843)
unben	-1.382***	-1.355***	-1.602***	-1.108***	-1.335***	-1.454***
	(-4.479)	(-3.853)	(-5.155)	(-3.224)	(-3.291)	(-2.989)
constant	-5.094***	-5.171***	-4.798***	-3.608***	-5.316***	-5.779***
	(-9.032)	(-7.285)	(-8.689)	(-5.281)	(-6.592)	(-5.380)
$\overline{R}^2$	0.911	0.910	0.824	0.814	0.920	0.917

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses.
unben – natural logarithm of the share of the users of unemployment benefits in total unemployment.
Monthly dummies are statistically significant, detailed results available upon request.
NLS – non-linear least squares. **TSNLS** – two-stage non-linear least squares with endogenous variables: unemployment, vacancies and the share of the users of unemployment benefits and instruments: **lagged** endogenous variables plus log of monthly index of construction works; log of monthly share of the average net in the average gross wage and log of the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises.

Source: Author's calculations based on CES data.

Still, more interesting results occur if we look at the disaggregated functions, i.e., different submarkets based on similar groups of occupations. In all the cases (submarkets) results are largely similar to those for the aggregate function. The differences mainly lie in the size of the elasticity coefficients (in the market for white-collar occupations there is somewhat smaller weight on the unemployed) or the coefficient for the time trend (slightly higher for white-collar occupations or slightly lower for blue-collar occupations). The share of the users of unemployment benefits among the unemployed negatively affects the matching process in both disaggregated markets.

[134]Šergo et al. (2009) state how the decrease in the labour market 'churn' as a function of time suggests that the labour market stabilizes over time because the number of firms searching for workers and the number of workers searching for jobs becomes less and less evident. They show that the improvement of the matching efficiency in Croatia has been rising since the war and the de-industrialization shocks in the 1990-ies, which indicates that Croatia is experiencing greater matching efficiency in the labour market over time. Similar is evidenced in Chapter 3.

However, the main difference lies in the coefficient for the mismatch indicator. For instance, it seems that in the market for white-collar occupations, the occupational mismatch index significantly positively[135] affects the process of matching, while in the market for blue-collar occupations this index has a negative (insignificant) impact. This finding suggests that perhaps due to the specific distribution of both unemployment and vacancies over different submarkets (occupations) and due to the size of each particular submarket, the mismatch index proves to be insignificant (and positive) on the aggregate level while it has different (opposite) effects in the submarkets for white- and blue-collar occupations. This result supports the logic behind the estimation of the disaggregated matching functions in this paper. Evidently, the labour market for white-collar and blue-collar occupations operates on different postulates.

As already mentioned, there has been a recession in Croatia since the second half of 2008, which has caused a huge rise in unemployment (Figure 4.2). In order to see whether the crisis may have caused some of the (unusual) results in our estimations, we estimate the (restricted) models again for two different sub-periods: 2004-2007 and 2008-2011 (Table 4.2). Although the sample is now much smaller (it is halved from 96 observations to only 48 observations), we can observe some differences between the two sub-periods. For instance, time trend is significant (and positive) for the blue-collar occupations as well as for the aggregate market only in the second sub-period (2008-2011) while for the white-collar occupational submarket the opposite is true. The coefficient for the incorporated mismatch index is not significant in any of the presented cases, although it suggests a positive impact on the matching process while the share of the users of unemployment benefits in total unemployment has a significant (negative) effect only in the labour market for white-collars. In addition, in almost all of the estimations the coefficient for the unemployment (α) is smaller than in the original model specification (Table 4.1). The 'appropriateness' of instruments also differs between the two sub-periods.

[135] Remember that in the empirical equation (expression 4.5) the coefficient for the mismatch index is expressed as $(1-\xi)$.

Table 4.2. Estimation results for the restricted estimation – crisis effect

	aggregate function				white-collars				blue-collars			
	2004-2007		2008-2011		2004-2007		2008-2011		2004-2007		2008-2011	
	NLS	TSNLS	NLS	TSNLS	NLS	TSNLS	NLS	TSNLS	NLS	TSNLS	NLS	TSNLS
α	0.660***	0.640***	0.624***	0.407**	0.701***	0.626***	0.926***	0.657*	0.714***	0.713***	0.527***	0.108
	(5.958)	(4.002)	(7.114)	(2.255)	(10.471)	(6.419)	(7.603)	(1.982)	(6.315)	(4.876)	(6.006)	(0.438)
β	0.340	0.360	0.376	0.593	0.299	0.374	0.074	0.343	0.286	0.287	0.473	0.892
	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)	(---)
ξ	-0.230	-0.267	-2.556	-3.273	-0.434	-0.755	-2.455	-1.194	-0.574	-0.332	-3.341	-29.365
	(-0.366)	(-0.342)	(-1.225)	(-1.507)	(-0.481)	(-0.773)	(-0.450)	(-0.994)	(-0.142)	(-0.077)	(-1.051)	(-0.391)
time trend	0.002	0.002	0.006***	0.008***	0.008***	0.007***	0.001	0.004	$9.25e^{-05}$	0.0002	0.006***	0.010***
	(1.431)	(0.913)	(3.780)	(3.102)	(7.220)	(5.535)	(1.066)	(1.143)	(0.046)	(0.093)	(4.065)	(3.585)
unben	-0.397	-0.204	-0.663	0.266	-1.828***	-1.448**	-1.793***	-0.719	-0.003	0.159	-0.470	1.220
	(-1.241)	(-0.510)	(-1.461)	(0.336)	(-4.873)	(-2.246)	(-3.832)	(-0.597)	(-0.007)	(0.267)	(-0.850)	(1.306)
constant	-2.961***	-2.607**	-3.335***	-1.345	-5.052***	-4.205***	-5.517***	-3.185	-2.668**	-2.435*	-3.297***	0.308
	(-3.642)	(-2.339)	(-4.003)	(-0.841)	(-7.857)	(-3.511)	(-5.548)	(-1.170)	(-2.497)	(-1.801)	(-3.437)	(0.154)
$\overline{R}^2$	0.934	0.934	0.930	0.920	0.749	0.743	0.901	0.886	0.956	0.955	0.933	0.908
res1	---	-0.648	---	-3.692**	---	-0.427	---	-2.392***	---	0.206	---	-2.320
	(---)	(-0.277)	(---)	(-2.470)	(---)	(-0.496)	(---)	(-3.047)	(---)	(0.142)	(---)	(-0.769)
res2	---	-0.695**	---	-0.567**	---	-0.767*	---	-0.011	---	0.031	---	-0.572**
	(---)	(-2.075)	(---)	(-2.664)	(---)	(-1.847)	(---)	(-0.034)	(---)	(0.159)	(---)	(-2.660)
res3	---	-3.830*	---	-3.530**	---	-3.664	---	-0.640**	---	-0.547	---	-4.129**
	(---)	(-1.750)	(---)	(-2.299)	(---)	(-1.298)	(---)	(-2.345)	(---)	(-0.432)	(---)	(-2.308)
F-statistics	---	27.401***	---	45.291***	---	4.622***	---	27.936***	---	49.195***	---	44.448***
$N*R^2$	---	6.762	---	9.447	---	12.374	---	9.494	---	9.936	---	5.969

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses. Monthly dummies are statistically significant, detailed results available upon request.
TSNLS – two-stage non-linear least squares with endogenous variables: unemployment, vacancies and the share of the users of unemployment benefits and instruments: **lagged** endogenous variables plus log of monthly index of construction works; log of monthly share of the average net in the average gross wage and log of the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises. *res1* – residuals from the regression of *u* onto the all exogenous regressors; *res2* – residuals from the regression of *v* onto the all exogenous regressors; *res3* – residuals from the regression of *unben* onto the all exogenous regressors; chi-squared (3, 0.05)=7.82; chi-squared (3, 0.01)=11.35; chi-squared (3, 0.001)=16.27; (q=3, i.e., number of instruments-number of endogenous regressors).

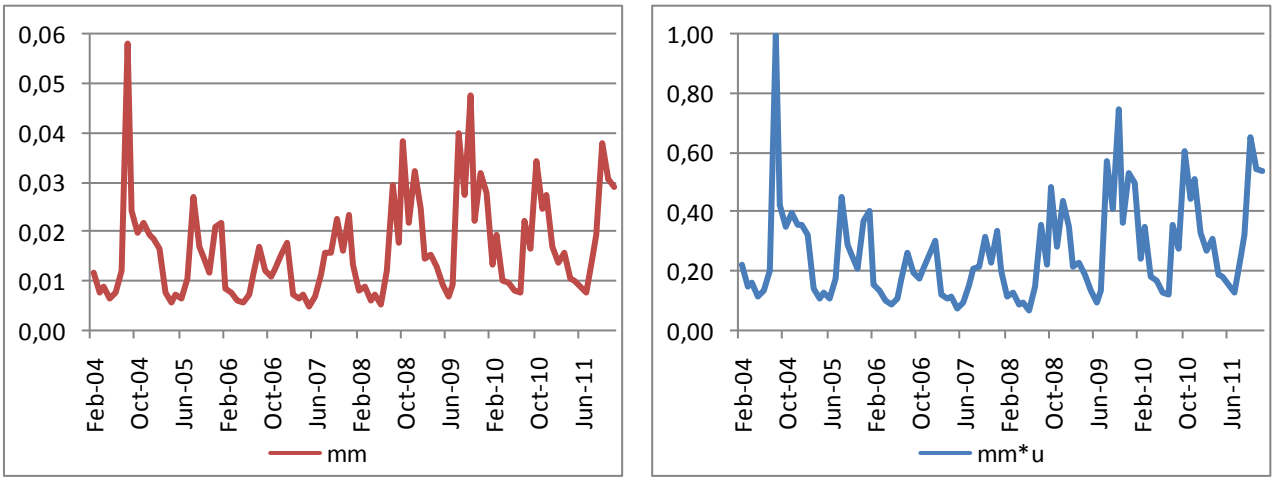
Source: Author's calculation based on CES data.

4.5.2 How much of unemployment is due to occupational mismatch?

As explained in the previous section, by using the estimated parameters from expression 4.3 we can determine how much of total unemployment can be attributed to occupational mismatch. The mismatch index (equation 4.4) is calculated with the estimated coefficients of elasticity from the TSNLS IV restricted estimation for the February2004[136]-December2011 period (column 2 in Table 4.1) and is illustrated in Figure 4.5 (left-hand side).

Figure 4.5 clearly shows that occupational mismatch explains only 1% to 6% of total unemployment, with significant variability (seasonality) of the index.[137] This result, together with regression estimations in Table 4.1, suggests that occupational mismatch is not very important for the high and persistent total (aggregate) unemployment in Croatia.

Figure 4.5. Share of total unemployment attributed to occupational mismatch (left) and unemployment attributed to occupational mismatch as a percentage of the labour force (right)



Notes. mm – mismatch index.

Source: Author's calculations based on CES data.

The right-hand side of Figure 4.5 shows unemployment attributed to occupational mismatch as a percentage of the labour force, which is calculated as the mismatch indicator, *mm*, multiplied by the unemployment rate, *u*. It is observable that the two indicators (relative and absolute) follow a similar trend, which implies that in the period when the unemployment rate was high, the mismatch index was also high, and vice versa. What's more, this pattern suggests that the mismatch indicator is counter-cyclical, i.e., it increases during recessions and decreases during booms. Then again, it needs to be pointed out that occupational mismatch is not very important

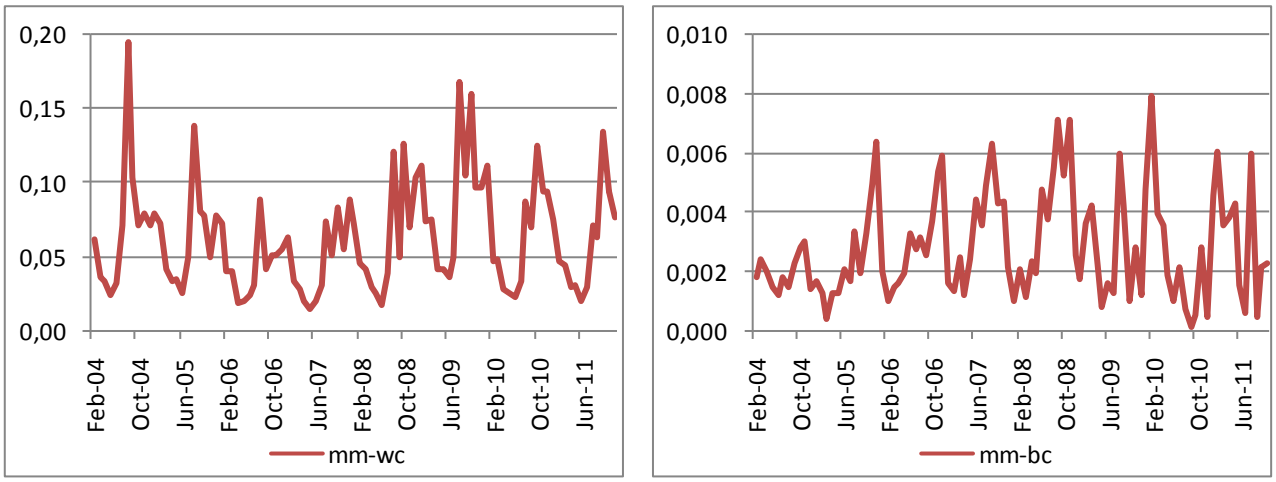
[136] Unemployment variable is lagged one month because it represents the so-called stock variable which means that the model uses the number of unemployed as reported at the end of the previous month, while vacancies are 'flow' variable, i.e., they are reported during the respective month.

[137] Obadić (2006a, b) calculated the 'implicit' regional mismatch indicator based on Jackman and Roper (1987) using arbitrary coefficients of elasticities - both α and β were set to 0.50 - and she obtained values for the regional mismatch indicator ranging from 2% to 4% in the period 1993-2002.

for the overall unemployment in Croatia. According to these results, if structural balance were achieved, i.e., if there were no (occupational) mismatch between unemployment and vacancies in the labour market, the unemployment rate would fall by roughly 0.2 to 0.8 percentage points.

As far as the mismatch indicator, *mm*, for each of the submarkets (groups of occupations) is concerned, there is again great (monthly) variability in the indicator in every submarket, together with significant difference across two different submarkets (Figure 4.6). In the case of white-collar workers, the indicator explains between 2% and 20% of total white-collar unemployment, but only up to 1% for blue-collar occupations. Once again, the results show remarkable difference between the functioning of the labour market for white- and blue-collar occupations in Croatia. Unfortunately, data on the size of the workforce by occupations do not exist so it was impossible to check how much of the unemployment as a percentage of the labour force is attributed to occupational mismatch for each of the occupational groups (submarkets).

Figure 4.6. Share of unemployment in white-collar (left) and blue-collar (right) occupational submarkets attributed to occupational mismatch



Notes. *mm* – mismatch index.

Source: Author's calculations based on CES data.

4.5.3 Robustness check

It needs to be pointed out that there are several possible shortcomings of this study. First of all, the number of vacancies used in the analysis is not the total number of open positions in a given month. If the extent of non-posting of vacancies were uniform across submarkets, our mismatch index would be unaffected (Dur, 1999). However, it is not very likely that this holds in reality.

Another problem concerns the variables used as instruments in the TSNLS estimation. Namely, this paper uses the same variables as instruments for all the submarkets (occupational groups) as well as for the aggregate function. For instance, it is evident that the variables that proved to be good instruments for the aggregate market (see Appendix C) may not be as good for the

analysed submarkets (especially in the case of blue-collar occupations). Thus, the obtained results should be taken with caution. Furthermore, since endogenous variables (especially unemployment) exhibit huge persistency throughout the observed period, lagged endogenous variables perhaps would not serve as sufficient instruments, and that is why we checked (only for the restricted model) whether endogenous variables transformed by within-transformation or first-differenced endogenous variables as instruments would provide better results (Table C.6 in Appendix C). However, the outcome shows rather similar results as when the lagged endogenous variables served as instruments, with tests for instrumental variables showing worse results than was the case with lagged endogenous variables.

Furthermore, since it has already been shown that there exists a regional mismatch in the Croatian labour market (Obadić, 2006a, b), the model could be controlled for (possible) regional mismatch.[138] This is done by estimating the model with the data for occupational distribution of unemployment and vacancies on a NUTS2 (three regions) level in Croatia.[139] Since there are no available data on a monthly basis for all the variables used in the analysis, we estimate only NLS using both fixed-effects panel estimation as well as regular NLS estimation with regional dummies. However, both models (Table C.7 in Appendix C) show that the regional effects are not significant (except perhaps in the case of white-collar occupations).

Additionally, the original model (Dur, 1999) assumes that the function exhibits constant returns to scale. Nevertheless, this is not true in all cases in this paper (especially in the case of blue-collar occupations). That is why some of the results might be biased; for instance, the calculation of the portion of total unemployment due to occupational mismatch in the market for blue-collars.

Finally, the choice of nine broad occupational groups can give rise to doubt if we consider two questions: (i) is it detailed enough to provide important information on the (in)existence of structural unemployment in the Croatian labour market and (ii) is the use of occupation categories a good proxy for skills? Even though it is not quite clear from the presented analysis, the answer to both of these questions is yes. As explained earlier, this is the best grouping of occupations available from the CES statistics, while the question of the use of occupations as a proxy for skills is justifiable on the grounds that more sophisticated occupations usually imply higher educational achievement (see Table C.4 in Appendix C).

4.6 Conclusions

The importance of structural unemployment in the Croatian labour market is analysed in this paper. For that purpose, the matching function approach is used through estimation of the matching function that incorporates the effect of occupational mismatch on the flow of filled

[138] For instance, Jurajda and Terell (2009) explain how within-country regional variation in inherited human capital in four transition economies (Czech Republic, Hungary, Bulgaria and Ukraine) accounts for the bulk of regional variation in unemployment.

[139] The analysis is done on a NUTS2 instead of a NUTS3 level since there were no data for specific occupations in many months in the latter, and thus the estimation (that uses logarithms) could not have been conducted.

vacancies (based on the model developed by Dur, 1999). This approach is used not only for the aggregate flow of filled vacancies, but also for different submarkets based on the grouping of similar occupations (white- and blue-collar). Additionally, with the estimated parameters from regressions the amount of unemployment that can be attributed to occupational mismatch is calculated for each submarket as well as for the aggregate function.

According to the obtained results it appears that occupational mismatch does not have significant impact on the aggregate flow of filled vacancies, i.e., on the matching process in the overall labour market. However, when the labour market is examined through its submarkets, i.e., similar occupational groups, occupational mismatch (significantly) positively affects the matching process in the market for white-collars, while it has negative (insignificant) impact in the (sub)market for blue-collar occupations. In addition, for both the overall labour market as well as for each of the submarkets (occupational groups) the share of the users of unemployment benefits in total unemployment has a negative impact on the matching process, while time trend positively affects the matching process which indicates that Croatia is experiencing greater matching efficiency in the labour market over time. Moreover, in most of the cases the hypothesis of constant returns to scale cannot be rejected.

Nonetheless, the fraction of total (aggregate) unemployment that can be attributed to occupational mismatch is estimated to be between 1% and 6%, depending on the time period. This number is too low to be able to explain the high and persistent unemployment in Croatia. The fraction of unemployment attributed to mismatch in different submarkets varies greatly; from 2% to 20% in the white-collar submarket and only up to 1% for blue-collar occupations. If there were no (occupational) mismatch in the Croatian labour market, the unemployment rate would fall by roughly 0.2 to 0.8 percentage points. Hence, the general conclusion is that occupational mismatch has some impact on the matching process in (occupational) submarkets, while its effect on the level of overall unemployment is not very important.

What do these findings tell us with respect to policy implications? Taking the obtained results from this paper, together with some previous findings (Obadić, 2004, 2006a, b), it seems that mismatch between supply and demand in the labour market is not a predominant factor in explaining unemployment in Croatia. This is especially true in the time of economic crisis, when deficient demand serves as a primary factor in explaining high and persistent unemployment. However, this does not mean that structural unemployment is not an issue, since the existing works present just 'the tip of the iceberg' in this area. Still, in order to propose concrete policy measures, further research concerning mismatch in the Croatian labour market is needed.

5 CONCLUDING REMARKS

Unemployment is a central problem in the labour market faced by most of the countries in the world. Given that it has adverse effects not only on individuals but also on the societies as a whole, finding a solution to the problem of unemployment should be one of the primary aims of economic policy (Gatzia, 2012). However, in order to find a solution one first needs to discover the reasons behind the appearance, existence, and persistence of unemployment in modern labour markets. Usually, the literature distinguishes between three types of unemployment: cyclical, structural, and frictional. The first type typically results from reduced demand (recessions); the second type occurs when the jobs that are available in the economy do not match (in skills or locations) with the unemployed workers; while the third type corresponds to temporary transitions made by workers and employers or resulting from workers and employers having inconsistent or incomplete information. Nevertheless, the causes of these three types of unemployment are not unequivocally confirmed in the literature, since each country presents a special case in itself.

This doctoral dissertation focuses on several different aspects of unemployment in Croatia. In this regard, it tackles all three types of unemployment: cyclical, structural, and frictional. Namely, the main goal of this dissertation is to embark upon the unemployment problem in Croatia by uncovering some of the popular stylised facts that have emerged in the literature in the last couple of decades. These primarily refer to demand deficiency, rigid legislation, regional inequalities, (skills) mismatch between vacancies and the unemployed, and the inadequate structure of the workforce in terms of age and education. In order to achieve the goal set, a combination of the methodology that emerges from the equilibrium search and matching theory and empirical evidence from Croatia are used.

On the one hand, this dissertation focuses on different characteristics and processes in the Croatian labour market since the beginning of the 1990-ies, while on the other it emphasizes the role of different institutions associated with the functioning of modern labour markets. Additionally, this doctoral dissertation also emphasizes the effect of the economic crisis on the (Croatian) labour market with potential proposals for policy makers. Furthermore, in order not to contribute only to understanding the issues in the Croatian labour market, but also to be able to use the proposed models as well as the obtained results in a wider context of the modern European labour markets, the theory and the obtained results are placed within the CEE and EU context. All these issues are explored through three different parts (essays) of this dissertation, where each of the essays deals with a specific research topic, but all three are connected through their main aim - to discover the main cause of high unemployment in Croatia.

First, this doctoral dissertation deals with the problem of rigid legislation in the Croatian labour market. Namely, the first essay (Chapter 2) addresses the issue of matching and adverse selection in a transition and post-transition context by augmenting the standard *model of adverse selection with firing costs* in a country characterized by underdeveloped labour market institutions with strict employment protection legislation. This chapter combines several different aspects of the job search theory in order to study the employment prospects of different

groups of job-seekers in Croatia: employed and unemployed/inactive. The original (theoretical) model of adverse selection with firing costs (Kugler and Saint-Paul, 2004) is upgraded in order to better correspond to the situation in a (post)transition context. In this respect, new variables, like endogenous firing costs and reservation wage, are introduced to capture the process of decision-making and subsequent matching between employers and employees. The model is empirically tested using the data from the Croatian Labour Force Survey in the period 1996-2009, which covers a considerable time span, capturing both the period during the transition as well as the one after transition, including the recent global economic crisis.

The main results from the first essay point to the existence of an adverse selection in the Croatian labour market. The reservation wage, as the main determinant of firing costs in the model, has a positive impact on the probability of changing job for employed job-seekers, while it negatively affects the probability of employment for unemployed job-seekers. As one of the main assumptions of the model is that employers perceive labour market status as a *signal* of job-seekers' productivity, lower probability of employing the unemployed signals the effect of firing costs, that is, adverse selection in the labour market due to high firing costs. However, if the reservation wage is treated as endogenous in the model, instrumental variable estimation shows that the effect of the reservation wage on the probability of employment becomes positive and significant only for the unemployed group. This is explained by the effect of educational attainment, which serves as an instrument and evidently works as an efficient signal for workers' productivity among the unemployed. Nevertheless, the effect of the reservation wage on employment probabilities for both groups (employed and unemployed) is declining over time, especially after the legislative reform in 2004, indicating lower impact of firing costs. Finally, the possibility of self-discrimination for the unemployed job-seekers receiving unemployment benefits is tested in this chapter. The results are consistent with regression estimation without controlling for educational attainment, indicating a positive impact of unemployment benefits on the reservation wage, and a negative one on the probability of finding a job.

The second essay (Chapter 3) primarily deals with regional disparities on the Croatian labour market, with emphasis on the role of (regional) Croatian Employment Service offices in the matching process. Hence, the main objective of this chapter is to evaluate the efficiency of the matching process in the labour market, taking the role of regional employment offices into account. The empirical analysis is conducted on a regional level using regional office-level data obtained from the Croatian Employment Service on a monthly basis in the period 2000-2011. Additionally, to take into account the effect of the crisis, the estimation is also conducted for two different sub-periods: pre-crisis (2000-2007) and crisis (2008-2011). The estimation is performed using the panel stochastic frontier model, as well as its modified version – basic-form transformed panel stochastic frontier model.

Results of the analysis suggest that the efficiency of the matching process on a regional level in Croatia is rising over time with significant regional variations. In order to explore these variations, structural characteristics of the labour market together with some policy variables are included into the second-stage estimation. Various structural variables have different impact on

the matching efficiency, while policy variables are mostly positively correlated with it. For instance, both active labour market programmes and the number of high-skilled employees in regional employment offices positively affect the matching efficiency. Additionally, when regional income per capita is included into the model it shows positive impact on the matching efficiency, indicating that demand fluctuations predominantly affect the matching process. In order to get consistent estimates, panel stochastic frontier model transformation is applied. Preliminary results show that there is no major difference in estimated mean technical efficiency coefficients in comparison to the original panel stochastic frontier model, while the opposite is true for the covariates of technical efficiency. Still, these results should be taken with caution since the model included only few of variables possibly affecting matching efficiency.

This doctoral dissertation deals with the aspects of structural unemployment in Chapter 4 (the third essay). This is done by estimating the matching function that directly incorporates the effect of occupational mismatch on the flow of filled vacancies (based on the model developed by Dur, 1999). This approach is used not only for the aggregate flow of filled vacancies, but also for different submarkets based on the grouping of similar occupations (white-collar and blue-collar occupations). Additionally, the estimated parameters from regressions are used to calculate the amount of unemployment that can be attributed to occupational mismatch for each submarket as well as for the aggregate function.

According to the obtained results, it appears that occupational mismatch does not have significant impact on the aggregate flow of filled vacancies, that is, on the matching process in the overall labour market. However, when the labour market is examined through its submarkets, i.e., similar occupational groups, occupational mismatch (significantly) positively affects the matching process in the market for white-collars, while it has a negative (insignificant) impact in the (sub)market for blue-collar occupations. Furthermore, the portion of total (aggregate) unemployment that can be attributed to occupational mismatch is estimated to be only up to 6%, which evidently cannot explain the high and persistent unemployment in Croatia. The fraction of unemployment attributed to mismatch in different submarkets varies greatly; from 2% to 20% in the white-collar submarket and only up to 1% for blue-collar occupations. In the end, the results indicate that if there were no (occupational) mismatch in the Croatian labour market, the unemployment rate would fall by roughly 0.2 to 0.8 percentage points.

Several research questions concerning the labour market in Croatia were asked in the first chapter. Having analysed different aspects of the labour market with the help of the search and matching theory, the following answers emerge. There is sign of adverse selection in the Croatian labour market, as the unemployed group of job-seekers is being discriminated in the hiring process. However, educational attainment serves as an efficient signal for workers' productivity among the unemployed, which suggests that more educated individuals among the unemployed have higher probability to get a job. As far as the role of the capacity of regional employment offices in the matching process is concerned, it has been shown that better (staff) capacity of regional offices increases the efficiency of the matching process in the labour market, which indicates that better capacity could help in decreasing regional disparities in the

Croatian labour market. Still, it is important to mention how demand deficiency has proved to be an even more important factor in explaining the regional matching (in)efficiency, i.e., high regional unemployment disparities. And lastly, despite the fact that (skills) mismatch is often cited as the main culprit for high and persistent unemployment in Croatia, the results indicate that only a small portion of the existing level of unemployment can be attributed to structural (occupational) mismatch. As for the hypotheses proposed in the first chapter, one can easily observe that the obtained results suggest that most of the hypotheses cannot be rejected.

For instance, the estimation results from the first essay (Chapter 2) show that the probability of changing labour market status for an employed individual is higher in comparison with an unemployed individual (hypothesis H.2.1) and that the probability of switching from unemployment to employment is higher for individuals not receiving unemployment benefits (hypothesis H.2.2). However, instrumental variable estimation shows that the educational attainment (years of schooling) serves as a good signal of the unemployed job-seeker's productivity and thus increases his/her probability of employment. The second essay (Chapter 3) provides proof of different technical efficiency scores for different regions (hypothesis H.3.1) while (after controlling for economic conditions) the quality of services provided by regional public employment offices proved to be important in increasing the efficiency of the matching process (hypothesis H.3.2). The third essay (Chapter 4), on the other hand, gives somewhat inconclusive results. Namely, based on the obtained results it could be said that there is a mismatch in terms of occupations between unemployment and vacancies in the Croatian labour market (hypothesis H.4.1). On the other hand, occupational mismatch proved not to be responsible for a large portion of unemployment in Croatia (rejection of hypothesis H.4.2). However, the size of the mismatch is different in different submarkets (occupational groups) (hypothesis H.4.3) which supports the logic behind the estimation of the disaggregated matching functions in this paper.

This dissertation's main contributions to the literature can be examined via two different aspects: global and local. Namely, as already mentioned in the introductory chapter, these topics are more-or-less dealt with for the first time for the Croatian labour market and thus present a novelty in the literature in themselves. However, some of the aspects explored in the thesis can be considered as value-added to the literature on a global level.

The main contributions of this dissertation are reflected in the following: (i) the original (both theoretical and empirical) model of adverse selection with firing costs (Kugler and Saint-Paul, 2004) is adjusted by endogeneizing firing costs in order to better correspond to a transition and post-transition context; (ii) the transformed panel stochastic frontier model developed by Wang and Ho (2010) is applied to the labour market for the first time; and (iii) the model that incorporates the mismatch index directly into the mismatch function (Dur, 1999) is applied on disaggregated data (markets) using occupational instead of educational (or industry) groups which should better mirror the reality since occupations are shown to be less changing during one's career. More local-specific contributions are primarily manifested through: (i) testing the model of adverse selection with firing costs on Croatian data, as well as indicating the impact of rigid legislation on the process of hiring; (ii) examining the role of regional employment offices

in the process of matching the unemployed and vacancies; and (iii) investigating the mismatch between supply and demand of occupations on the Croatian labour market.

Nevertheless, one needs to bear in mind that this dissertation tackles only a few of the many issues associated with the Croatian labour market. Furthermore, there are some possible limitations of the research performed in this dissertation. This primarily concerns the data (un)availability as well as the structure of much of the available data. First of all, this refers to the 'transition' period for which the data were (unfortunately) unavailable, except for some of the data in the second chapter which were available as of 1996. Then, there are problems with incomplete data for vacancies as well as the inexistence of the data for on-the-job search in the third and fourth chapter. Detailed data on regional employment offices in the third chapter were also lacking, while additional statistics in all of the cases was more or less incomplete. Still, the analysis in all the chapters (essays) was conducted taking into account all of the mentioned issues, trying to make the best of what was available. Hence, in order to get a clear answer to the issue of high and persistent unemployment in the Croatian labour market as well as to be able to make some strong policy recommendations, the research of these topics needs to continue further. Hopefully, the research conducted in this dissertation will provide a starting point for many future articles, not only of this author but of many others as well.

REFERENCE LIST

Addison, J., Centeno, M., & Portugal, P. (2009). Do Reservation Wages Really Decline? Some International Evidence on the Determinants of Reservation Wages. *Journal of Labor Research*, *30*(1), 1-8.

Aghion, P., & Blanchard, O. J. (1994). On the Speed of Transition in Central Europe. In S. Fischer & J. Rotemberg (Eds.), *NBER Macroeconomics Annual 1994* (pp. 283-330). Cambridge, MA: MIT Press.

Aigner, D., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, *6*(1), 21–37.

Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, *84*(3), 488-500.

Albrecht, J. (2011). Search Theory: The 2010 Nobel Memorial Prize in Economic Sciences. *Scandinavian Journal of Economics*, *113*(2), 237-259.

Altavilla, C., & Caroleo, F. E. (2009). Unintended Effects of National-based Active Labour Market Policies. *IZA Discussion Paper No. 4045*. Bonn: Institute for the Study of Labor (IZA).

Anderson, P. M., & Burgess, S. M. (1995). Empirical Matching Functions: Estimation and Interpretation Using Disaggregate Data. *NBER Working Paper No. 5001*. Cambridge, MA: National Bureau of Economic Research, Inc.

Arandarenko, M. (2004). International Advice and Labour Market Institutions in South-East Europe. *Global Social Policy*, *4*(1), 27-53.

Autor, D. (2008). The Economics of Labor Market Intermediation: An Analytic Framework. *NBER Working Paper No. 14348*. Cambridge, MA: National Bureau of Economic Research, Inc.

Babić, Z. (2003). Uloga aktivne politike na tržištu rada u Hrvatskoj [The Role of Active Labour Market Policies in Croatia]. *Financijska teorija i praksa*, *27*(4), 547-566.

Barcena-Martín, E., Santiago Budría, S., & Moro-Egido, A. I. (2012). Skill mismatches and wages among European university graduates. *Applied Economics Letters*, *19*(15), 1471-1475.

Barakat, B., Holler, J., Prettner K., & Schuster, J. (2010). The Impact of the Economic Crisis on Labour and Education in Europe. *Vienna Institute of Demography Working Paper No. 6/2010*. Vienna: Vienna Institute of Demography & Austrian Academy of Sciences.

Barlevy, G. (2011). Evaluating the Role of Labor Market Mismatch in Rising Unemployment. *Economic Perspectives*, *35*(3), 82-96.

Bartlett, W. (2012). Structural Unemployment in the Western Balkans: Challenges for Skills Anticipation and Matching Policies. *European Planning Studies*. Retrieved December 15, 2012, from 10.1080/09654313.2012.722933 (DOI)

Battese, G. E., & Coelli, T. J. (1993). A stochastic frontier production function incorporating a model for technical inefficiency effects. *University of New England Working Paper No. 69*. Armidale, NSW: University of New England.

Battese, G. E., & Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics*, *20*(2), 325–332.

Batyra, A., & De Vroey, M. (2012). From One To Many Islands: The Emergence Of Search And Matching Models. *Bulletin of Economic Research*, *64*(3), 393-414.

Bean, C. R., & Pissarides, C. A. (1991). Skill shortages and structural unemployment in Britain: a (mis)matching approach. In F. P. Schioppa (Ed.), *Mismatch and Labour Mobility* (pp. 325-354). Cambridge: Cambridge University Press.

Bejaković, P. (2004). Labour Force Competitiveness in Croatia: Status and Problems. In P. Bejaković & J. Lowther (Eds.), *The Competitiveness of Croatia's Human Resources* (pp. 1-13). Zagreb: Institute of Public Finance.

Bejaković, P., & Gotovac, V. (2011). Aktivnosti na gospodarskom oporavku u Republici Hrvatskoj s naglaskom na tržište rada [Activities on Economic Recovery in Croatia, with Particular Attention to the Labour Market]. *Revija za socijalnu politiku*, *18*(3), 331-355.

Bentolila, S, Cahuc, P., Dolado, J. J., & Le Barbanchon, T. (2012). Two-Tier Labor Markets in the Great Recession: France vs. Spain. *The Economic Journal*, *122*(562), 155–187.

Bićanić, I., & Babić, Z. (2008). Survey of the Croatian Labour Market. In D. Boršič & A. Kavlker (Eds.), *Labour Market Characteristics in Selected Economies* (pp. 51-69). Maribor: Schwarz, Ltd.

Birdsall, N., Graham, C., & Pettinato, S. (2000). Stuck in the Tunnel: Is Globalization Muddling the Middle Class? *Brookings Institution (Center on Social and Economic Dynamics) Working Paper No. 14*. Washington, DC: The Brookings Institution.

Blackaby, D. H., Murphy, P. D., Sloane, P. J., Latreille, P. L., & O'Leary, N. C. (2006). An Analysis of Reservation Wages for the Economically Inactive. *IZA Discussion Paper No. 1980*. Bonn: Institute for the Study of Labor (IZA).

Blanchard, O. J., & Diamond, P. A. (1989). The Beveridge Curve. *Brookings Papers on Economic Activity*. *20*(1), 1–76.

Blanchard, O. J., & Diamond, P. A. (1994). Ranking, Unemployment Duration, and Wages. *Review of Economic Studies*, *61*(3), 417-434.

Boeri, T. (1997a). Labour market reforms in transition economies. *Oxford review of economic policy*, *13*(2), 126-140.

Boeri, T. (1997b). Learning from Transition Economies: Assessing Labor Market Policies across Central and Eastern Europe. *Journal of comparative economics*, *25*(3), 366-384.

Boeri, T. (2000). Optimal Speed of Transition 10 Years After. *CEPR Discussion Paper No. 2384*. London: Centre for Economic Policy Research (CEPR).

Boeri, T. (2011). Institutional Reforms and Dualism in European Labor Markets. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 1173-1236). Amsterdam: North-Holland.

Boeri, T., Garibaldi, P., & Moen, E. R. (2012). The Labor Market Consequences of Adverse Financial Shocks. *IZA Discussion Paper No. 6826*. Bonn: Institute for the Study of Labor (IZA).

Boeri, T., & Terell, K. (2002). Institutional determinants of labour reallocation in transition. *Journal of Economic Perspectives*, *16*(1), 51-76.

Boeri, T., & Van Ours, J. (2008). *The Economics of Imperfect Labour Markets*. New Jersey, NY: Princeton University Press.

Bornhorst, F., & Commander, S. (2006). Regional unemployment and its persistence in transition countries. *Economics of Transition*, *14*(2), 269-288.

Botrić, V. (2004). Regional Aspects of Unemployment in Croatia. *Croatian Economic Survey*, *6*(1), 77-95.

Botrić, V. (2007). Regional Labour Market Differences in Croatia: Evidence from the 2000-2005 Labour Force Survey Data. *Privredna kretanja i ekonomska politika*, *17*(113), 26-51.

Botrić, V. (2009). Unemployed and long-term unemployed in Croatia: evidence from Labour Force Survey. *Revija za socijalnu politiku*, *16*(1), 25-44.

Botrić, V. (2011). Structural unemployment and its determinants in Southeast Europe, *Ekonomska misao i praksa*, *20*(1), 81-100.

Brada, J. C., & Signorelli, M. (2012). Comparing Labor Market Performance: Some Stylized Facts and Key Findings. *Comparative Economic Studies*, *54*(2), 231-250.

Brixiova, Z., Li, W., & Yousef, T. (2009). Skill shortages and labour market outcomes in Central Europe. *Economic Systems*, *33*(1), 45-59.

Brown, A. J. G., Merkl, C., & Snower, D. J. (2009). An Incentive Theory of Matching. *IZA Discussion Paper No. 4145*. Bonn: Institute for the Study of Labor (IZA).

Brown, A. J. G., & Koettl, J. (2012). Active Labor Market Programmes: Employment Gain of Fiscal Drain? *IZA Discussion Paper No. 6880*. Bonn: Institute for the Study of Labor (IZA).

Bruno, R. L. (2006). Optimal speed of transition with a shrinking labour force and under uncertainty. *Economics of Transition*, *14*(1), 69-100.

Burda, M. C. (1994). Structural Change and Unemployment in Central and Eastern Europe: Some Key Issues. *CEPR Discussion Paper No. 977*. London: Centre for Economic Policy Research (CEPR).

Burdett, K., & Mortensen, D. T. (1998). Wage Differentials, Employer Size, and Unemployment. *International Economic Review*, *39*(2), 257–273.

Burgess, S. M. (1994). Matching models and labour market flows. *European Economic Review*, *38*(3-4), 809-816.

Burgess, S. M., & Mawson, D. (2003). Aggregate Growth and the Efficiency of Labour Reallocation. *CEPR Discussion Papers No. 3848*. London: Centre for Economic Policy Research (CEPR).

Buzas, J. S., & Stefanski, L. A. (1996). Instrumental variable estimation in a probit measurement error model. *Journal of Statistical Planning and Inference*, *55*(1), 47-62.

Calmfors, L. (1994). Active labour market policy and unemployment – a framework for the analysis of crucial design features. *OECD Economic Studies No. 22*. Paris: Organization for Economic Cooperation and Development (OECD).

Canziani, P., & Petrogolo, B. (2001). Firing costs and stigma: A theoretical analysis and evidence from microdata. *European Economic Review*, *45*(10), 1877-1906.

Cazes, S. (2002). Do labour market institutions matter in transition economies? An analysis of labour market flexibility in the late nineties. *ILO Discussion Papers No. DP/140/2002*. Geneve: International Labour Organization (ILO).

Cazes, S., & Nesporova A. (2003). *Labour Markets in Transition: Balancing Flexibility and Security in Central and Eastern Europe*. Geneve: International Labour Organization (ILO).

Castanheira, M., & Roland, G. (2000). The Optimal Speed of Transition: A General Equilibrium Analysis. *International Economic Review*, *41*(1), 219–239.

CBS (Croatian Bureau of Statistics) official web page: http://www.dzs.hr.

CEDEFOP (2010). *The skill matching challenge – Analysing skill mismatch & Policy implications*. Luxemburg: European Centre for the Development of Vocational Training (CEDEFOP).

CES (Croatian Employment Service) official web page: http://www.hzz.hr.

CES (Croatian Employment Service) (2008). *Employers' Survey 2007*. Zagreb: Croatian Employment Service (CES).

CES (Croatian Employment Service) (2009). *Employers' Survey 2008*. Zagreb: Croatian Employment Service (CES).

CES (Croatian Employment Service) (2010). *Employers' Survey 2009*. Zagreb: Croatian Employment Service (CES).

CES (Croatian Employment Service) (2011). *Employers' Survey 2010.* Zagreb: Croatian Employment Service (CES).

CNB (Croatian National Bank) (2010). *Bulletin No. 160 – Quarterly Report.* Zagreb: Croatian National Bank (CNB).

Coles, M. G., & Petrongolo, B. (2002). A Test Between Unemployment Theories Using Matching Data. *CEPR Discussion Papers No. 3241*. London: Centre for Economic Policy Research (CEPR).

Cotti, C. D., & Drewianka, S. (2012). Labor Market Inefficiency during the Current Business Cycle: Evidence from Industry Beveridge Curves. *University of Wisconsin-Milwaukee Working Papers,* UWM. Milwaukee, WI: University of Wisconsin-Milwaukee.

Čučković, N. (2011). Transicion economica a integracion en la UE: un viaje lento y cansado, pero casi completado [Croatian Economic Transition and EU Integration: A Slow and Tiring Journey, but Almost There]. *CULTURAS - Revista De Amalysis Y Debate Sobre Oriente Proximo Y El Mediterraneo, 2011*(9), 82-95.

Davidson, R., & MacKinnon, J. G. (2003). *Econometric Theory and Methods*. New York, NY: Oxford University Press.

Destefanis, S., & Fonseca, R. (2007). Matching Efficiency and Labour Market Reform in Italy: A Macroeconometric Assessment. *Labour, 21*(1), 57-84.

Diamond, P. A. (1982a). Wage Determination and Efficiency in Search Equilibrium. *Review of Economic Studies, 49*(2), 217-227.

Diamond, P. A. (1982b). Aggregate Demand Management in Search Equilibrium. *Journal of Political economy, 90*(5), 881-894.

Diamond, P. A., & Maskin, E. S. (1979). An Equilibrium Analysis of Search and Breach of Contract, I: Steady States. *Bell Journal of Economics, 10*(1), 282-316.

Dmitrijeva, J., & Hazans, M. (2007). A Stock-Flow Matching Approach to Evaluation of Public Training Programme in a High Unemployment Environment. *Labour, 21*(3), 503-540.

Domadenik, P. (2007). Does Rigid Employment Legislation Impede Employment Prospects? Evidence from Slovenia. *Privredna kretanja i ekonomska politika, 17*(110), 28-59.

Domadenik, P., & Vehovec, M. (2006). Enterprise Defensive Restructuring: Cross-Country Evidence within Transitional Settings. In F. E. Caroleo & S. Destefanis (Eds.), *The European Labour Market: Regional Dimensions* (pp. 165-178). Heidelberg: Physica-Verlag, Springer Company.

Dow, J. C. R., & Dicks-Mireaux, L. (1958). The Excess Demand for Labour: A Study of Conditions in Great Britain, 1946-1956. *Oxford Economic Papers, 10*(1), 1–33.

Dur, R. A. J. (1999). Mismatch between unemployment and vacancies in the Dutch labour market. *Applied Economics, 31*(2), 237-244.

EC (European Commission) (2012). Labour Market Developments in Europe 2012. *The European Economy series No. 5*. Brussels: European Commission, Directorate-General for Economic and Financial Affairs.

Eichhorst, W., Escudero, V., Marx, P., & Tobin, S. (2010). The Impact of the Crisis on Employment and the Role of Labour Market Institutions. *IZA Discussion Paper No. 5320*. Bonn: Institute for the Study of Labor (IZA).

Estevao, M., & Tsounta, E. (2011). Has the Great Recession Raised U.S. Structural Unemployment? *IMF Working Paper No. WP/11/105*. Washington, DC: International Monetary Fund (IMF).

Faberman, R. J., & Mazumder, B. (2012). Is there a skills mismatch in the labor market? *Chicago Fed Letter No. 300*. Chicago, IL: The Federal Reserve Bank of Chicago.

Faggio, G., & Konings, J. (2003). Job creation, job destruction and employment growth in transition countries in the 90s. *Economic Systems, 27*(2), 129-154.

Faggio, G. (2007). Job Destruction, Job Creation and Unemployment in Transition Countries: What Can We Learn? *CEP Discussion Paper No. 798*. London: LSE Centre for Economic Performance (CEP).

Fahr, R., & Sunde, U. (2001). Disaggregate Matching Functions. *IZA Discussion Paper No. 335*. Bonn: Institute for the Study of Labor (IZA).

Fahr, R., & Sunde, U. (2002). Estimations of Occupational and Regional Matching Efficiencies Using Stochastic Production Frontier Models. *IZA Discussion Paper No. 552*. Bonn: Institute for the Study of Labor (IZA).

Fahr, R., & Sunde, U. (2004). Occupational job creation: patterns and implications. *Oxford Economic Papers*. *56*(3), 407-435.

Fahr, R., & Sunde, U. (2006). Regional dependencies in job creation: an efficiency analysis for Western Germany. *Applied Economics*, *38*(10), 1193–1206.

Fahr, R., & Sunde, U. (2009). Did the Hartz Reforms Speed-Up the Matching Process? A Macro-Evaluation Using Empirical Matching Functions. *German Economic Review*, *10*(3), 284-316.

Farčnik, D., & Domadenik, P. (2012). Has the Bologna reform enhanced the employability of graduates?: early evidence from Slovenia. *International Journal of Manpower, 33*(1), 51-75.

Feldmann, H. (2005). Labour Market Institutions and Labour Market Performance in Transition Countries. *Post-Communist Economies*, *17*(1), 47-82.

Ferragina, A. M., & Pastore, F. (2006). Regional Unemployment in the OST literature. In F. E. Caroleo and S. Destefanis (Eds.), *The European Labour Market: Regional Dimensions* (pp. 33-87). Heidelberg: Physica-Verlag, Springer Company.

Franičević, V. (2011). Croatia: Prolonged crisis with an uncertain ending. In D. Vaughan-Whitehead (Ed.), *Inequalities in the world of work: The effects of the crisis* (pp. 139-208). Geneve: International Labour Organization (ILO).

Gabrisch, H., & Buscher, H. (2006). The Relationship between Unemployment and Output in Post-communist Countries. *Post-Communist Economies*, *18*(3), 261-276.

Gatzia, D. E. (2012). The problem of unemployment. *Economics, Management, and Financial Markets*, *7*(2), 36-54.

Gibbons, R., & Katz, L. F. (1991). Layoffs and Lemons. *Journal of Labor Economics*, *9*(4), 351-380.

Gotovac, V. (2003). Izmjene i dopune zakona o radu [Amendments to Labour Act]. *Revija za socijalnu politiku*, *10*(3-4), 389-412.

Gotovac, V. (2011). *Supporting strategies to recover from the crisis in South Eastern Europe: country assessment: Croatia*. Budapest: International Labour Organization (ILO).

Greene, W. H. (2005a). Fixed and Random Effects in Stochastic Frontier Models. *Journal of Productivity Analysis*, *23*(1), 7-32.

Greene, W. H. (2005b). Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics*, *126*(2), 269-303.

Greene, W. H. (2008). *Econometric Analysis*, 6th edition. New Jersey, NJ: Prentice Hall

Greenwald, B. C. (1986). Adverse Selection in the Labour Market. *The Review of Economic Studies*, *53*(3), 325-347.

Greg, P., & Petrongolo, B. (2005). Stock-flow Matching and the Performance of the Labor Market. *European Economic Review*, *49*(8), 1987-2011.

Hagen, T. (2003). Three Approaches to the Evaluation of Active Labour Market Policy in East Germany Using Regional Data. *ZEW Discussion Paper No. 03-27*. Mannheim: Centre for European Economic Research (ZEW).

Haltiwanger, J., Lehmann, H., & Terrell, K. (2003). Symposium on Job Creation and Job Destruction in Transition Countries. *Economics of Transition*, *11*(2), 205-219.

Hersch, J. (1991). Education match and job match. *Review of Economics and Statistics*, *73*(1), 140–144.

Hoffman, S. D., Bićanić, I., & Vukoja, O. (2012). Wage inequality and the labor market impact of economic transformation: Croatia, 1970–2008. *Economic Systems*, *36*(2), 206–217.

Hujer, R., Blien, U., Caliendo, M., & Zeiss, C. (2002). Macroeconometric Evaluation of Active Labour Market Policies in Germany - A Dynamic Panel Approach Using Regional Data. *IZA Discussion Paper No. 616*. Bonn: Institute for the Study of Labor (IZA).

Hynninen, S. M., Kangasharju, A., & Pehkonen, J. (2009). Matching Inefficiencies, Regional Disparities, and Unemployment. *Labour*, *23*(3), 481-506.

Ibourk, A., Maillard, B., Perelman, S., & Sneessens, H. (2001). The Matching Efficiency of Regional Labour Markets: A Stochastic Production Frontier Estimation, France 1990-1995. *IZA Discussion Paper No. 339*. Bonn: Institute for the Study of Labor (IZA).

Ibourk, A., Maillard, B., Perelman, S., & Sneessens, H. (2004). The Matching Efficiency of Regional Labour Markets: A Stochastic Production Frontier Estimation, France: 1990-1994. *Empirica*, *31*(2), 1–25.

Jackman, R., Layard, R., & Savouri, S. (1991). Mismatch: a framework for thought. In F. P. Schioppa (Ed.), *Mismatch and Labour Mobility* (pp. 44-101). Cambridge: Cambridge University Press.

Jackman, R., & Roper, S. (1987). Structural Unemployment. *Oxford Bulletin of Economics and Statistics*, *49*(1), 9-36.

Jaimovich, N., & Siu, H. E. (2012). The Trend is the Cycle: Job Polarization and Jobless Recoveries. *NBER Working Paper No. 18334*. Cambridge, MA: National Bureau of Economic Research, Inc.

Jeong, B., Kejak, M., & Vinogradov, V. (2008). Changing composition of human capital: The Czech Republic, Hungary and Poland. *Economics of Transition*, *16*(2), 247-271.

Jeruzalski, T., & Tyrowicz, J. (2009). (In)Efficiency of Matching – The Case of A Post-transition Economy. *University of Warsaw, Faculty of Economics Working paper No. 10/2009 (20)*. Warsaw: University of Warsaw, Faculty of Economics.

Jurajda, S., & Terrell, K. (2009). Regional unemployment and human capital in transition economies. *Economics of Transition*, *17*(2), 241-274.

Katić, M. (2006). Trends in Croatian labour market. *Ekonomska misao i praksa*, *15*(1), 27-50.

Kogan, I., & Unt, M. (2005). Transition from school to work in transition economies. *European Societies*, *7*(2), 219-53.

Kornai, J. (2006). The great transformation of Central Eastern Europe. *Economics of Transition*, *14*(2), 207-244.

Kucel, A., Vilalta-Bufi, M., & Robert, P. (2011). Graduate labor mismatch in Central and Eastern Europe. *Working Papers in Economics No. 259*. Barcelona: Universitat de Barcelona Espai de Recerca en Economia.

Kuddo, A. (2009). Employment Services and Active Labor Market Programmes in Eastern European and Central Asian Countries. *The World Bank SP Discussion Paper No. 0918*. Washington, DC: The World Bank.

Kugler, A. D., & Saint-Paul, G. (2004). How Do Firing Costs Affect Worker Flows in a World with Adverse Selection? *Journal of Labor Economics*, *22*(3), 553-584.

Lamo, A., & Messina, J. (2010). Formal education, mismatch and wages after transition: Assessing the impact of unobserved heterogeneity using matching estimators. Economics of Education Review, 29(6), 1086-1099.

Lancaster, T., & Chesher, A. (1983). An Econometric Analysis of Reservation Wages. *Econometrica*, *51*(6), 1661-1676.

Layard, R., & Nickell, S. (1999). Labor market institutions and economic performance. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 3029-3084). Amsterdam: North-Holland.

Layard, R., Nickell, S., & Jackman, R. (2005). *Unemployment: Macroeconomic Performance and the Labour Market*. New York, NY: Oxford University Press.

Lazear, E. P. (1990). Job Security Provisions and Employment. *Quarterly Journal of Economics*, *105*(3), 700-726.

Lehmann, H., & Muravyev, A. (2011). Labor Markets and Labor Market Institutions in Transition Economies. *IZA Discussion Paper No. 5905*. Bonn: Institute for the Study of Labor (IZA).

Leschke, J., & Watt, A. (2010). How do institutions affect the labour market adjustment to the economic crisis in different EU countries? *ETUI Working papers No. 2010.04*. Brussels: European Trade Union Institute.

Ljungqvist, L., & Sargent, T. J. (2007). Understanding European unemployment with matching and search-island models. *Journal of Monetary Economics*, *54*(8), 2139-2179.

Lucas, R., & Prescott, E. (1974). Equilibrium search and unemployment. *Journal of Economic Theory*, *7*(2), 188–209.

Luo, X. (2007). Regional Disparities in Labor Market Performance in Croatia: The Role of Individual and Regional Structural Characteristics. *The World Bank Policy Research Working Paper No. 4148*. Washington, DC: The World Bank.

Mandal, A. (2011). Matching Function: Estimations using JOLTS. *The International Journal of Applied Economics and Finance*, *5*(3), 157-166.

Marimon, R., & Zilibotti, F. (1999). Unemployment vs. mismatch of talents: Reconsidering unemployment benefits. *Economic Journal*, *109*(455), 266-291.

Marelli, E., Patuelli, R., & Signorelli, M. (2012). Regional unemployment in the EU before and after the global crisis. *Post-Communist Economies*, *24*(2), 155-175.

Matković, T. (2003). Restrukturiranje rada? Transformacija strukture zaposlenosti [Restructuring Work? Transformation of the Employment Structure]. *Revija za socijalnu politiku*, *10*(2), 161-184.

Matković, T. (2009). Pregled statističkih pokazatelja participacije, prolaznosti i režima plaćanja studija u Republici Hrvatskoj 1991.-2007 [An Overview of the Tertiary Education Participation, Completion and Tuition Fee Indicators in the Republic of Croatia 1991-2007]. *Revija za socijalnu politiku*, *16*(2), 239-250.

Matković, T. (2011). *Obrasci tranzicije iz obrazovnog sustava u svijet rada u Hrvatskoj* [Patterns of Transition from Education to the World of Work in Croatia]. Doctoral dissertation. Zagreb: Pravni fakultet Sveučilišta u Zagrebu.

Matković, T. (2012). Educational origins and occupational destinations? Dissecting the education-job mismatch in school to work transitions in Croatia. Paper presented at the workshop "Skills and the Labour Market in the Western Balkans", Belgrade, May 2012.

Matković, T., Arandarenko, M., & Šošić, V. (2011). *Utjecaj ekonomske krize na tržište rada [Impact of Economic Crisis on the Croatian Labour Market]*. UNDP Report. Zagreb: United Nations Development Programme (UNDP) Croatia.

Matković, T., & Biondić, I. (2003). Reforma zakona o radu i promjena indeksa zakonske zaštite zaposlenja [Reform of the Labour Law and Change of the Employment Protection Legislation Index]. *Financijska teorija i praksa*, *27*(4), 515-528.

McCall, J. J. (1970). Economics of information and job search. *Quarterly Journal of Economics*, *84*(1), 113-126.

Meeusen, W., & van den Broeck, J. (1977). Efficiency Estimation from Cobb-Douglas Production Functions With Composed Error. *International Economic Review*, *18*(2), 435-444.

Mian, A. R., & Sufi, A. (2012). What explains high unemployment? The aggregate demand channel. *NBER Working Paper No. 17830*. Cambridge, MA: National Bureau of Economic Research, Inc.

Mincer, J. A. (1974). *Schooling, Experience and Earnings*. Cambridge, MA: National Bureau of Economic Research (NBER).

Mortensen, D. T. (1977). Unemployment Insurance and Job Search Decisions. *Industrial and Labor Relations Review*, *30*(4), 505-517.

Mortensen, D. T. (1982). The Matching Process as a Non-cooperative Bargaining Game. In J. J. McCall (Ed.), *The Economics of Information and Uncertainty* (pp. 233-258), New York, NY: NBER Conference Volume.

Mortensen, D. T., & Pissarides, C. (1994). Job creation and job destruction in the theory of unemployment. *Review of Economic Studies, 61*(3), 397-415.

Mortensen, D. T., & Pissarides, C. A. (1999a). New Developments in Models of Search in the Labor Market. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 2567–2627). Amsterdam: North-Holland.

Mortensen, D. T., & Pissarides, C. A. (1999b). Job reallocation, employment fluctuations and unemployment. In J. B. Taylor & M. Woodford (Eds.), *Handbook of Macroeconomics* (pp. 1171-1228). Amsterdam: North-Holland.

Mortensen, D. T., & Pissarides, C. A. (2011). *Job matching, wage dispersion, and unemployment.* New York, NY: Oxford University Press.

Munich, D., Svejnar, J., & Terrell, K. (1999). Worker-Firm Matching and Unemployment in Transition to a Market Economy: (Why) Were the Czechs More Successful than Others? *CERGE-EI Working Paper No. 141*. Prague: CERGE-EI.

Münich, D., & Svejnar, J. (2007). Unemployment in East and West Europe. *Labour Economics, 14*(84), 681-694.

Munich, D., & Svejnar, J. (2009). Unemployment and Worker-Firm Matching Theory and Evidence from East and West Europe. *The World Bank Policy Research Working Paper No. 4810*. Washington, DC: The World Bank.

Nesporova, A. (2003). Zaposlenost i politika tržišta rada u tranzicijskim gospodarstvima [Employment and Labour Market Policies in Transition Economies]. *Revija za socijalnu politiku, 7*(2), 183-196.

Nestić, D. (2002). Ekonomske nejednakosti u Hrvatskoj 1973-1998 [Economic Inequality in Croatia 1973-1998]. *Financijska teorija i praksa, 26*(3), 595-613.

Nickell, S. (1997). Unemployment and Labor Market Rigidities: Europe versus North America. *Journal of Economic Perspectives, 11*(3), 55-74.

Nickell, S., Nunziata, L., Ochel, W., & Quintini, G. (2003). The Beveridge curve, unemployment and wages in the OECD from the 1960s to the 1990s. In: P. Aghion, R. Frydman, J. E. Stiglitz, and M. Woodford (Eds.), *Knowledge, information and expectations in modern macroeconomics: in honor of Edmund S. Phelps* (pp. 394-431). New Jersey, NJ: Princeton University Press.

Nordin, M., Person, I., & Rooth, D. O. (2010). Education-occupation Mismatch: Is there an income penalty? *Economics of Education Review*, *29*(6), 1047-1059.

Obadić, A. (2003). *Modeliranje tržišta rada odabranih tranzicijskih zemalja matching funkcijom* [Labour Market Modelling of Selected Transition Countries by Matching Function]. Doctoral dissertation. Zagreb: Ekonomski fakultet Sveučilišta u Zagrebu.

Obadić, A. (2004). Regionalna analiza učinkovitosti hrvatskog tržišta rada [Regional Analysis of Croatian Labour Market Efficiency]. *Ekonomski pregled*, *55*(7-8), 531-556.

Obadić, A. (2006a). Theoretical and empirical framework of measuring mismatch on a labour market. *Zbornik Ekonomskog fakulteta u Rijeci*, *24*(1), 55-80.

Obadić, A. (2006b). Influence of regional mismatch on the employment process in selected transition countries. *Ekonomski pregled*, *57*(1-2), 3-30.

Oračić, D. (1997). Zakon o radu u svjetlu komparativnih istraživanja o nezaposlenosti [The Labour Law in the Light of Comparative Research on Unemployment]. *Revija za socijalnu politiku*, *4*(1), 1-7.

Pastore, F. (2012). Primum vivere ... industrial change, job destruction and the geographical distribution of unemployment. *IZA Journal of European Labor Studies*, *1*(7), 1-15.

Petrongolo, B., & Pissarides, C. A. (2001). Looking Into The Black Box: A Survey Of The Matching Function. *Journal of Economic Literature, 39*(2), 390-431.

Phelps, E. (1968). Money–Wage Dynamics and Labor Market Equilibrium. *Journal of Political Economy, 76*(4), 678–711.

Pissarides, C. A. (1979). Job Matchings with State Employment Agencies and Random Search. *Economic Journal*, *89*(356), 818-833.

Pissarides, C. A. (1984). Search Intensity, Job Advertising and Efficiency. *Journal of Labor Economics*, *2*(1), 128-143.

Pissarides, C. A. (1985). Short-Run Equilibrium Dynamics of Unemployment, Vacancies, and Real Wages. Cambridge. *American Economic Review*, *75*(4), 676-690.

Pissarides, C. A. (1986). Unemployment and Vacancies in Britain. *Economic Policy*, *1*(3), 499-559.

Pissarides, C. A. (1994). Search Unemployment with On-the-Job Search. *Review of Economic Studies*, *61*(3), 457-475.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory*, 2nd edition. Cambridge, MA: MIT Press.

Pološki Vokić, N., Tomić, I., & Zrnc, J. (2011). (Ne)podudarnost kompetencija radne snage kao ograničavajući čimbenik rasta hrvatskog gospodarstva [Competences mismatch of the labour force as a binding constraint for the growth of Croatian economy]. In Bićanić, I. (Ed.), *Diagnostics of barriers to growth toward a new growth policy in Croatia*. Zagreb: Ekonomski fakultet Sveučilišta u Zagrebu (unpublished).

Puljiz, J., & Maleković, S. (2007). Regional Income and Unemployment Disparities in Croatia. In Z. Reić and M. Fredotović, (Eds.), *Seventh International Conference on Enterprise in Transition: Enterprise in Transition Proceedings*, CD ROM. Split: Faculty of Economics, University of Split.

Quintini, G. (2011). Over-Qualified or Under-Skilled: A Review of Existing Literature. *OECD Social, Employment and Migration Working Paper No. 121*. Paris: Organisation for Economic cooperation and Development (OECD).

Roberts, K. (1998). School-to-Work Transitions in Former Communist Countries. *Journal of Education and Work, 11*(3), 221-238.

Rogerson, R. Shimer, R., & Wright, R. (2005). Search-Theoretic Models of the Labour Market: A Survey. *Journal of Economic Literature*, *43*(4), 959-988.

Rogerson, R., & Shimer, R. (2011). Search in Macroeconomic Models of the Labor Market. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 619-700). Amsterdam: North-Holland.

Róna-Tas, Á. (1996). Post-Communist Transition and the Absent Middle Class in East-Central Europe. In V. E. Bonnell (Ed.), *Identities in Transition: Eastern Europe and Russia After the Collapse of Communism* (pp. 29-44). Berkley, CA: University of California Press.

Rubil, I. (2013). Accounting for Regional Poverty Differences in Croatia: Exploring the Role of Disparities in Average Income and Inequality. *EIZ Working Papers EIZ-WP-1205*. Zagreb: Institute of Economics, Zagreb.

Rutkowski, J. J. (1996). High skills pay off: the changing wage structure during economic transition in Poland. *Economics of Transition*, *4*(1), 89-112.

Rutkowski, J. J. (2003). Analiza i prijedlozi poboljšanja tržišta rada u Hrvatskoj [Analysis of and Proposals for Improvement of the Labour Market in Croatia]. *Financijska teorija i praksa*, *27*(4), 495-513.

Sahin, A., Song, J., Topa, G., & Violante, G. L. (2012). Mismatch Unemployment. *NBER Working Paper No. 18265*. Cambridge, MA: National Bureau of Economic Research, Inc.

Saint-Paul, G. (2002). The Political Economy of Employment Protection. *Journal of Political Economy, 110*(3), 672-704.

Sattinger, M. (1993). Assignment models of the distribution of earnings. *Journal of economic literature, 31*(2), 831-880.

Scarpetta, S. (1996). Assesing the role of labour market policies and institutional settings on unemployment: A cross country study. *OECD Economics Studies*, (26); 43-98.

Schioppa, F. P. (Ed.) (1991). *Mismatch and Labour Mobility*. Cambridge: Cambridge University Press.

Shah, C., & Burke, G. (2001). Occupational Replacement Demand in Australia. *International Journal of Manpower, 22*(7), 648-663.

Shimer, R. (2005). The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review, 95*(1), 25-49.

Shimer, R. (2007). Mismatch. *American Economic Review, 97*(4), 1074-1101.

Shimer, R. (2010). *Labor Markets and Business Cycles.* Princeton, NJ: Princeton University Press.

Siebert, H. (1997). Labor Market Rigidities: At the Root of Unemployment in Europe. *Journal of Economic Perspectives, 11*(3), 37-54.

Simai, M. (2006). Poverty and Inequality in Eastern Europe and the CIS Transition Economies. *UN DESA Working Paper No. 17*. Washington, DC: United Nations Department of Economic and Social Affairs.

Sloane, P. J., Battu, H., & Seaman, P. T. (1999). Overeducation, undereducation and the British labour market. *Applied Economics, 31*(11), 1437-1453.

Soininen, H. (2007). Finnish Evidence of Changes in Labor Market Matching. *Finnish Economic Papers, 20*(1), 57-71.

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics, 87*(3), 355-374.

Stevens, M. (2007). New Micro-foundations for the Aggregate Matching Function. *International Economic Review, 48*(3), 847-868.

Stigler, G. J. (1961). The economics of information. *Journal of Political Economy, 69*(3), 213-225.

Stigler, G. J. (1962). Information in the labour market. *Journal of Political Economy, 70*(5), Part 2, 94-105.

Svejnar, J. (1999). Labor markets in the transitional Central and East European economies. In O. C. Ashenfelter & D. Card (Eds.), *Handbook of Labor Economics* (pp. 2809-2857). Amsterdam: North-Holland.

Svejnar, J. (2002a). Transition economies: Performance and challenges. *Journal of Economic Perspectives, 16*(1), 3–28.

Svejnar, J. (2002b). Labor Market Flexibility in Central and East Europe. *William Davidson Institute Working Paper No. 496*. Ann Arbor, MI: University of Michigan, The William Davidson Institute (WDI).

Šergo, Z., Poropat, A., and Gržinić, J. (2009). Croatia's Beveridge Curve and Estimation of Natural Rate of Unemployment. *Ekonomska istraživanja, 22*(3), 29-47.

Škare, M. (2001). Nezaposlenost u Hrvatskoj i determinante potražnje za radom [The Factors of Labour Demand and the Nature of Unemployment in Croatia]. *Revija za socijalnu politiku, 8*(1), 19-34.

Šošić, V. (2004). Regulation and Flexibility of the Croatian Labour Market. *The wiiw Balkan Observatory Working Paper No. 048*. Vienna: The Vienna Institute for International Economic Studies (wiiw).

Šošić, V. (2008). Contribution of Gross Job Flows to the Dynamics of Corporate Restructuring in Croatia. *Financial Theory and Practice, 32*(4), 499-517.

Tachibanaki, T. (Ed.) (1998). *Wage Differentials: An International Comparison*. New York, NY: St. Martin's Press, Inc.

Tomić, I., & Tyrowicz, J. (2010). What Happened to the Middle Class in the New Market Economies? The Case of Croatia and Poland. *Croatian Economic Survey, 12*(1), 9-44.

Turvey, R. (1977). Structural Change and Structural Unemployment. *International Labour Review, 116*(2), 209-215.

Tyrowicz, J., & Wójcik, P. (2010). Active Labour Market Policies and Unemployment Convergence in Transition. *Review of Economic Analysis, 2*(1), 46-72.

Van den Berg, G. J., & Ridder, G. (1998). An Empirical Equilibrium Search Model of the Labor Market. *Econometrica*, *66*(5), 1183-1221.

Van Ours, J. (1991). The Efficiency of the Dutch Labour Market in Matching Unemployment and Vacancies. *De Economist*, *139*(3), 358-378.

Vehovec, M., & Domadenik, P. (2003). Comparative Review of Defensive Resructuring of Firms in Croatia and Slovenia. *Financijska teorija i praksa*, *27*(4), 609-623.

Vehovec, M. (Ed.) (2008). *New Perspectives on a Longer Working Life in Croatia and Slovenia*. Zagreb: The Institute of Economics, Zagreb and Friedrich Ebert Stiftung.

Vujčić, B., & Šošić, V. (2008). Does It Pay to Invest in Education in Croatia?. *EFZG Working Paper No. 07-08*. Zagreb: Ekonomski fakultet Sveučilišta u Zagrebu.

Vukorepa, I. (2010). Novi zakon o radu [New Labour Act]. *Revija za socijalnu politiku*, *17*(2), 333-337.

Waldman, M. (1984). Job Assignments, Signalling, and Efficiency. *The RAND Journal of Economics*, *15*(2), 255-267.

Wang, H. J., & Ho, C. W. (2010). Estimating fixed-effect panel stochastic frontier models by model transformation. *Journal of Econometrics*, *157*(2), 286-296.

Wang, H. J., & Schmidt, P. (2002). One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency levels. *Journal of Productivity Analysis*, *18*(2), 129-144.

Warren, R. S. (1991). The Estimation of Frictional Unemployment: A Stochastic Frontier Approach. *The Review of Economics and Statistics*, *73*(2), 373-377.

Winiecki, J. (2008). Employment and unemployment in transition: the legacy of the communist past. *Post-Communist Economies*, *20*(3), 377-390.

World Bank and United Nations Development Programme (2010). *Social impact of the crisis and building resilience*. Zagreb: The World Bank & UNDP Croatia.

World Bank (2011). *Employment Protection Legislation and Labor Market Outcomes: Theory, Evidence and Lessons for Croatia*. The World Bank Policy Notes. Washington, DC: The World Bank.

Zakon o radu [Labour Act]. *Narodne novine* [Official Gazette] no. 38/95, 54/95 - corrigendum, 65/95 - corrigendum, 17/01, 82/01, 114/03, 142/03, 30/04, 137/04 - revised text, 68/05.

Zakon o radu [Labour Act]. *Narodne novine* [Official Gazette] no. 149/09, 61/11.

Zakon o kriterijima za sudjelovanje u tripartitnim tijelima i reprezentativnosti za kolektivno pregovaranje [Act on the Criteria for Participation in Tripartite Bodies and Representativeness for Collective Bargaining]. *Narodne novine* [Official Gazette] no. 82/12, 88/12 – corrigendum.

Zanetti, F. (2011). Labor market institutions and aggregate fluctuations in a search and matching model. *European Economic Review, 55*(5), 644–658.

APPENDICES

LIST OF APPENDICES

Appendix A: Appendix to Chapter 2

A.1 Effects of firing costs on dismissal thresholds

In the original model (Kugler and Saint-Paul, 2004) $J(m,\eta)=\frac{(1-\varphi)(m+\eta-w^r)+\gamma\hat{J}(\eta)}{r+\gamma+a}$ represented the value of a job filled if $m\le\tilde{m}$,[140] where $\hat{J}(\eta)=\int_{m_c}^{\bar{m}}J(m,\eta)g(m)dm-G(m_c(\eta))F(w)$ (now F is a function of w), which after some transformations becomes:

$$\hat{J}(\eta)=\frac{\left[\int_{\tilde{m}}^{\bar{m}}\frac{(1-\varphi)(m+\eta-w^r)}{r+\gamma}g(m)dm+\int_{m_c}^{\tilde{m}}\frac{(1-\varphi)(m+\eta-w^r)}{r+\gamma+a}g(m)dm-G(m_c(\eta))F(w)\right]}{\left\{1-\frac{\gamma}{(r+\gamma)}\left[G(\bar{m})-G(\tilde{m})\right]-\frac{\gamma}{(r+\gamma+a)}\left[G(\tilde{m})-G(m_c(\eta))\right]\right\}} \quad \text{(a.1)}$$

Totally differentiating equation 2.3 with respect to η, w^r, and w (as a replacement for F) and equation a.1 with respect to η, w^r, and w (as a replacement for F), we get the following results:

$$\frac{dm_c}{d\eta}=-1-\frac{\gamma}{(1-\varphi)}\frac{d\hat{J}(\eta)}{d\eta};$$

$$\frac{dm_c}{dw^r}=\frac{-dF(w)}{dw}(r+\gamma+a)+1-\frac{\gamma}{(1-\varphi)}\left(\frac{d\hat{J}(\eta)}{dw^r}\right);$$

$$\frac{dm_c}{dF(w)}\Rightarrow\frac{dm_c}{dw}=-\frac{dF(w)}{dw}\frac{(r+\gamma+a)}{(1-\varphi)}-\frac{\gamma}{(1-\varphi)}\left(\frac{d\hat{J}(\eta)}{dw}\right);$$

where:

$$\frac{d\hat{J}(\eta)}{d\eta}=\frac{\left[\frac{(1-\varphi)}{(r+\gamma)}\left[G(\bar{m})-G(\tilde{m})\right]+\frac{(1-\varphi)}{(r+\gamma+a)}\left[G(\tilde{m})-G(m_c(\eta))\right]\right]}{\left\{1-\frac{\gamma}{(r+\gamma)}\left[G(\bar{m})-G(\tilde{m})\right]-\frac{\gamma}{(r+\gamma+a)}\left[G(\tilde{m})-G(m_c(\eta))\right]\right\}}>0;$$

$$\frac{d\hat{J}(\eta)}{dw^r}=-\frac{d\hat{J}(\eta)}{d\eta}-\frac{\frac{dF(w)}{dw}(1-\varphi)G(m_c(\eta))}{const.}<0\left\langle \sin ce\ \frac{dF(w)}{dw}\ge 0\ \&\ \frac{d\hat{J}(\eta)}{d\eta}>0\right\rangle;$$

[140] If $m>\tilde{m}\Rightarrow J(m,\eta)=\frac{(1-\varphi)(m+\eta-w^r)+\gamma\hat{J}(\eta)}{r+\gamma}$.

$$\frac{d\hat{J}(\eta)}{dF(w)} \Rightarrow \frac{d\hat{J}(\eta)}{dw} = \frac{-\frac{dF}{dw}G(m_c(\eta))}{\left\{1-\frac{\gamma}{(r+\gamma)}\left[G(\overline{m})-G(\tilde{m})\right]-\frac{\gamma}{(r+\gamma+a)}\left[G(\tilde{m})-G(m_c(\eta))\right]\right\}} < 0.$$

By substitution we get:

$$\frac{dm_c}{d\eta} < 0 \tag{a.2}$$

$$\frac{dm_c}{dw^r} = \left[\frac{-dF(w)}{dw}(r+\gamma+a)\right] + \left[1-\frac{\gamma}{(1-\varphi)}\left(\frac{d\hat{J}(\eta)}{dw^r}\right)\right] \tag{a.3}$$

Following Kugler and Saint-Paul (2004) we can prove that the second term in equation a.3 is positive. The first term is negative and the final effect of increasing reservation wage on dismissal threshold depends on the magnitude of positive and negative effect.

$$\frac{dm_c}{dF(w)} \Rightarrow \frac{dm_c}{dw} = \left[\frac{-dF(w)}{dw}\frac{(r+\gamma+a)}{(1-\varphi)}\right] + \left[-\frac{\gamma}{(1-\varphi)}\left(\frac{d\hat{J}(\eta)}{dw}\right)\right] \tag{a.4}$$

It can be shown that a value of a job decreases by wage increase. Therefore, the second term in equation a.4 is positive. The first term is again negative and the joint effect depends on the magnitude of positive and negative effect.

Although we know that $m_c(\eta_H) < m_c(\eta_L)$, we cannot be sure about the effect of change in reservation wage and *F* on dismissal threshold of good and bad workers. If we assume that *F* does not depend on wage, then we can prove that dismissal threshold for good workers is more responsive to change in *w* and *F* due to the discount effect (Kugler and Saint-Paul, 2004). However, the opposite effect works through dismissal costs being related to wage. If we assume that the quitting rate is higher in the case of high-productivity (good) workers compared with less productive workers but, on the other hand, good workers are less likely to be fired (lower *r*), then the magnitude of the second term determines the effect of *w* on the dismissal threshold of good and bad workers. Therefore, we might conclude that dismissal threshold of good workers on *w* and *F* is more sensitive than dismissal threshold of bad workers.

A.2 Effects of firing costs on the quality of unemployed

Assuming steady-state conditions (inflow and outflow are the same for both types of workers) the relationship between z_U and p_U can be derived as follows:

$$z_U = z\frac{\gamma + \frac{ap_U}{G_L}}{\gamma + ap_U\left(\frac{1-z}{G_H} + \frac{z}{G_L}\right)} \qquad \text{(a.5)}$$

From expression a.5 we get $\frac{dz_U}{dp_U} = \frac{\frac{a}{G_L}(>0)}{\gamma az(1-z)\left(\frac{1}{G_L} - \frac{1}{G_H}\right)}$.

Assuming that $G_L > G_H$ then $\frac{dz_U}{dp_U} < 0$.

Following Kugler and Saint-Paul (2004) we can show that the rise in F (followed by increase in w) decreases the proportion of good workers among unemployed, that is:

$$\frac{dz_U}{dF(w)}(p_u = const.) \Rightarrow \frac{dz_U}{dw} =$$

$$-\gamma\left[\frac{g_L}{(G_L)^2}\frac{dm(\eta_L)}{dw} - \frac{g_H}{(G_H)^2}\frac{dm(\eta_H)}{dw}\right] - \frac{ap_U}{G_H G_L}\left[\frac{g_L}{G_L}\frac{dm(\eta_L)}{dw} - \frac{g_H}{G_H}\frac{dm(\eta_H)}{dw}\right]$$

If $G_L > G_H$ and $0 > \frac{dm_c(\eta_L)}{dw} > \frac{dm_c(\eta_H)}{dw}$ (Appendix A.1), then $\frac{dz_U}{dw} < 0$.

A.3 Additional statistics

A.3.1 Summary statistics for different types of job-seekers

Table A.1. Summary statistics among successful switchers for different types of job-seekers

period/variable	pre-reform				post-reform			
	1996-1998		1999-2003		2004-2006		2007-2009	
	emp	unp/inct	emp	unp/inct	emp	unp/inct	emp	unp/inct
Individual characteristics								
age	33.95	27.19	34.32	29.51	35.19	28.97	34.59	29.42
	(9.11)	(8.88)	(10.05)	(10.12)	(10.55)	(9.99)	(10.48)	(10.25)
gender – female#	0.43	0.46	0.39	0.51	0.39	0.51	0.40	0.52
	(0.50)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)	(0.49)	(0.50)
marital status - single#	0.31	0.61	0.36	0.58	0.39	0.62	0.46	0.66
	(0.46)	(0.49)	(0.48)	(0.49)	(0.49)	(0.49)	(0.50)	(0.47)
years of schooling	11.79	11.53	11.63	11.70	11.59	11.76	11.66	11.94
	(2.48)	(2.47)	(2.49)	(2.45)	(2.45)	(2.28)	(2.13)	(2.29)
training in the last 3 months#	0.04	0.03	0.01	0.02	0.01	0.02	0.02	0.01
	(0.19)	(0.17)	(0.10)	(0.13)	(0.11)	(0.13)	(0.13)	(0.10)
head of household#	0.58	0.30	0.58	0.37	0.55	0.32	0.47	0.29
	(0.49)	(0.46)	(0.49)	(0.48)	(0.50)	(0.46)	(0.50)	(0.45)
urban settlement#	0.63	0.55	0.51	0.49	0.47	0.44	0.45	0.40
	(0.48)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)
unemployment dummy#	n.a.	0.47	n.a.	0.70	n.a.	0.73	n.a.	0.68
	(n.a.)	(0.50)	(n.a.)	(0.46)	(n.a.)	(0.45)	(n.a.)	(0.47)
Distribution by occupation								
white collar#	0.14	0.11	0.13	0.11	0.12	0.10	0.09	0.11
	(0.35)	(0.31)	(0.34)	(0.31)	(0.33)	(0.30)	(0.29)	(0.32)

(table continues)

(continued)

blue collar[#]	0.63	0.70	0.67	0.68	0.69	0.68	0.67	0.66
	(0.48)	(0.46)	(0.47)	(0.47)	(0.46)	(0.46)	(0.47)	(0.47)
other occupation[#]	0.23	0.19	0.20	0.21	0.19	0.22	0.24	0.22
	(0.42)	(0.39)	(0.40)	(0.41)	(0.39)	(0.41)	(0.42)	(0.42)
Distribution by industry								
services[#]	0.59	0.55	0.55	0.56	0.55	0.55	0.57	0.57
	(0.49)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
manufacturing[#]	0.33	0.35	0.33	0.31	0.31	0.33	0.33	0.32
	(0.47)	(0.48)	(0.47)	(0.46)	(0.46)	(0.47)	(0.47)	(0.47)
other industry[#]	0.08	0.10	0.10	0.12	0.11	0.12	0.10	0.12
	(0.27)	(0.30)	(0.30)	(0.33)	(0.32)	(0.33)	(0.30)	(0.32)
General economic conditions								
local rate of unemployment	n.a.	n.a.	0.15	0.16	0.13	0.14	0.09	0.10
	(n.a.)	(n.a.)	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
res. wage - emp	2045.10	n.a.	2813.08	n.a.	3348.86	n.a.	3641.38	n.a.
	(1143.85)	(n.a.)	(1780.80)	(n.a.)	(2095.01)	(n.a.)	(1560.46)	(n.a.)
res. wage – unp/inct	n.a.	1803.40	n.a.	2329.37	n.a.	2687.00	n.a.	3253.12
	(n.a.)	(822.29)	(n.a.)	(1203.39)	(n.a.)	(1304.75)	(n.a.)	(1143.73)
average industry wage	2247.12	2326.48	3224.93	3212.55	4040.62	4019.44	4668.52	4621.46
	(468.44)	(498.26)	(724.47)	(750.01)	(808.78)	(840.64)	(1007.04)	(970.85)
regionally adjusted industry wage	n.a.	n.a.	2877.48	2823.11	3446.12	3426.25	3846.85	3836.77
	(n.a.)	(n.a.)	(617.88)	(659.73)	(683.89)	(696.40)	(649.96)	(696.85)

Notes. Standard deviation is in parentheses.
Data are represented as mean values or as share (for dummy variables - #) in the associated sample.

Source: Authors' calculation based on Croatian Labour Force Survey for the period 1996-2009.

A.3.2 Results for the pool 2000-2003 (without imputed data for 1999)

Table A.2. Results for the pool 2000-2003 (without imputed data for 1999) - marginal effects of different variables on the probability of switch to employment for different types of job-seekers

period/variable	after probit		after ivprobit	
	emp	unp/inct	emp	unp/inct
Individual characteristics				
age	-0.005***	-0.017***	-0.005***	-0.014***
	(0.000)	(0.001)	(0.001)	(0.001)
gender – female#	-0.069***	-0.030**	-0.093***	0.061***
	(0.012)	(0.014)	(0.016)	(0.018)
marital status - single#	-0.003	0.114***	0.008	0.118***
	(0.018)	(0.021)	(0.018)	(0.020)
training in the last 3 months#	-0.089*	-0.098**	-0.076	-0.099**
	(0.047)	(0.044)	(0.043)	(0.042)
head of household#	-0.009	-0.015	-0.008	-0.013
	(0.018)	(0.020)	(0.018)	(0.019)
urban settlement#	-0.016	-0.009	-0.012	-0.030**
	(0.013)	(0.013)	(0.013)	(0.013)
Distribution by occupation				
blue collar#	0.055***	-0.083***	-0.023	0.085***
	(0.021)	(0.026)	(0.042)	(0.032)
other occupation#	0.009	-0.085***	-0.032	0.001
	(0.023)	(0.026)	(0.029)	(0.029)
Distribution by industry				
manufacturing#	-0.077***	-0.062***	-0.084***	-0.035**
	(0.013)	(0.015)	(0.013)	(0.015)
other industry#	-0.141***	0.072***	-0.164***	0.102***
	(0.016)	(0.024)	(0.018)	(0.022)
General economic conditions				
local rate of unemployment	-0.413***	-0.857***	-0.448***	-0.593***
	(0.105)	(0.112)	(0.106)	(0.119)
year dummy# (1)[a]	0.066***	-0.044**	0.063***	-0.026
	(0.018)	(0.018)	(0.018)	(0.018)
year dummy# (2)[b]	0.050***	0.019	0.048***	0.033*
	(0.017)	(0.018)	(0.017)	(0.017)
year dummy# (3)[c]	0.033*	0.052***	0.031*	0.069***
	(0.017)	(0.020)	(0.017)	(0.019)
reservation wage - emp	0.158***	n.a.	-0.004	n.a.
	(0.015)	(n.a.)	(0.074)	(n.a.)
reservation wage – unp/inct	n.a.	-0.107***	n.a.	0.606***
	(n.a.)	(0.021)	(n.a.)	(0.095)
y = Pr(switch to employment) (predict)	0.321	0.329	0.324	0.361
Number of observations	6498	5994	6498	5994
Log likelihood	-3933.51	-3171.48	-6928.84	-4746.35
Pseudo R^2	0.044	0.188	n.a.	n.a.
Wald test of exogeneity (Prob > chi2)	n.a.	n.a.	0.026	0.000

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. Standard errors are in parentheses.
emp – employed job-seeker; *unp/inct* – unemployed/inactive job-seeker.
- dy/dx is for a discrete change of the dummy variable from 0 to 1. a – 2001; b – 2002; c – 2003.

Source: Author's calculation based on Croatian Labour Force Survey for the period 1996-2009.

A.3.3 Correlation matrixes

Table A.3. Correlation matrix for 1996-1998

variable	switch	age	gender	marital status	training	house head	urban sett.	blue collar	other occup.	manuf.	other indus.	unemp. dummy	res. wage	years of school.	av. ind. wage
switchers	1.00														
age	-0.29	1.00													
gender-female	-0.02	-0.10	1.00												
marital status - single	0.23	-0.54	-0.08	1.00											
training	0.07	-0.05	0.01	0.05	1.00										
head of household	-0.21	0.57	0.04	-0.64	-0.03	1.00									
urban settlement	0.01	0.09	0.10	-0.05	0.03	0.11	1.00								
blue collar	0.00	-0.11	-0.13	0.04	-0.08	-0.09	-0.25	1.00							
other occupation	-0.03	0.06	0.17	-0.02	0.05	0.06	0.18	-0.78	1.00						
manufacturing	-0.06	0.05	-0.13	-0.05	-0.05	0.03	-0.08	0.20	-0.13	1.00					
other industry	-0.06	0.05	-0.09	-0.01	-0.02	0.03	-0.16	0.10	-0.08	-0.28	1.00				
unemployment dummy	-0.03	0.07	0.01	0.03	-0.03	-0.03	0.02	0.05	-0.02	0.05	-0.05	1.00			
reservation wage	0.03	0.08	-0.18	-0.02	0.06	0.06	0.13	-0.25	0.09	-0.02	-0.09	0.04	1.00		
years of schooling	**0.06**	-0.05	0.06	0.04	0.08	-0.02	0.27	**-0.50**	**0.26**	-0.17	-0.17	-0.11	**0.28**	1.00	
average industry wage	**0.04**	0.00	-0.09	0.05	0.07	0.00	0.13	-0.33	0.25	-0.27	-0.01	-0.02	**0.22**	0.20	1.00

Source: Author's calculation based on Croatian Labour Force Survey for the period 1996-1998.

Table A.4. Correlation matrix for 1999-2003

variable	switch	age	gender	marital status	training	house head	urban sett.	blue collar	other occup.	manuf.	other indus.	local rate unemp.	unemp. dummy	res. wage	years of school.	reg. adj. ind. wage
switchers	1.00															
age	-0.32	1.00														
gender-female	-0.03	-0.08	1.00													
marital status - single	0.23	-0.54	-0.09	1.00												
training	-0.21	0.56	0.08	-0.71	1.00											
head of household	-0.03	0.08	0.06	-0.03	0.07	1.00										
urban settlement	0.00	-0.02	0.02	0.01	0.00	0.02	1.00									
blue collar	0.00	-0.08	-0.11	0.01	-0.03	-0.21	-0.04	1.00								
other occupation	-0.03	0.05	0.14	-0.01	0.02	0.14	0.03	-0.78	1.00							
manufacturing	-0.09	0.08	-0.18	-0.04	0.04	-0.09	-0.01	0.18	-0.11	1.00						
other industry	0.00	0.02	-0.05	-0.01	0.00	-0.10	-0.02	0.06	-0.05	-0.27	1.00					
local rate of unemploy.	-0.09	0.06	0.00	-0.03	0.03	0.03	0.00	0.01	-0.01	-0.04	0.00	1.00				
unemployment dummy	-0.14	0.07	0.02	0.01	-0.01	0.00	0.02	0.06	-0.01	0.04	-0.04	0.15	1.00			
reservation wage	0.02	0.09	-0.16	-0.05	0.06	0.13	0.03	-0.32	0.14	-0.07	-0.08	-0.03	-0.05	1.00		
years of schooling	**0.09**	-0.10	0.08	0.09	-0.08	0.24	0.04	**-0.49**	**0.26**	-0.18	-0.12	-0.02	-0.11	**0.34**	1.00	
regionally adj. ind. wage	**0.05**	-0.02	0.02	0.03	-0.02	0.13	0.05	-0.32	0.23	-0.12	-0.45	0.03	0.03	**0.23**	0.25	1.00

Source: Author's calculation based on Croatian Labour Force Survey for the period 1999-2003.

Table A.5. Correlation matrix for 2004-2006

variable	switch	age	gender	marital status	training	house head	urban sett.	blue collar	other occup.	manuf.	other indus.	local rate unemp.	unemp. dummy	res. wage	years of school.	reg. adj. ind. wage
switchers	1.00															
age	-0.34	1.00														
gender-female	-0.03	-0.03	1.00													
marital status - single	0.23	-0.57	-0.18	1.00												
training	-0.22	0.60	0.13	-0.72	1.00											
head of household	0.01	0.05	0.06	-0.01	0.05	1.00										
urban settlement	0.02	-0.04	0.01	0.02	-0.01	0.04	1.00									
blue collar	-0.03	-0.04	-0.12	0.00	-0.03	-0.22	-0.07	1.00								
other occupation	0.00	0.02	0.12	0.00	0.03	0.16	0.04	-0.79	1.00							
manufacturing	-0.05	0.07	-0.18	-0.03	0.03	-0.07	-0.03	0.16	-0.11	1.00						
other industry	-0.07	0.05	-0.03	-0.03	0.03	-0.15	-0.02	0.11	-0.08	-0.31	1.00					
local rate of unemploy.	-0.06	0.06	0.00	-0.07	0.08	-0.01	-0.01	0.05	-0.05	0.01	0.02	1.00				
unemployment dummy	-0.04	0.13	0.06	-0.03	0.03	0.04	-0.04	0.03	0.01	0.08	-0.11	0.15	1.00			
reservation wage	0.09	0.02	-0.14	-0.03	0.05	0.13	0.05	-0.32	0.15	-0.03	-0.18	-0.09	-0.07	1.00		
years of schooling	**0.09**	-0.15	0.09	0.10	-0.11	0.22	0.09	**-0.50**	**0.24**	-0.15	-0.17	-0.08	-0.12	**0.35**	1.00	
regionally adj. ind. wage	**0.11**	-0.05	0.00	0.03	-0.01	0.18	0.03	-0.33	0.25	0.10	-0.66	-0.02	0.07	**0.32**	0.27	1.00

Source: Author's calculation based on Croatian Labour Force Survey for the period 2004-2006.

Table A.6. Correlation matrix for 2007-2009

variable	switch	age	gender	marital status	training	house head	urban sett.	blue collar	other occup.	manuf.	other indus.	local rate unemp.	unemp. dummy	res. wage	years of school.	reg. adj. ind. wage
switchers	1.00															
age	-0.37	1.00														
gender-female	-0.05	0.00	1.00													
marital status - single	0.26	-0.61	-0.18	1.00												
training	-0.27	0.66	0.14	-0.75	1.00											
head of household	0.03	0.06	0.07	-0.01	0.08	1.00										
urban settlement	0.03	-0.02	0.04	0.00	0.01	0.05	1.00									
blue collar	-0.09	0.03	-0.12	-0.05	0.03	-0.21	-0.08	1.00								
other occupation	0.06	-0.04	0.12	0.03	-0.02	0.14	0.02	-0.79	1.00							
manufacturing	-0.06	0.05	-0.21	-0.05	0.04	-0.10	-0.04	0.13	-0.10	1.00						
other industry	-0.13	0.07	0.01	-0.04	0.05	-0.11	0.00	0.11	-0.10	-0.31	1.00					
local rate of unemploy.	-0.12	0.08	0.00	-0.07	0.08	-0.06	-0.02	0.09	-0.08	0.04	0.05	1.00				
unemployment dummy	-0.12	0.14	0.07	-0.06	0.06	-0.03	-0.05	0.06	-0.01	0.04	-0.05	0.14	1.00			
reservation wage	0.14	-0.01	-0.19	0.03	-0.01	0.15	0.07	-0.39	0.19	-0.03	-0.18	-0.13	-0.12	1.00		
years of schooling	**0.11**	-0.17	0.10	0.16	-0.15	0.25	0.09	**-0.53**	**0.25**	-0.15	-0.17	-0.09	-0.16	**0.43**	1.00	
regionally adj. ind. wage	**0.17**	-0.07	-0.01	0.08	-0.07	0.15	0.04	-0.34	0.23	0.01	-0.61	-0.06	0.01	**0.33**	0.32	1.00

Source: Author's calculation based on Croatian Labour Force Survey for the period 2004-2006.

Appendix B: Appendix to Chapter 3

B.1 Data description

Table B.1. Data description

Variable	Description	Type*	Period	Source	Mean	Std. Dev.
M	number of employed persons from the CES Registry during the month	flow	monthly	CES	538.838	498.130
U	number of registered unemployed persons at the end of the previous (t-1) month	stock	monthly	CES	14174.79	12536.88
V	posted vacancies during the month	flow	monthly	CES	514.403	595.357
U_new	number of newly registered unemployed during the month	flow	monthly	CES	954.800	899.247
U_sum	sum of the no. of unemp. at the end of the previous month and the no. of newly registered unemp. during the month	stock + flow	monthly	CES	15129.59	13338.36
V/U	vacancy ratio (measure of labour market tightness)	flow over stock	monthly	CES	0.039	0.030
Reg_unrate	regional unemployment rate (per counties) on 31 March each year	stock	yearly	CBS	0.244	0.088
M/delisted	ratio of employed to delisted from the Registry for other reasons	flow	monthly	CES	0.898	1.319
M_female	share of females in total flows to employment	flow	monthly	CES	0.528	0.085
U_female	share of females in total unemployment	stock	monthly	CES	0.566	0.047
U_<24y	share of youth (≤24 years) in total unemployment	stock	monthly	CES	0.215	0.056
U_12m+	share of long-term unemployed (12 months or more) in total unemployment	stock	monthly	CES	0.547	0.079
U_w/o_experience	share of persons without experience in total unemployment	stock	monthly	CES	0.221	0.066
U_primary_sector	share of those previously employed in primary sector of economic activity in total unemployment	stock	monthly	CES	0.039	0.026
U_benefits	share of unemployed persons receiving unemployment benefits in total unemployment	stock	monthly	CES	0.235	0.086
U_low skilled	share of low-skilled (no schooling and uncompleted basic school + basic school) persons in total unemployment	stock	monthly	CES	0.349	0.077
U_high skilled	share of high-skilled (non-university college + university and postgraduate degrees) persons in total unemployment	stock	monthly	CES	0.060	0.033
U_almp coverage	share of persons in active labour market programmes in total number of unemployed in each regional office at the year end	stock	yearly	CES	0.049	0.041
CES_high skilled	number of highly skilled (non-university college + university and postgraduate degrees) employed at CES over the number of registered unemployed	stock	year over month	CES	0.003	0.001
Net income_pc	Net income p/c in a specific county	stock	yearly	MFIN/TA	18043.24	4986.01
Pop_density	population density per km^2	stock	yearly	CBS	81.663	59.082

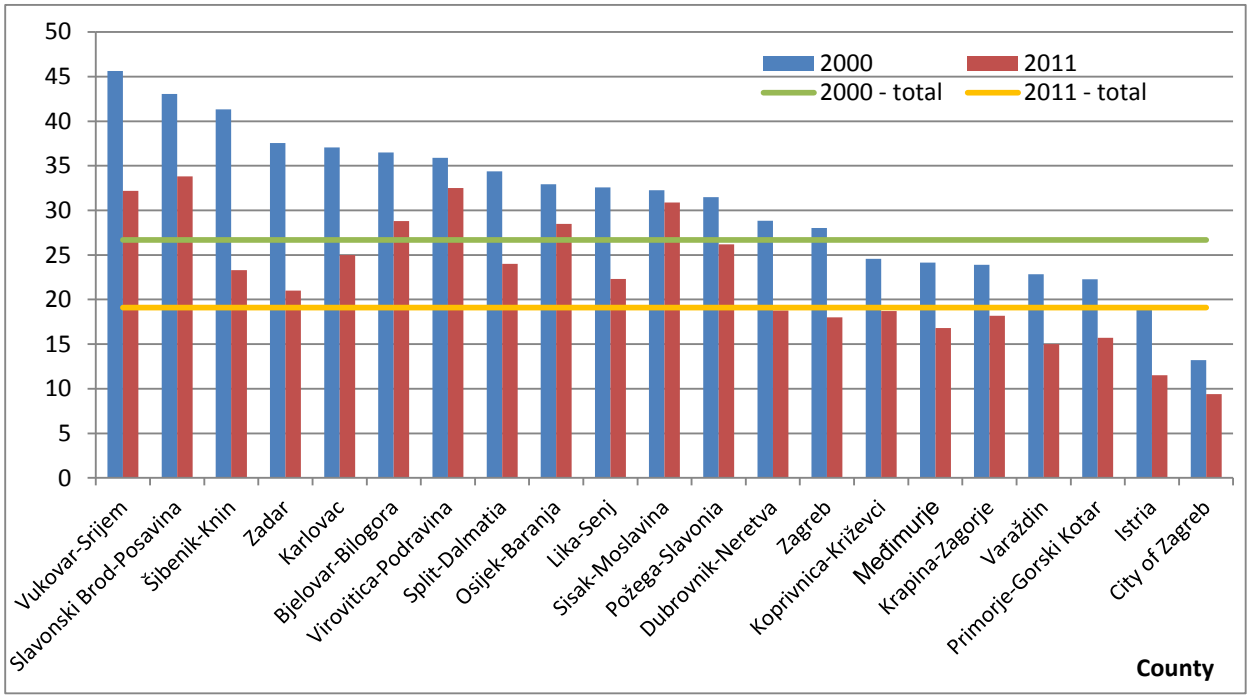
Notes. * - *flow variable* – during the month; *stock variable* – end of the previous (t-1) month or end of the year.

Table B.2. Distribution of regional offices

NUTS2	County (NUTS3)	Regional office	
Northwest Croatia	City of Zagreb	Zagreb	ZG
	Zagreb		
	Krapina-Zagorje	Krapina	KR
	Varazdin	Varazdin	VZ
	Koprivnica-Krizevci	Krizevci	KZ
	Medimurje	Cakovec	CK
Central and Eastern (Pannonian) Croatia	Bjelovar-Bilogora	Bjelovar	BJ
	Virovitica-Podravina	Virovitica	VT
	Pozega-Slavonia	Pozega	PZ
	Slavonski Brod-Posavina	Slavonski Brod	SB
	Osijek-Baranja	Osijek	OS
	Vukovar-Srijem	Vukovar	VU
		Vinkovci	VK
	Karlovac	Karlovac	KA
	Sisak-Moslavina	Sisak	SK
		Kutina	KT
Adriatic Croatia	Primorje-Gorski Kotar	Rijeka	RI
	Lika-Senj	Gospic	GS
	Zadar	Zadar	ZD
	Sibenik-Knin	Sibenik	SI
	Split-Dalmatia	Split	ST
	Istria	Pula	PU
	Dubrovnik-Neretva	Dubrovnik	DU

B.2 Additional charts

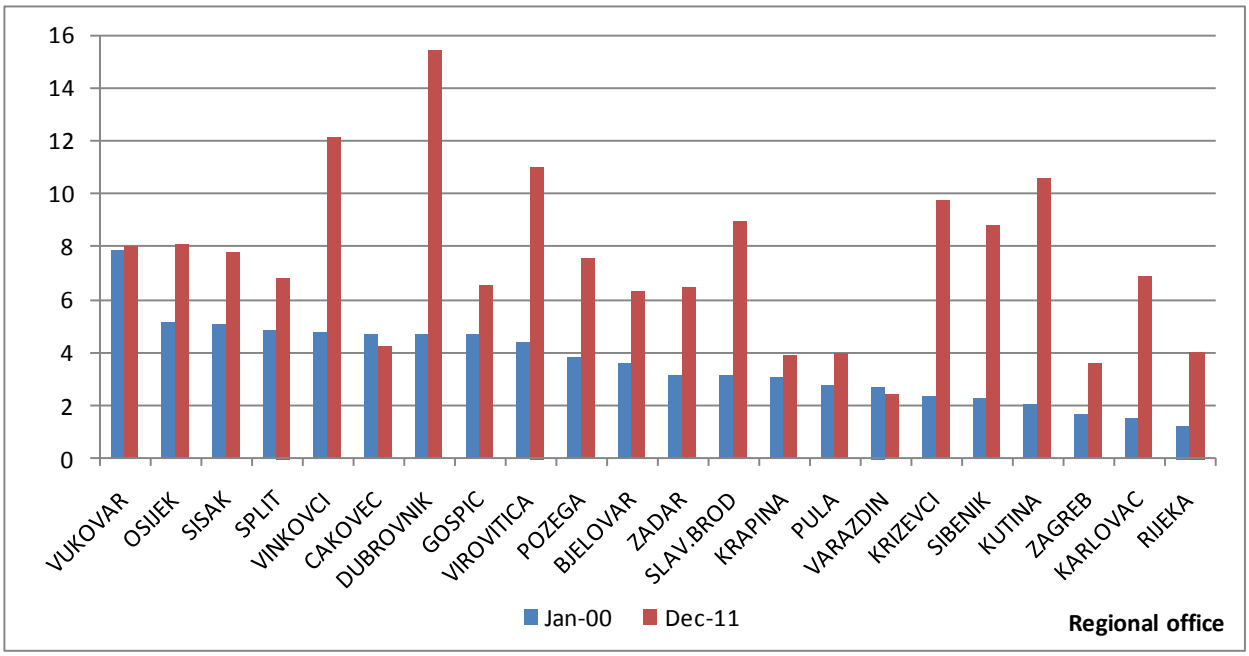
Figure B.1. Regional unemployment rates



Notes. Data relating to 31 March each year.

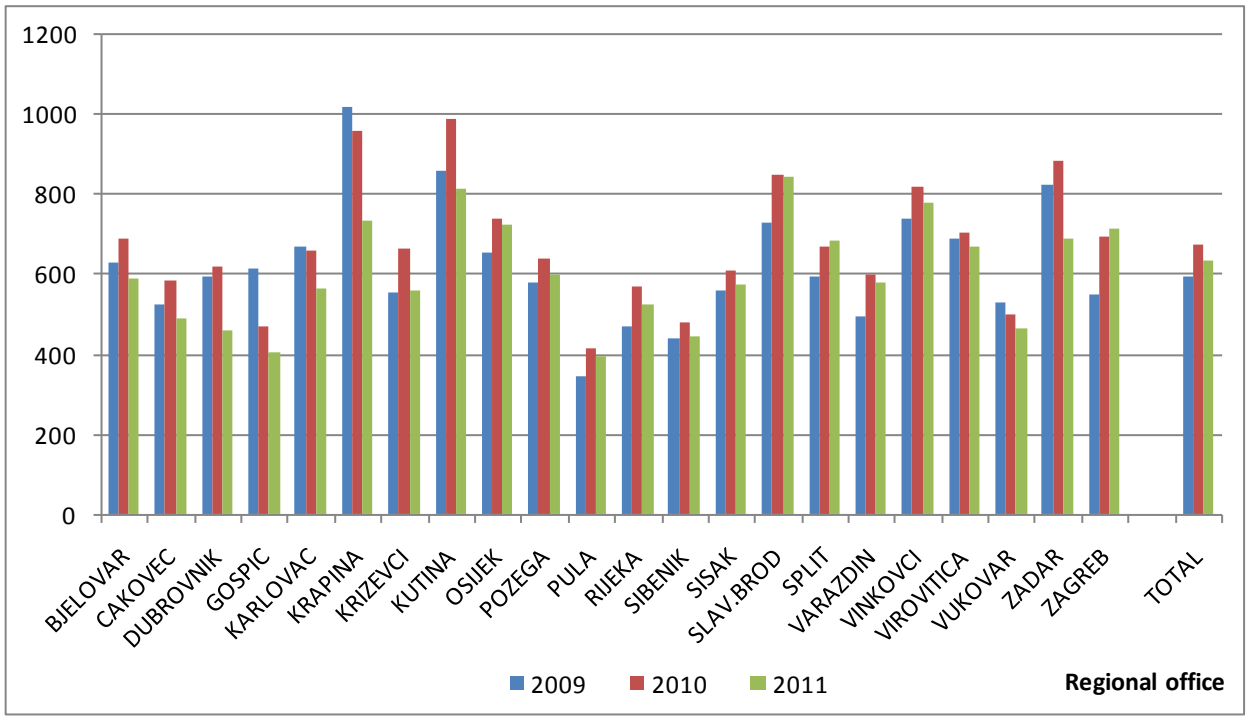
Source: CBS.

Figure B.2. Newly registered unemployed to newly registered vacancies (U-new/V)



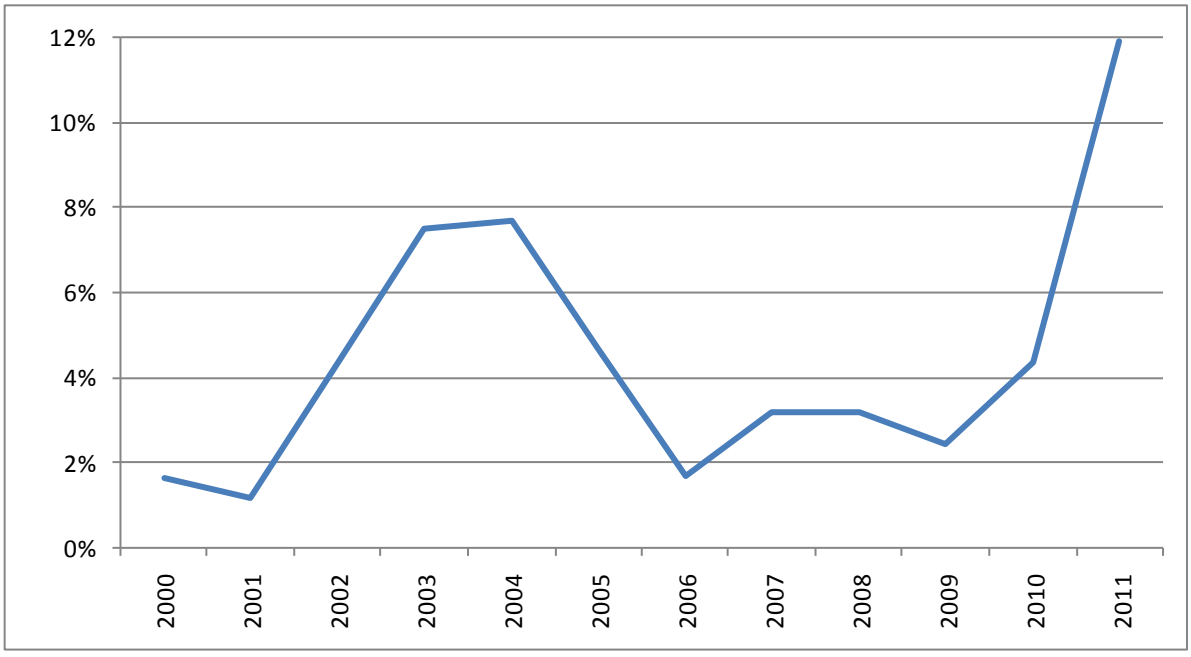
Source: Author's calculations based on CES data.

Figure B.3. Number of registered unemployed persons per one job counsellor by regional office (2009-2011)



Source: Author's calculations based on CES data.

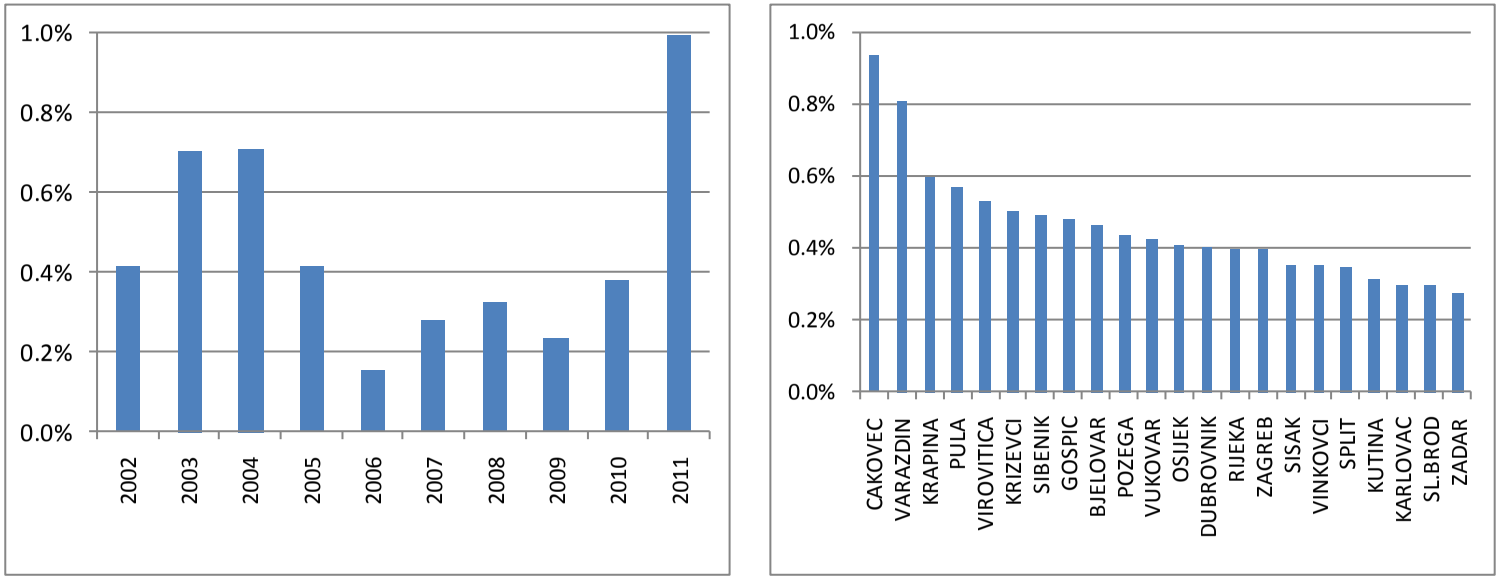
Figure B.4. ALMP coverage rate over the years (2000-2011)



Notes. ALMP coverage rate – the share of persons included in one of the active labour market programmes in total unemployment.

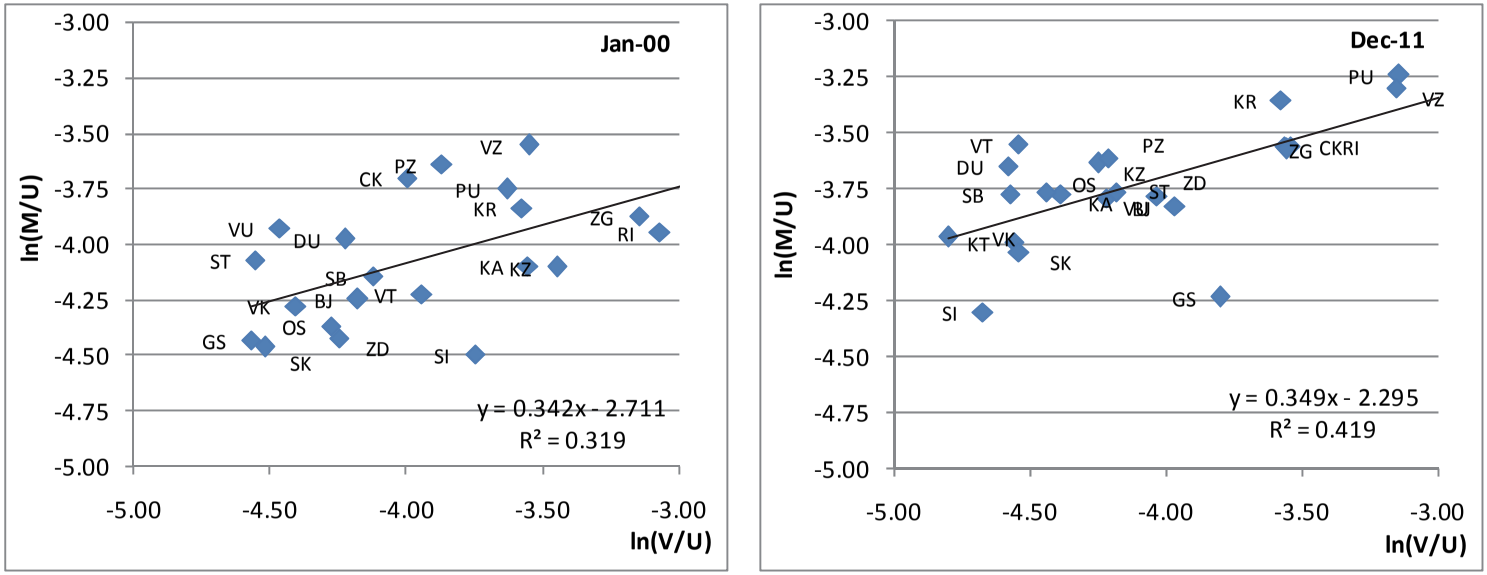
Source: Author's calculations based on CES data.

Figure B.5. Mean share of the new entrants into active labour market programmes in total number of unemployed over years (left) and across regional offices (right)



Source: Author's calculations based on CES data.

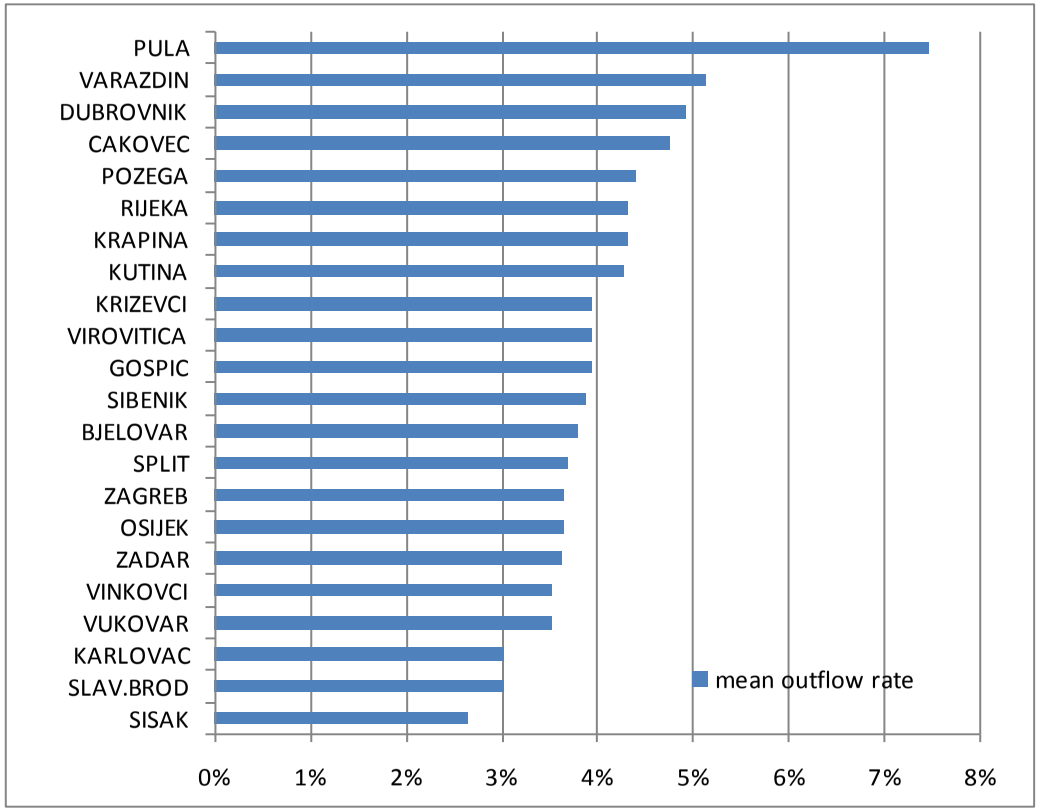
Figure B.6. Vacancy ratio and hiring probabilities across regions – 2000m1 (left) and 2011m12 (right)



Notes. M/U – hiring probability (outflow rate); V/U – vacancy ratio.

Source: Author's calculations based on CES data.

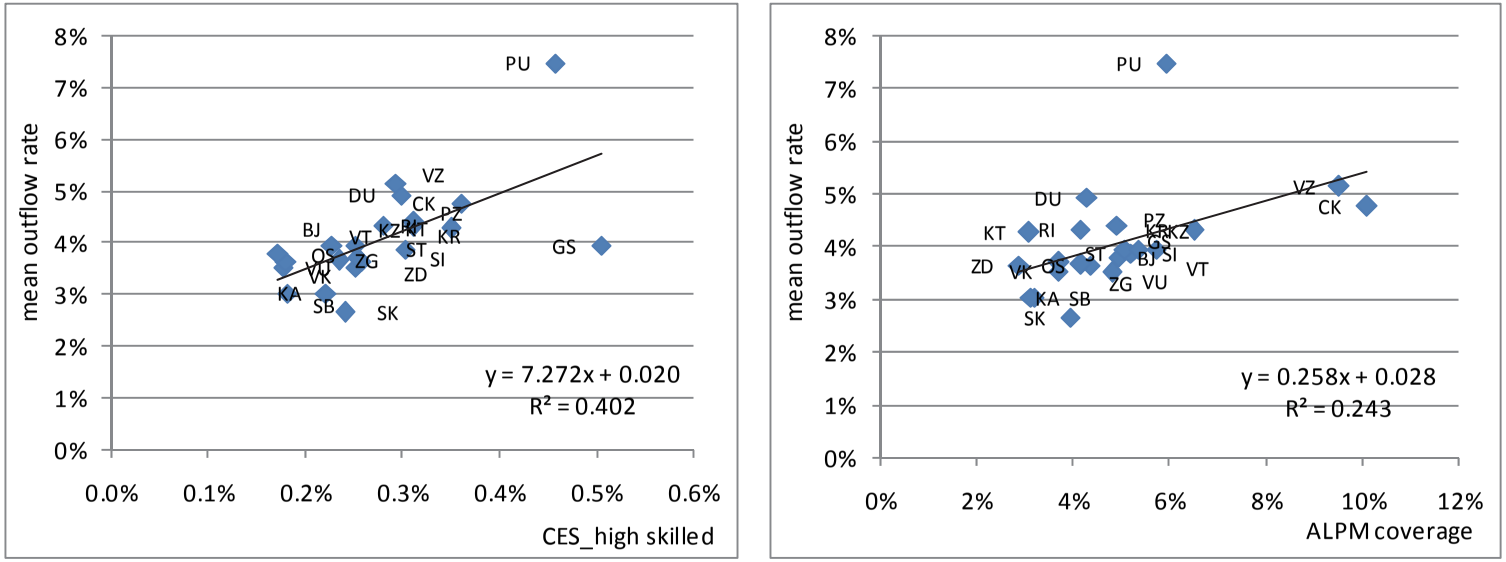
Figure B.7. Mean outflow rate by regional office (2000m1-2011m12)



Notes. outflow rate – M/U.

Source: Author's calculations based on CES data.

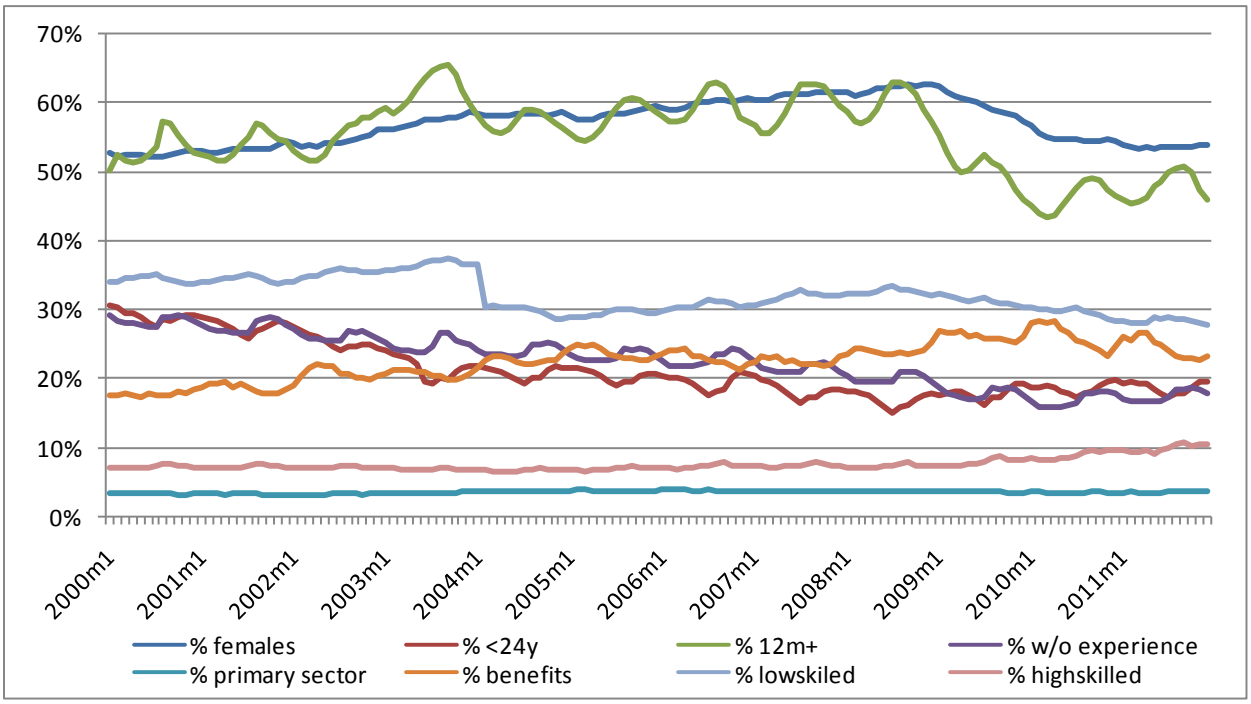
Figure B.8. Mean outflow rate and number of highly skilled CES employees per number of the unemployed (left) and ALMP coverage rate (right)



Notes. M/U – hiring probability (outflow rate); ALMP coverage rate - the share of persons included in one of the active labour market programmes in total unemployment; CES_high skilled - number of highly skilled employed at respective CES office over the number of registered unemployed.

Source: Author's calculations based on CES data.

Figure B.9. Unemployed workers main characteristics (2000m1-2011m12)



Source: CES.

B.3 Robustness check

B.3.1 Estimation results without Zagreb region

Table B.3. Stochastic frontier estimation excluding Zagreb region

	Unrestricted estimation				Restricted estimation		
Variables	**Stocks of u**	**Flows of u**	**Both**	**Sum**	**Stocks of u**	**Both**	**Sum**
u	0.773***		0.924***		0.760***	0.921***	
	(0.021)		(0.029)		(0.010)	(0.022)	
v	0.242***	0.260***	0.235***	0.250***	0.240***	0.235***	0.249***
	(0.010)	(0.012)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
u_new		0.019	-0.155***			-0.155***	
		(0.021)	(0.019)			(0.019)	
u_sum				0.765***			0.751***
				(0.021)			(0.010)
Returns to scale	CRS	DRS	CRS	CRS	---	---	---
Constant	-2.721***	7.245	-2.923***	-2.817***	-2.600***	-2.888***	-2.680***
	(0.180)	(6.556)	(0.209)	(0.187)	(0.037)	(0.054)	(0.037)
Mean technical efficiency	**0.762**	**0.038**	**0.692**	**0.805**	**0.765**	**0.693**	**0.807**
	(0.002)	(0.0003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Wald χ^2	7685.43***	4693.50***	7395.96***	7563.52***	9001.19***	5767.96***	8935.95***
γ	0.086	0.716	0.155	0.077	0.083	0.154	0.073
	(0.032)	(0.065)	(0.049)	(0.033)	(0.031)	(0.048)	(0.030)
η	0.007***	0.0001	0.005***	0.007***	0.007***	0.005***	0.007***
	(0.001)	(0.0003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log likelihood	89.924	-230.525	127.090	60.848	89.682	127.075	60.562
No. of observations	3024	3024	3024	3024	3024	3024	3024

Notes. Dependent variable: log of monthly flows to employment out of unemployment (m). γ represents the share of total variance accounted for by the variance of the inefficiency effect ($\gamma \equiv \sigma_u{}^2 / \sigma_S^2$) while η comes from the time-varying decay model ($u_{it} = \exp^{-\eta(t-T_i)} u_i$), where the non-negative effects u_i decrease, remain constant, or increase over time, if η>0, η=0 or η<0, respectively. Monthly and annual dummies are statistically significant, detailed results available upon request. Variables are in logarithms, lagged when necessary. CRS – test-statistics of Wald test of coefficient restrictions, where null hypothesis is equal to α+β=1, indicates that the matching function exhibits constant returns to scale.
Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculations based on CES data.

B.3.2 Exploring the implications of the crisis

Table B.4. Stochastic frontier unrestricted estimation

	pre-crisis (2000-2007)				crisis (2008-2011)			
Variables	**Stocks of u**	**Flows of u**	**Both**	**Sum**	**Stocks of u**	**Flows of u**	**Both**	**Sum**
u	0.792***		0.891***		0.806***		1.035***	
	(0.030)		(0.035)		(0.048)		(0.060)	
v	0.240***	0.288***	0.240***	0.243***	0.210***	0.252***	0.196***	0.223***
	(0.012)	(0.014)	(0.012)	(0.012)	(0.019)	(0.020)	(0.018)	(0.018)
u_new		-0.160	-0.116***			-0.114***	-0.235***	
		(0.026)	(0.023)			(0.043)	(0.037)	
u_sum				0.778***				0.765***
				(0.026)				(0.037)
Returns to scale	CRS	DRS	CRS	CRS	CRS	DRS	CRS	CRS
Constant	-2.572***	5.266***	-2.692***	-2.577***	-2.810***	5.818***	-3.108***	-2.653***
	(0.228)	(0.265)	(0.235)	(0.212)	(0.423)	(0.418)	(0.460)	(0.331)
Mean technical efficiency	**0.564**	**0.357**	**0.559**	**0.594**	**0.700**	**0.341**	**0.615**	**0.752**
	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.007)	(0.003)	(0.002)
Wald χ^2	4506.57***	3034.54***	4605.50***	4733.67***	3603.93***	2655.86***	3709.92***	3845.68***
γ	0.144	0.802	0.178	0.112	0.206	0.860	0.325	0.138
	(0.050)	(0.056)	(0.055)	(0.040)	(0.076)	(0.046)	(0.087)	(0.053)
η	0.009***	0.0002	0.008***	0.010***	0.002	-0.001	0.001	0.002
	(0.002)	(0.0003)	(0.001)	(0.002)	(0.004)	(0.001)	(0.003)	(0.004)
Log likelihood	156.849	-66.112	169.837	138.235	93.498	-18.278	113.702	78.969
No. of observations	2112	2112	2112	2112	1056	1056	1056	1056

Notes. Dependent variable: log of monthly flows to employment out of unemployment (m). γ represents the share of total variance accounted for by the variance of the inefficiency effect ($\gamma \equiv \sigma_u^2 / \sigma_S^2$) while η comes from the time-varying decay model ($u_{it} = \exp^{-\eta(t-T_i)} u_i$), where the non-negative effects u_i decrease, remain constant, or increase over time, if η>0, η=0 or η<0, respectively. Monthly and annual dummies are statistically significant, detailed results available upon request. Variables are in logarithms, lagged when necessary. CRS – test-statistics of Wald test of coefficient restrictions, where null hypothesis is equal to α+β=1, indicates that the matching function exhibits constant returns to scale.
Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculations based on CES data.

Table B.5. Stochastic frontier restricted estimation

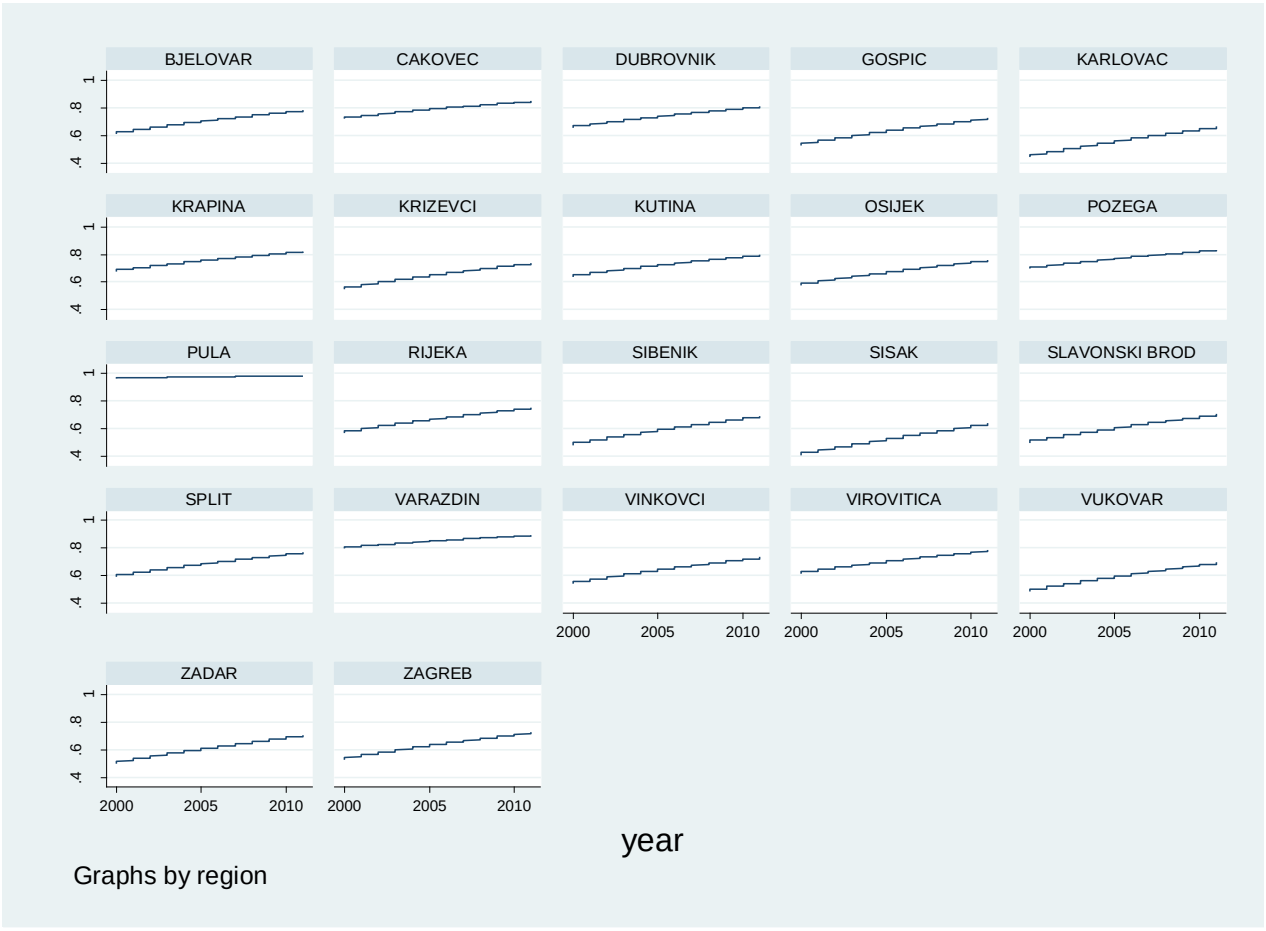
	pre-crisis (2000-2007)			crisis (2008-2011)		
Variables	**Stocks of u**	**Both**	**Sum**	**Stocks of u**	**Both**	**Sum**
u	0.763***	0.878***		0.790***	1.039***	
	(0.012)	(0.025)		(0.019)	(0.043)	
v	0.237***	0.239***	0.241***	0.210***	0.196***	0.223***
	(0.012)	(0.012)	(0.012)	(0.019)	(0.018)	(0.019)
u_new		-0.117***			-0.235***	
		(0.022)			(0.036)	
u_sum			0.759***			0.777***
			(0.012)			(0.019)
Constant	-2.334***	-2.582***	-2.411***	-2.674***	-3.144***	-2.767***
	(0.088)	(0.109)	(0.083)	(0.204)	(0.234)	(0.158)
Mean technical efficiency	**0.593**	**0.572**	**0.610**	**0.704**	**0.614**	**0.750**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Wald χ^2	5575.72***	5562.26***	5524.25***	4177.81***	3193.63***	4063.53***
γ	0.124	0.169	0.101	0.192	0.328	0.146
	(0.039)	(0.050)	(0.034)	(0.061)	(0.081)	(0.052)
η	0.009***	0.008***	0.010***	0.002	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)	(0.004)
Log likelihood	156.150	169.693	137.856	93.429	113.698	78.894
No. of observations	2112	2112	2112	1056	1056	1056

Notes. Dependent variable: log of monthly flows to employment out of unemployment (m). γ represents the share of total variance accounted for by the variance of the inefficiency effect ($\gamma \equiv \sigma_u^2 / \sigma_S^2$) while η comes from the time-varying decay model ($u_{it} = \exp^{-\eta(t-T_i)} u_i$), where the non-negative effects u_i decrease, remain constant, or increase over time, if η>0, η=0 or η<0, respectively. Monthly and annual dummies are statistically significant, detailed results available upon request. Variables are in logarithms, lagged when necessary.
Standard errors reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10% levels, respectively.

Source: Author's calculations based on CES data.

B.4 Technical efficiency

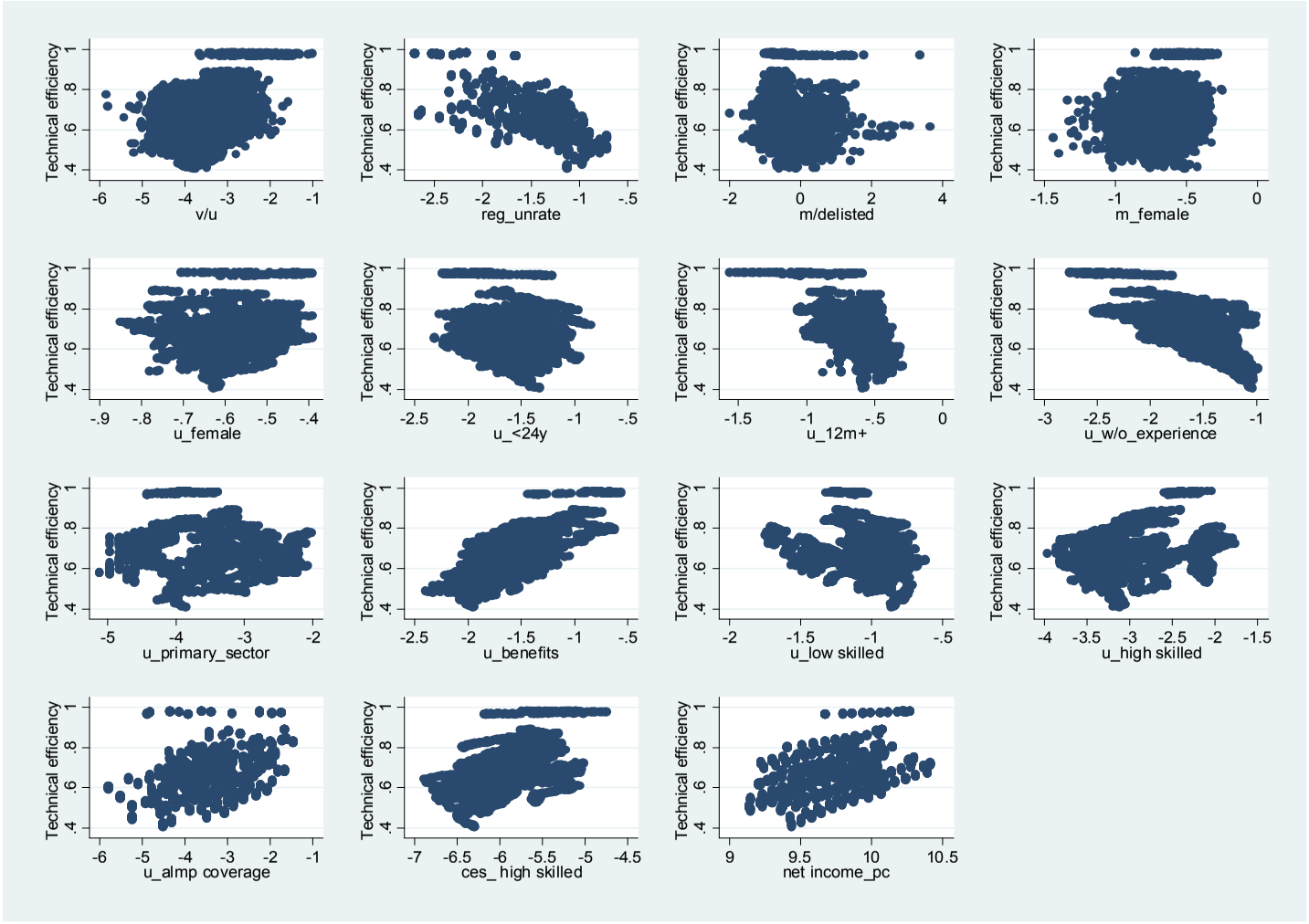
Figure B.10. Technical efficiency across regional offices over the years



Notes. Efficiency estimates from the (restricted) specification with both stocks and flows of the unemployed (column 6 in Table 3.1) are presented.

Source: Author's calculations based on CES data.

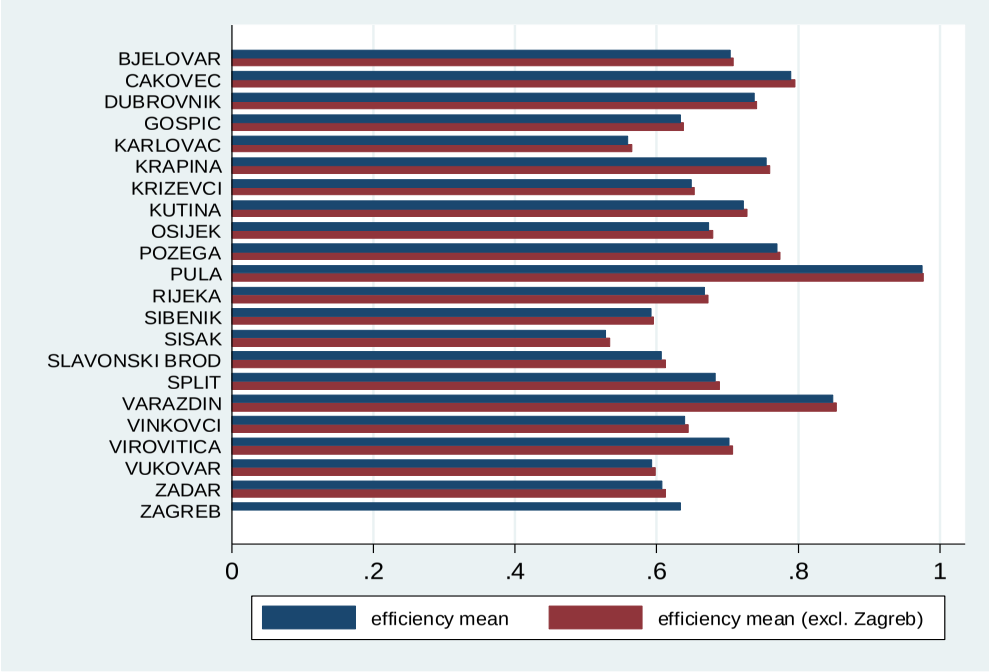
Figure B.11. Technical efficiency vs. explanatory variables

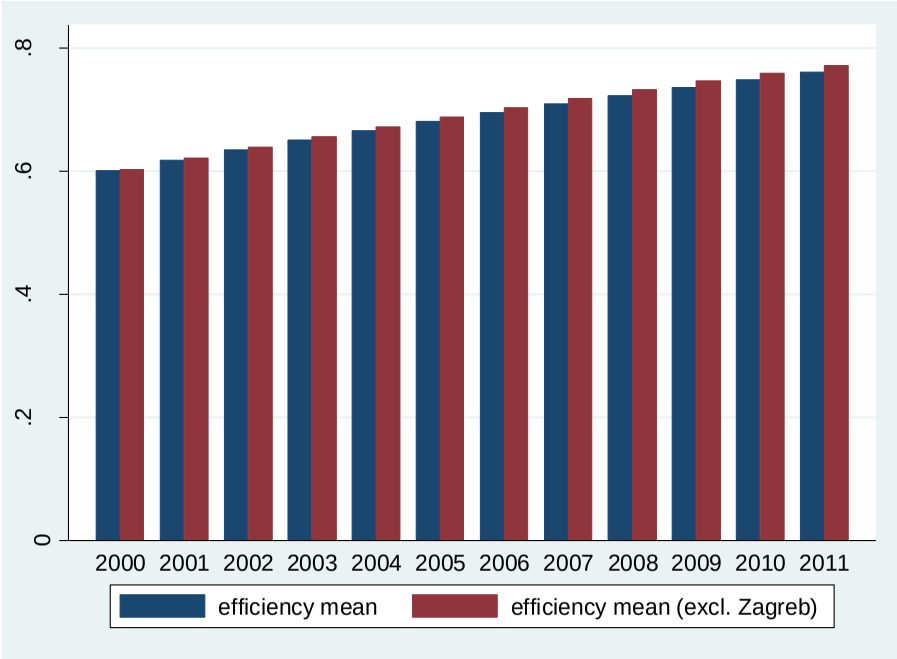


Notes. Efficiency estimates from the (restricted) specification (column 6 in Table 3.1) are presented. Explanatory variables are in logarithmic form.

Source: Author's calculations based on CES data.

Figure B.12. Mean technical efficiency across regional offices (left) and over the years (right) - with and without Zagreb region





Notes. Efficiency estimates from the (restricted) specification with both stocks and flows of the unemployed (column 6 in Table 3.1 and Table B.3) are presented.

Source: Author's calculations based on CES data.

Appendix C: Appendix to Chapter 4

C.1 More details about derivations of equations 4.3, 4.4 and 4.5

C.1.1 Perfect structural balance

Matching function, *M (·)*, is by assumption convex, linearly homogeneous function, so it can be written in a following form: $M_i = V_i f\left(U_i / V_i\right)$, where $f' > 0,\ f'' < 0$, and index *i* stands for the occupational group in this case.

If there is no structural unemployment, the existing number of unemployed, given the pattern of vacancies, should maximize aggregate hires (matches), i.e., $\max M = \max \sum_i M_i = \max \sum_i V_i f\left(U_i / V_i\right);\quad s.t. \sum_i U_i = U = const. \,\&\, V_i - given.$ First order condition gives: $f'\left(U_i / V_i\right) = const.$ which provides the definition of the **structural balance** where the ratio of unemployment to vacancies is equalized across submarkets (Jackman and Roper, 1987).

C.1.2 Mismatch indicator

It needs to be pointed out that the result from expression 4.4 $\left(U - U_S = U \cdot \left(1 - \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}\right) = U \cdot mm\right)$ holds only in the case of $\alpha + \beta = 1$, i.e., if the matching function exhibits constant returns to scale. Namely, in perfect structural balance (*S*) it holds that $\sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta} = 1$ as well as that $\frac{U_S}{V_S} = \frac{U}{V}$, which also gives the following result $\frac{U_S}{U} = \frac{V_S}{V}$. In deriving the expression 4.4, all the preceding assumptions are equally important.

By substituting the appropriate expressions for M_S and M into $M_S = M$ (expression 4.3: $M = \sum_i M_i = kU^{\alpha} V^{\beta} \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}$) we get: $kU_S^{\alpha} V_S^{\beta} = kU^{\alpha} V^{\beta} \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}$. Next, dividing both sides by U^{α} and by V^{β} (and k) we obtain $\left(\frac{U_S}{U}\right)^{\alpha} \left(\frac{V_S}{V}\right)^{\beta} = \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}$. Replacing $\frac{V_S}{V}$ by $\frac{U_S}{U}$ leads us to $\left(\frac{U_S}{U}\right)^{\alpha} \left(\frac{U_S}{U}\right)^{\beta} = \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}$ after which one gets the relationship between perfect structural balance unemployment (U_S) and actual unemployment (U):

$$\frac{U_S}{U} = \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta} \Rightarrow U_S = U \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta} \Rightarrow U - U_S = U \cdot \left(1 - \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta}\right) = U \cdot mm,$$

but only if the assumption that $\alpha + \beta = 1$, i.e., $\beta = 1 - \alpha$ holds.

In case the assumption about constant returns to scale does not hold the relationship between perfect structural balance unemployment (U_S) and actual unemployment (U) is: $U_S = U \sum_i \left(\frac{U_i}{U}\right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{V_i}{V}\right)^{\frac{\beta}{\alpha+\beta}}$. However, if we stick to the assumption from the original model ($\alpha + \beta = 1$) the difference between actual unemployment and perfect structural balance unemployment is equal to expression 4.4.

C.1.3 Empirical counterpart of equation 4.3

Evidently, the expression 4.5 is slightly more flexible than the exact 'empirical' counterpart of expression 4.3 (which would look more like this: $\log M = const. + \sum_j \lambda_j \log k_j + \alpha \log U + \beta \log V + \zeta \log \sum_i \left(\frac{U_i}{U}\right)^{\alpha} \left(\frac{V_i}{V}\right)^{\beta} + \varepsilon$). However, if we want to follow the procedure from the original paper (Dur, 1999), where the author stresses that he does not initially enforce constant returns to scale nor a unitary coefficient for the mismatch index, we will stick to expression 4.5 $\left(\log M_t = const. + \sum_j \lambda_j \log k_{j,t-1} + \alpha \log U_{t-1} + \beta \log V_t + (1-\xi) \log \sum_i \left(\frac{U_{i,t-1}}{U_{t-1}}\right)^{\alpha} \left(\frac{V_{i,t}}{V_t}\right)^{\beta} + \varepsilon_t\right)$ in our estimation too.

C.2 Instruments

In this part we show some details about the instrumental variable estimation, i.e., choosing the 'appropriate' instruments and evaluating their 'appropriateness'.

C.2.1 Correlation matrix

Table C.1 shows correlation coefficients between endogenous variables (unemployed, vacancies and the share of the users of unemployment benefits in total unemployment) and potential instruments.

As is evident from the table variables that are highly (negatively) correlated with the unemployment variables are indices for the state of the economy in different areas: construction, industrial production, retail trade or the official Zagreb Stock Exchange share index. In addition, the share of the average net in the average gross wage is also correlated with the unemployment variables. In this case, we chose the index of construction works as an instrument for the unemployment variables being that in most of the observed period (2004-2011) construction

sector was the 'driving force' of the Croatian economy. Moreover, from table C.1 one can observe that this index is not correlated with the matching variable. In the case of vacancies – none of the observable variables is highly correlated with the number of vacancies on a monthly basis (apart from the number of opened vacancies for seasonal employment). Still, there are some variables that are pretty correlated with (aggregate) vacancies and not with the number of hirings (like the index of construction works or the share of net in gross wage). For the share of the users of unemployment benefits in total unemployment, the most correlated variable is the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises. This variable is not correlated with the number of hirings (matchings), and it is only slightly correlated with the number of vacancies, and could serve as a good instrument.

Table C.1. Correlation coefficients between endogenous variables and potential instruments

	utot	u_wc	u_bc	vtot	v_wc	v_bc	mtot	m_wc	m_bc	unben
construction	-0.79	-0.81	-0.68	0.37	-0.03	0.42	0.19	-0.03	0.25	-0.13
industrial production	-0.61	-0.56	-0.57	0.37	-0.01	0.41	0.35	0.29	0.34	-0.30
retail trade	-0.70	-0.50	-0.74	0.02	-0.07	0.04	0.24	0.14	0.25	-0.37
net/gross wage	0.65	0.69	0.54	-0.35	0.02	-0.39	0.02	0.10	-0.02	-0.15
cpi-ppi	-0.19	-0.44	-0.01	-0.07	-0.34	0.03	-0.18	-0.42	-0.09	-0.02
crobex	-0.54	-0.55	-0.47	0.33	0.03	0.35	0.04	0.07	0.03	-0.32
export-import	-0.59	-0.43	-0.62	0.39	0.11	0.39	0.35	0.45	0.29	-0.22
newly registered unemployed	0.23	0.37	0.12	-0.42	0.27	-0.55	-0.47	-0.01	-0.58	0.30
seasonal vacancies	0.10	0.02	0.14	0.79	0.05	0.86	0.53	0.31	0.56	0.27
spread1	0.36	0.50	0.24	-0.06	0.01	-0.07	0.14	0.21	0.11	0.34
spread2	0.49	0.72	0.29	-0.29	0.07	-0.34	0.06	0.22	0.00	0.53

Notes. *u_tot* – total unemployment; *u_wc* – white-collar unemployment; *u_bc* – blue-collar unemployment (same goes for *v*- vacancies and *m* – matchings); *unben* - the share of the users of unemployment benefits in total unemployment; *construction* – monthly index of construction works; *industrial production* – monthly index of industrial production; *retail trade* – monthly index of retail trade; *net/gross wage* – monthly share of the average net in the average gross wage; *cpi-ppi* - consumers minus produces price index; *crobex* – monthly Zagreb Stock Exchange share index; *export-import* – monthly index of exports of goods minus imports of goods; *newly registered unemployed* – monthly number of newly registered unemployed that came directly from employment; *seasonal vacancies.* – vacancies for seasonal employment; *spread1* – spread between interest rates on long-term loans for enterprises and interest rates on foreign currency time deposits for enterprises; *spread2* – spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises.

Source: Author's calculation based on CES data.

C.2.2 Hausman test

This test usually evaluates the significance of an estimator versus an alternative estimator. In this case, we test the potential endogeneity of regressors by comparing LS and IV (TSLS) estimator.

The null hypothesis says that the potentially endogenous regressors (*u*, *v* and *unben*) are actually exogenous, i.e., both the LS and IV estimators are consistent (Greene, 2008).

In this case we use the so-called *variable addition test* as explained in Greene (2008). In the first step we regress all three variables - *u*, *v* and *unben* - onto the all exogenous regressors (including all the instruments) and save the (estimated) residuals from each of the three regressions. The endogenous regressor is exogenous in the case if these residuals are not correlated with residuals from the original specification (regression). Since we do not have information about the residuals from the original specification, in the second step we regress the dependent variable from the model (*m*) that should be correlated with the residuals from the original specification onto the all the variables from the original model plus the residuals from the first step. If the coefficient for the residuals in this second step is significant, we have endogenous regressors in the original specification and must proceed with IV (TSLS) estimation. Table C.2 shows estimated coefficients for residuals in the second step. In addition, *F-statistics* is also shown. As is evident from the tables, in some cases the coefficients for residuals are significant while in others (especially for vacancies) are not.

Table C.2. Hausman specification test

	aggregate function		**white-collars**		**blue-collars**	
	unrestricted	**restricted**	**unrestricted**	**restricted**	**unrestricted**	**restricted**
res1	-4.325***	-4.299***	-1.441**	-0.945	-5.211***	-4.559***
	(-4.094)	(-3.526)	(-2.284)	(-1.066)	(-3.921)	(-3.227)
res2	0.327***	0.257**	-0.081	-0.879***	0.051	0.188
	(3.448)	(2.367)	(-0.486)	(-4.364)	(0.441)	(1.152)
res3	-0.827	-0.497***	-1.097	-4.764***	-1.909**	-1.240
	(-1.328)	(-2.525)	(-1.008)	(-2.651)	(-2.411)	(-1.542)
F-statistics	60.090***	60.869***	26.718***	14.144***	78.097***	69.601***

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses.
res1 – residuals from the regression of *u* onto the all exogenous regressors; *res2* – residuals from the regression of *v* onto the all exogenous regressors; *res3* – residuals from the regression of *unben* onto the all exogenous regressors.

Source: Author's calculation based on CES data.

C.2.3 Test of over-identifying restrictions

Test of over-identifying restrictions is often called *Sargan* or *Hansen test*. It is based on the assumption that if the instruments are really exogenous then the residuals (from TSLS IV estimation) should be uncorrelated with the exogenous variables. The over-identifying restrictions test statistic can be calculated as $N*R^2$ (the number of observations multiplied by the coefficient of determination) from the LS regression of the residuals onto the set of exogenous variables (including instruments). This statistic will be asymptotically *chi-squared* under the null hypothesis that the error term is uncorrelated with the instruments, i.e., that all the instruments

are exogenous. Test statistic has *q*, or in our case 3(6), degrees of freedom (number of instruments - number of endogenous regressors). Table C.3 shows values of the test statistic ($N*R^2$) for each of the models estimated before. One can observe that in most of the cases the null hypothesis cannot be rejected.

Table C.3. Test of over-identifying restrictions (Sargan test)

	aggregate function		white-collars		blue-collars	
	unrestricted	**restricted**	**unrestricted**	**restricted**	**unrestricted**	**restricted**
$N*R^2$	7.802	6.956	3.008	5.922	-10.058	12.502

Notes. chi-squared (3, 0.05)=7.82; chi-squared (3, 0.01)=11.35; chi-squared (3, 0.001)=16.27; (q=3, i.e., number of instruments-number of endogenous regressors).

Source: Author's calculation based on CES data.

C.3 Robustness check

This part presents some of the mentioned alternative calculations for the model presented in the main text. This is not robustness check as understood usually in the literature; it is more of a 'normative robustness check' where some alternatives to the existing calculations as well as some new calculations are presented.

Table C.4. Relation between occupational and educational groups of unemployed - 2011

Occupation/education	No school/ uncompleted basic school	Basic school	Secondary school	Non-university college	University/ postgraduate degrees
Legislators, senior officials and managers	0.5%	3.8%	44.3%	19.2%	32.2%
Professionals	0.2%	0.2%	17.6%	12.8%	69.2%
Technicians and associate professionals	0.2%	0.9%	72.6%	22.3%	3.9%
Clerks	0.4%	4.2%	91.9%	2.3%	1.2%
Service workers and shop and market sales w.	1.2%	13.3%	84.9%	0.5%	0.2%
Skilled agricultural and fishery workers	6.5%	24.5%	68.6%	0.3%	0.1%
Craft and related trades workers	3.3%	19.2%	77.3%	0.1%	0.0%
Plant and machine operators and assemblers	5.4%	30.1%	64.2%	0.2%	0.1%
Elementary occupations	17.8%	55.7%	26.3%	0.2%	0.1%

Source: CES.

C.3.1 Unrestricted estimation results

Table C.5. Estimation results for the unrestricted estimation

	aggregate function		white-collars		blue-collars	
	NLS	**TSNLS**	**NLS**	**TSNLS**	**NLS**	**TSNLS**
α	1.089***	1.312***	0.610***	0.945	1.144***	1.286***
	(5.879)	(6.551)	(2.169)	(1.618)	(6.516)	(6.655)
β	0.250***	0.409***	-0.003	-0.001	0.280***	0.375**
	(3.320)	(2.843)	(-0.348)	(-0.074)	(3.282)	(3.721)
ξ	-0.089	0.211	15.415	128.432	2.130	1.525
	(-0.170)	(0.656)	(0.882)	(0.091)	(1.302)	(1.541)
time trend	0.003***	0.003***	0.007***	0.009*	0.003***	0.002**
	(6.029)	(4.303)	(2.685)	(1.895)	(3.901)	(3.425)
unben	-1.241***	-0.713	-2.050***	-2.086***	-1.017**	-0.618
	(-3.637)	(-1.563)	(-7.751)	(-4.305)	(-2.335)	(-1.356)
constant	-8.288***	-11.441***	3.959	1.038	-10.225***	-12.035***
	(-3.830)	(-4.730)	(1.187)	(0.188)	(-4.707)	(-5.461)
CRS	2.329	7.662***	1.910	0.009	3.164*	7.047***
$\overline{R}^2$	0.927	0.907	0.842	0.839	0.927	0.925

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses.
unben – natural logarithm of the share of the users of the unemployment benefits in total unemployment.
Monthly dummies are statistically significant, detailed results available upon request.
NLS – non-linear least squares. **TSNLS** – two-stage non-linear least squares with endogenous variables: unemployment, vacancies and the share of the users of unemployment benefits and instruments: **lagged** endogenous variables plus log of monthly index of construction works; log of monthly share of the average net in the average gross wage and log of the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises. **CRS** - constant returns to scale-shows the *F-statistics* of Wald test of coefficient restrictions, where null hypothesis is equal to $\alpha+\beta=1$.

Source: Author's calculations based on CES data.

C.3.2 Different set of instruments

Table C.6. Estimation results for the restricted estimation – different set of instruments

	aggregate function		**white-collars**		**blue-collars**	
	TSNLS1	**TSNLS2**	**TSNLS1**	**TSNLS2**	**TSNLS1**	**TSNLS2**
α	0.817***	0.877***	0.734***	0.664***	0.850***	0.965***
	(15.601)	(12.253)	(13.002)	(8.148)	(11.320)	(10.032)
β	0.183	0.123	0.266	0.336	0.150	0.035
	(---)	(---)	(---)	(---)	(---)	(---)
ξ	-1.191	-0.921	-1.305**	-1.158*	1.999	20.300
	(-1.417)	(-0.705)	(-2.349)	(-1.935)	(0.416)	(0.306)
time trend	0.003***	0.004***	0.005***	0.005***	0.002**	0.003***
	(5.965)	(5.583)	(7.728)	(5.871)	(3.064)	(3.556)
unben	-1.387***	-1.859***	-1.605***	-1.723***	-1.336***	-1.917***
	(-4.483)	(-4.200)	(-5.164)	(-3.662)	(-3.293)	(-3.606)
constant	-5.107***	-6.032***	-4.808***	-4.741***	-5.319***	-6.604***
	(-9.027)	(-7.153)	(-8.680)	(-5.091)	(-6.594)	(-6.090)
$\overline{R}^2$	0.911	0.907	0.824	0.818	0.919	0.914
res1	$7.98e^{12}$	0.926	$-3.81e^{11}$**	-0.096	$-1.62e^{12}$**	0.087
	(0.446)	(0.862)	(-2.581)	(-0.345)	(-2.054)	(0.245)
res2	$-1.75e^{07}$	-0.636*	$-4.65e^{11}$**	0.184	$-9.19e^{12}$	0.339***
	(-0.128)	(-1.881)	(-2.426)	(1.325)	(-1.467)	(2.956)
res3	$8.88e^{07}$	-2.449	$7.55e^{09}$	1.395***	$5.10e^{08}$	1.301**
	(0.064)	(-1.569)	(1.651)	(3.116)	(0.493)	(2.180)
F-statistics	52.493***	11.800***	26.866***	20.471***	60.736***	63.671***
$N*R^2$	2.162	4.606	10.355	14.852	11.305	17.766

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses.
unben – natural logarithm of the share of the users of the unemployment benefits in total unemployment.
Monthly dummies are statistically significant, detailed results available upon request.
TSNLS1 – two-stage non-linear least squares with endogenous variables: unemployment, vacancies and the share of the users of unemployment benefits and instruments: **within-transformed** endogenous variables plus log of monthly index of construction works; log of monthly share of the average net in the average gross wage and log of the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises.
TSNLS1 – two-stage non-linear least squares with endogenous variables: unemployment, vacancies and the share of the users of unemployment benefits and instruments: **first-differenced** endogenous variables plus log of monthly index of construction works; log of monthly share of the average net in the average gross wage and log of the spread between interest rates on short-term loans for enterprises and interest rates on foreign currency deposits for enterprises.
res1 – residuals from the regression of *u* onto the all exogenous regressors; *res2* – residuals from the regression of *v* onto the all exogenous regressors; *res3* – residuals from the regression of *unben* onto the all exogenous regressors.
chi-squared (3, 0.05)=7.82; chi-squared (3, 0.01)=11.35; chi-squared (3, 0.001)=16.27; (q=3, i.e., number of instruments-number of endogenous regressors).

Source: Author's calculation based on CES data.

C.3.3 Region effect

Table C.7. Estimation results for the restricted estimation – region effect

	fixed-effects panel estimation			**NLS – dummy variable estimation**		
	aggregate function	**white-collars**	**blue-collars**	**aggregate function**	**white-collars**	**blue-collars**
α	0.766***	0.849***	0.794***	0.663***	0.734***	0.689***
	(28.793)	(23.584)	(31.301)	(9.834)	(11.072)	(9.524)
β	0.234	0.151	0.206	0.337	0.266	0.311
	(---)	(---)	(---)	(---)	(---)	(---)
ξ	-1.506*	-1.064	2.244	-1.105*	0.201	0.562
	(-1.805)	(-1.572)	(8.113)	(-1.904)	(0.351)	(0.192)
time trend	0.002*	0.003***	0.001	0.001	0.007***	-0.0003
	(1.706)	(3.003)	(0.684)	(1.045)	(4.231)	(-0.257)
reg_dummy_1	---	---	---	0.013	-0.079*	0.050
	(---)	(---)	(---)	(0.234)	(-1.780)	(0.768)
reg_dummy_2	---	---	---	0.089	-0.055	0.131*
	(---)	(---)	(---)	(1.241)	(-0.872)	(1.738)
constant	-2.783***	-2.837***	-3.085***	-2.262***	-2.391***	-2.517***
	(-23.267)	(-19.202)	(-24.891)	(-9.330)	(-10.912)	(-9.281)
$\overline{R}^2$	0.781	0.654	0.835	0.821	0.656	0.867
redundant fixed-effects test	0.327	10.715***	0.527	---	---	---
cross-section effect 1	0.030	-0.003	0.039	---	---	---
cross-section effect 2	0.002	0.079	-0.009	---	---	---
cross-section effect 3	-0.031	-0.076	-0.030	---	---	---

Notes. * p < 0.1; ** p < 0.05; *** p < 0.01. t-statistics is in parentheses.
NLS – non-linear least squares. Monthly dummies are statistically significant, detailed results available upon request. *Redundant fixed-effects test* tests the joint significance of the fixed effects estimates in least squares specifications where null hypothesis says that the cross-section effects are redundant (*F-statistics* is shown).
reg_dummy_1- Adriatic Croatia; reg_dummy_2- Central and Eastern (Pannonian) Croatia.
cross-section effect 1 – Adriatic Croatia; cross-section effect 2 – Northwest Croatia; cross-section effect 3 – Central and Eastern (Pannonian) Croatia

Source: Author's calculation based on CES data.

DALJŠI POVZETEK DISERTACIJE V SLOVENSKEM JEZIKU

Glavni cilj disertacije je obravnavanje težav z brezposelnostjo na Hrvaškem z odkrivanjem nekaterih priljubljenih stiliziranih dejstev, ki so se v zadnjih nekaj desetletjih pojavila v literaturi. To se nanaša predvsem na pomanjkanje povpraševanja, togo zakonodajo, regionalno neenakost, neujemanje (veščin) med prostimi delovnimi mesti in brezposelnimi osebami in neustrezno strukturo delovne sile glede na starost in izobrazbo. Za doseganje zastavljenega cilja smo uporabili kombinacijo metodologije, ki izvira iz ravnotežja teorije iskanja in ujemanja, in empirične dokaze, pridobljene za Hrvaško. Cilj je bil razširiti obstoječe modele iskanja in ujemanja, da bi ti bolj ustrezali posebnostim situacije na hrvaškem trgu dela in da bi lahko upoštevali tudi njihovo uporabnost v drugih državah v tranziciji ter drugod po Evropi. Tako je mogoče razkriti pomembne institucionalne pomanjkljivosti in podati določena priporočila za nosilce ekonomske politike.

Po eni strani se disertacija osredotoča na različne značilnosti in procese na hrvaškem trgu dela od začetka devetdesetih let prejšnjega stoletja, po drugi strani pa poudarja vlogo različnih institucij, ki so povezane z delovanjem sodobnega trga dela. V disertaciji poleg tega poudarjamo tudi vpliv gospodarske krize na (hrvaški) trg dela in obravnavamo morebitne predloge za snovalce ukrepov ekonomske politike. Da pa ne bi prispevali zgolj k razumevanju problematike na hrvaškem trgu dela in da bi lahko predlagane modele ter pridobljene rezultate uporabili v širšem kontekstu sodobnih evropskih trgov dela, smo teorijo in pridobljene rezultate postavili v kontekst regije Srednje in vzhodne Evrope ter Evropske unije. Vse te zadeve smo preučili v treh različnih delih (esejih) disertacije, od katerih vsako obravnava točno določeno raziskovalno tematiko, vsem trem pa je skupen cilj – odkriti glavni vzrok visoke brezposelnosti na Hrvaškem.

UJEMANJE, NEGATIVNA SELEKCIJA IN PRETOK TRGA DELA V (POST)TRANZICIJSKEM OKOLJU: PRIMER HRVAŠKE

Cilj te naloge je odkriti glavne vzroke visoke neaktivnosti in stopnje brezposelnosti na Hrvaškem v obdobju tranzicije in po njej z osredotočanjem na različne priložnosti za zaposlitev pri različnih tipih iskalcev zaposlitve, torej pri zaposlenih, brezposelnih in neaktivnih osebah. Naloga poleg tega proučuje tudi vlogo, ki jo institucije trga dela opravljajo pri brezposelnih iskalcih zaposlitve, ki prejemajo nadomestilo za brezposelnost, glede njihove »pripravljenosti na iskanje dela«. Poleg tega poskušamo identificirati skupino aktivne populacije, ki bi jo lahko prizadela implicitna diskriminacija zaradi pomanjkljivega razvoja institucij trga dela. Glavno raziskovalno vprašanje eseja se torej glasi, kako status na trgu dela, skupaj z institucionalnimi in posameznimi značilnostmi, vpliva na proces ujemanja na Hrvaškem. Zaradi tega so glavne domneve oblikovane na naslednji način:

D.1: Verjetnost, da spremeni svoj status na trgu dela, je večja pri zaposlenem posamezniku kot pri brezposelnem posamezniku.
D.2: Verjetnost prehoda iz statusa brezposelnosti v zaposlenost je večja pri posameznikih, ki ne prejemajo nadomestila za brezposelnost.

V študiji se opiramo predvsem na dela, ki obravnavajo negotovost, asimetrične informacije in negativno selekcijo na trgu dela (Akerlof, 1970; Gibbons in Katz, 1991; Spence, 1973) in ki razlikujejo med različnimi iskalci zaposlitve. Poleg tega smo upoštevali tudi študije Blancharda in Diamonda (1994), s katerimi je bila uvedena segmentacija različnih prosilcev zaposlitve, in študije Domadenikove (2007) ter Kuglerja in Saint-Paula (2004), ki obravnavajo negativno selekcijo med iskalci zaposlitve in uvajajo stroške odpuščanja. Ekonomiko informacij v klasični *teoriji iskanja* – ki sta jo v svojih delih razvila McCall (1970) in Stiglerj (1961, 1962), smo uporabili, da bi pokazali, kako agenti na trgu pridobivajo informacije o tržnih razmerah in kako se združujejo na podlagi njihovih posameznih optimalnih strategij. Model te naloge pravzaprav vključuje izboljšanje modela, ki sta ga uporabila Kugler in Saint-Paul (2004), tako, da smo po eni strani poenostavili nekatere vidike, da bi ohranili analitično obvladljivost, po drugi strani pa uvedli nekaj novosti, da bi se bolje prilagodili situaciji v (post)tranzicijskem okolju.

Za preizkus domneve smo uporabili model negativne $\frac{dF(w)}{dw} \geq 0$ selekcije s stroški odpuščanja. Model iz naloge je prilagojen tako, da bi bolj ustrezal (post)tranzicijskem okolju. Stroški odpuščanja so najprej postali endogena spremenljivka modela. V tem primeru so stroški odpuščanja naraščajoča funkcija plače. Poleg tega smo uvedli tudi koncept rezervacijske mezde, da bi bolje prikazali proces sprejemanja odločitev ter naslednje ujemanje podjetij in iskalcev zaposlitve na (hrvaškem) trgu dela:

$$F(w) = F\left[\varphi(m+\eta) + (1-\varphi)w^r\right], \tag{1}$$

pri čemer domnevamo, da je $\frac{dF(w)}{dw} \geq 0$. Domneva se, da so plače enake fiksnemu delu, φ, donosa z učinkovitostjo, značilno za posameznega delavca, η, in učinkovitostjo, ki je značilna za posamezno podjetje, m, plus del rezervacijske mezde, w^r. Poleg tega velja, da je $0 \leq \varphi \leq 1$, kar kaže, da podjetja z dobrimi delavci ustvarijo večji dobiček kot s slabimi delavci.

Razlikujemo dva tipa iskalca zaposlitve. Prvi tip je že zaposlen, medtem ko je drugi tipbrezposeln ali neaktiven. Vsi ti potencialni delavci pa imajo eno skupno točko, ki nazadnje odloča o tem, ali bodo sprejeli ponudbo za zaposlitev ali jo bodo zavrnili in nadaljevali z iskanjem. Domnevamo, da bo posameznik nadaljeval z iskanjem, vse dokler pričakovani mejni donos ne bo enak mejnemu strošku iskanja (Stigler, 1962). Na ta način vsi iskalci zaposlitve določijo svojo rezervacijsko mezdo, ki je za brezposelne iskalce zaposlitve določena po Addison et al. (2009) in za zaposlene iskalce zaposlitve po Van den Bergu in Ridderju (1998).[1] Pri modelu se domneva, da ne podjetja ne delavci nimajo popolnih informacij drug o drugem, ko poskušajo zasesti prosto delovno mesto. Podjetja lahko uporabijo načelo diskrecije, ko gre za odločitev o tem, koga odpustiti, zato je verjetneje, da bodo prej odpustila manj produktivne kot bolj produktivne delavce. Posledično je delež nizkokakovostnih delavcev višji med

[1] Rezervacijska mezda za nezaposlenega iskalca zaposlitve je odvisna od nadomestila za brezposelnost, ponujene plače in diskontne stopnje, medtem ko zaposleni iskalec zaposlitve sprejme ponujeno plačilo le, če to presega njegovo trenutno plačo.

brezposlenimi kot med zaposlenimi. Delodajaci, ki nameravajo zaposlovati, pa se tega dejstva tudi zavedajo.

V procesu ujemanja se srečujejo delavci in podjetja ter ustvarjajo dodano vrednost na vloženi kapital. Uspeh pri iskanju zaposlitve je odvisen od *srstepogodb*, *stopnje ponujenih zaposlitev* in *stopnje sprejema*. Glavna razlika med »dobrimi« in »slabimi« delavci je stopnja ponujenih zaposlitev. Če je bila oseba uspešna pri iskanju zaposlitve v danem časovnem intervalu, dobi odvisna spremenljivka *y* vrednost 1, v nasprotnem primeru pa vrednost nič. Izraz za verjetnost zaposlitve je videti takole:

$$\Pr(y=1) = \Phi(\beta_0' X_{it} + \beta_1' OCC_{it} + \beta_2' IND_{it} + \beta_3 U_{it-1} + \beta_4 u_{it}^l + \beta_5 w_{it}^r + \beta_6' Y_t), \qquad (2)$$

pri čemer je Φ kumulativna normalna distribucija in indeks *i* označuje posameznika, indeks *t* pa določa obdobje (leto). X_{it} je vektor posameznih značilnosti iskalca zaposlitve kot so starost, spol, zakonski stan, dejstvo, ali se je oseba v zadnjih treh mesecih udeležila kakršnega koli usposabljanja in ali je glavni nosilec gospodinjstva, ter prebivališče(mestno okolje ali podeželje). Spremenljivki OCC_{it} in IND_{it} predstavljata vektorje poklica iskalca zaposlitve oziroma njegove panoge. U_{it-1} je slamnata spremenljivka brezposelnosti, ki ima vrednost 1 za tiste, ki so v predhodnem letu bili brezposelni, u_{it}^l je lokalna stopnja brezposelnosti, w_{it}^r predstavlja rezervacijsko mezdo, Y_t pa je slamnata (angl. dummy) spremenljivka za leta, ki nadzoruje splošne gospodarske razmere.

Očitno je, da spremenljivke, ki jih vsebuje vektor *X*, vplivajo na vse tri dele stopnje zaposlitve, torej na *srsto pogodb, stopnjo ponujenih zaposlitev* in *stopnjo sprejema.* Na *stopnjo sprejema* pa vendarle vpliva tudi rezervacijska mezda (w^r), medtem ko *stopnjo ponujenih zaposlitev* večinoma označuje zaposlitveni status v predhodnem obdobju (*U*), ki služi kot znak prosilčeve učinkovitosti. Na *stopnjo pogodb* naj bi po drugi strani dodatno vplivali še lokalna stopnja brezposelnosti (u^1) in ekonomska aktivnost (ki je predstavljena z letnimi slamnatimi spremenljivkami).

Vseeno je pričakovati, da je v izvirni specifikaciji modela (enačba 2) rezervacijska mezda endogena, t.j. da je spremenljivka določena v modelu samem. Zato imamo namesto izvirne probit ocene pravzaprav naslednje:

$$\Pr(y=1 \mid X=x, Z=z) = \Phi(\beta_x' x + \beta_z' z), \qquad (3)$$

pri čemer je $X = (1, X_*')'$, X_* je vektor kovarianc, domnevno merjen brez napake, *Z* (w^r) pa prediktorski vektor z merilno napako (Buzas in Stefanski, 1996). Če ignoriramo endogenost w^r, potem koeficient ni dosledno ocenjen. Da bi rešili to težavo, uporabljamo instrumentalno spremenljivko probit ocene. Upoštevajoč institucionalne značilnosti in spremenljivke pri enačbi 2, sta dolžina šolanja in regionalno prilagojena panožna mezda[2] izbrana kot ustrezna instrumenta za rezervacijsko mezdo v našem modelu.

[2] Povprečna plača v panogi zaposlovanja, vendar po različnih regijah. Za tiste, ki v času raziskave niso bili zaposleni, smo upoštevali panogo predhodne zaposlitve, da bi izračunali povprečno industrijsko plačo.

Da bi raziskali pripravljenost brezposelnih iskalcev zaposlitve, ki prejemajo nadomestilo za brezposelnost, za iskanje zaposlitve, smo izračunali ocene elastičnosti rezervacijske mezde v razmerju do nadomestila za brezposelnost, ob upoštevanju metodologije, ki je uporabljena pri Blackabyju et al. (2006):

$$\frac{\partial Lnw^r}{\partial Lnb} = \frac{b}{w^r}\frac{1}{1+\theta/\rho} = \frac{b}{w^r}\frac{x-w^r}{x-b}, \tag{4}$$

pri čemer velja, da je w^r rezervacijska mezda; b je vsota nadomestil za brezposelnost; Θ je verjetnost zaposlitve (produkt verjetnosti nastopa zaposlitve in verjetnosti sprejema ponudbe za zaposlitev, ki je tudi *stopnja tveganja*); ρ je stopnja diskonta; x pa predstavlja pričakovane mezde pri zaposlitvi ($x = E(w \mid w > w^r)$). Poleg tega ob predpostavki, da je distribucija ponudbe za plačo razdeljena po Paretu, izražamo tudi prožnost *stopnje tveganja* v razmerju do nadomestila za brezposelnost.

Ob upoštevanju podatkov, pridobljenih s hrvaško Anketo o delovni sili (ADS) v obdobju 1996–2009, zajema analiza pomemben časovni razmik, ki prikazuje tako obdobje med tranzicijo kot obdobje po njej ter nedavno globalno gospodarsko krizo. Ob upoštevanju institucionalnega in gospodarskega okolja na hrvaškem trgu dela, poleg strukture ankete, je bila empirična analiza izvedena z združevanjem podatkov v štirih različnih obdobjih: 1996–1998; 1999–2003; 2004–2006 in 2007–2009.

Ob uporabi probit ocene naši glavni rezultati kažejo, da je na hrvaškem trgu dela prisotna negativna selekcija, ko gre za brezposelne iskalce zaposlitve. Rezervacijska mezda pozitivno vpliva na verjetnost menjave službe, ko gre za zaposlene iskalce zaposlitve, medtem ko negativno vpliva na verjetnost menjave statusa na trgu dela, ko gre za brezposelne iskalce zaposlitve. Ena glavnih predpostavk modela je ta, da delodajalci vidijo status na trgu dela kot posredno mero produktivnosti iskalcev zaposlitve, kar pomeni, da so prepričani, da je v brezposelni skupini višji delež manj učinkovitih delavcev. Ker so stroški odpuščanja (zaposlovanja) visoki, si ne morejo »privoščiti« zaposlovanja delavcev iz te skupine, zato nižja verjetnost zaposlovanja brezposelnih kaže na vpliv stroškov odpuščanja, t.j. negativno selekcijo na trgu dela zaradi visokih stroškov odpuščanja. Kljub temu je skupna verjetnost zaposlitve v danem letu višja pri nezaposlenem oziroma neaktivnem prebivalstvu. Rezultati ne kažejo pomembnih razlik med obdobji, razen tega, da obstaja splošno povečanje verjetnosti menjave pri kontrolni skupini (moški, poročen, pisarniški delavec, zaposlen v storitvenem sektorju), pri čemer je ta učinek višji pri brezposelnem tipu iskalcev zaposlitve. Če pa spremenljivko rezervacijske mezde obravnavamo kot endogeno in ocenimo model z upoštevanjem instrumentalnih spremenljivk, postane vpliv rezervacijske mezde na verjetnost zamenjave pomemben in pozitiven le pri brezposelnih iskalcih zaposlitve in zanemarljiv pri zaposlenih iskalcih zaposlitve. Ta rezultat bi lahko pojasnili z učinkom enega od »instrumentov«. Dosežena izobrazba, ki jo uporabljamo kot instrument, pri brezposelnih velja za pomembnejšo pojasnjevalno spremenljivko kot pri zaposlenih osebah, ki menjajo službo. Izobrazba zato služi kot pomemben znak višje učinkovitosti posameznikov v skupini brezposelnih iskalcev dela.

Na koncu smo preizkusili verjetnost samodiskriminacije pri brezposelnih iskalcih zaposlitve, ki prejemajo nadomestilo za brezposelnost. Glede na obdobje analize se z višanjem nadomestil za 1 hrvaško kuno poviša rezervacijska mezda v znesku od 0,40 kun do 0,55 kun, ob intenzivnejšem višanju po reformi zakonodaje o trgu dela iz leta 2004. Po drugi strani se z višanjem nadomestil niža *izhodna stopnja* oziroma verjetnost zaposlitve. Ti rezultati sledijo regresijski oceni brez nadzora nad doseženo izobrazbo. Poleg tega vpliv rezervacijske mezde upada glede na verjetnost zaposlitve za zaposlene in brezposelne iskalce zaposlitve, kar kaže na nižji vpliv rezervacijske mezde na stroške odpuščanja. To kaže na manj stroge predpise na trgu dela, kar vodi k nižjim stroškom odpuščanja na ravni podjetja. Čeprav so spremembe v zakonodaji veljale za nezadostne, očitno nekoliko le vplivajo na vedno manjši vpliv stroškov odpuščanja (in zaposlovanja) na zaposlitev.

UČINKOVITOST PROCESA UJEMANJA: PROUČEVANJE VPLIVA REGIONALNIH ZAVODOV ZA ZAPOSLOVANJE NA HRVAŠKEM

Ta naloga se ukvarja predvsem z relativno visokimi razlikami v stopnji brezposelnosti na regionalni (NUTS3) ravni na Hrvaškem. Glavni cilj naloge je oceniti in razložiti spremembe učinkovitosti ujemanja v času in po regijah pri čemer Je potrebno upoštevati vpliv regionalnih zavodov za zaposlovanje na učinkovitost ujemanja. Čeprav je Hrvaški zavod za zaposlovanje (HZZ) centraliziran tako, da se finančna struktura in glavni ukrepi sprejemajo na centralni ravni, je sama izvedba odvisna od lokalnih posebnosti. Zato je cilj naloge preiskati vlogo, ki so je imeli zavodi za zaposlovanje pri spremembi uspešnosti ujemanja prostih delovnih mest in brezposelnih na Hrvaškem, in sicer ob upoštevanju različnih regionalnih značilnosti trga dela. Osrednje raziskovalno vprašanje je torej, ali bi boljša (ustreznejša) organizacija regionalnih zavodov za zaposlovanje pripomogla k zmanjšanju regionalnih neskladij na hrvaškem trgu dela. Glavne domneve tega eseja so naslednje:

D.3: Učinkovitost procesa ujemanja se razlikuje glede na regionalne oddelke.
D.4: Če kontroliramo za različne ekonomske razmere v regijah, kakovost storitev, ki jih zagotavljajo regionalni javni zavodi za zaposlovanje, pomembno vpliva na učinkovitost procesa ujemanja.

Empirična analiza je bila izvedena na regionalni ravni ob upoštevanju podatkov na ravni regionalnih zavodov, ki jih je Hrvaški zavod za zaposlovanje pridobil na mesečni podlagi v obdobju 2000–2011. Zaradi upoštevanja vpliva krize je bila ocena izvedena za dve različni obdobji, torej za obdobje pred krizo (2000–2007) in za obdobje krize (2008–2011). Zato, da bi izvedli oceno, smo uporabili model stohastične meje za panelne podatke ter njegovo modificirano različico – preoblikovani model stohastične meje. Uporaba metode stohastične meje glede na trditve omogoča podrobnejšo analizo determinant regionalne učinkovitosti ujemanja (Ibourk et al., 2004).

Ocena stohastične meje izvira iz ocene proizvodne funkcije. Osnovna ideja modela stohastične meje je ocenjevanje učinkovitosti proizvodnega procesa, pri čemer je glavna predpostavka, da vsako podjetje potencialno proizvaja manj, kot bi lahko zaradi določene stopnje neučinkovitosti.

Enak model lahko uporabimo na primeru trga dela oziroma za testiranje učinkovitosti procesa ujemanja delavcev, ki iščejo zaposlitev, in podjetij, ki iščejo delavce. V tem primeru je donos enak številu zadetkov/zaposlovanj, vložka pa sta število brezposelnih delavcev, ki iščejo zaposlitev, in število prostih delovnih mest. Ta model ocenjevanja je na primeru trga dela prvi uporabil Warren (1991), pred kratkim pa je bil uporabljen v številnih delih, v katerih je bila ocenjena učinkovitost procesa ujemanja na posameznih trgih dela: Destefanis in Fonseca (2007) za Italijo, Fahr in Sunde (2002; 2006) za Nemčijo, Hynninen et al. (2009) za Finsko, Ibourk et al. (2004) za Francijo ter Jeruzalski in Tyrowicz (2009) za Poljsko.

Model v tej nalogi večinoma temelji na modelih avtorjev Ibourku et al. (2004) ter Jeruzalski in Tyrowicz (2009), pri čemer je skupno število zadetkov funkcija skupnega števila prostih delovnih mest in iskalcev zaposlitve, dodatno pa smo vključili tudi nabor spremenljivk, ki predstavljajo delež vsake skupine *j* v skupni brezposelnosti. Če nekoliko omilimo predpostavko o homogenosti intenzitete posameznega iskanja, lahko v model vpeljemo spremenljivke, ki merijo ukrepe nosilcev ekonomske politike. Uporabljamo torej nestohastični model, kjer lahko imajo različne skupine iskalcev zaposlitve različno intenziteto iskanja:

$$M_{it} = E_{it} V_{it}^{\beta_1} \left(\sum\nolimits_j (1 + c^j) U_{it-1}^j\right)^{\beta_2}, \tag{5}$$

pri čemer je c^j odstopanje od povprečne intenzitete iskanja, tako da so negativne vrednosti značilne za podpovprečno prizadevanje pri iskanju. Če bi vse skupine imele identično intenziteto iskanja, bi bil c^j enak 0 za vsak *j* in bi se zato vrnili k standardnemu modelu brez heterogenosti.

Ob upoštevanju Battesea in Coellija (1995) lahko domnevamo, da imajo učinki heterogenosti, ki vplivajo na intenziteto iskanja neposreden vpliv na učinkovitost ujemanja (in ne na sam proces ujemanja), oziroma da so vključeni v izraz z_{it} v naslednji enačbi:

$$m_{it} = \left[\alpha + \beta_1 v_{it} + \beta_2 u_{it-1} + \upsilon_{it}\right] + \left[z_{it}\delta + \omega_{it}\right], \tag{6}$$

pri čemer majhne črke označujejo logaritem spremenljivk. ω_{it} je določen s krajšanjem normalne distribucije s sredino, ki je enaka nuli in varianco σ_ω^2.

Koeficient učinkovitosti smo pridobili z izračunom pogojnih ocen:

$$\hat{e}_{it} = E\left[e^{Z_{it}\hat{\delta}+\hat{\omega}_{it}} \mid M, V, U, Z\right] \tag{7}$$

A s klasično oceno stohastične meje za panelne podatke funkcije ujemanja je vseeno nekaj težav, vključno z možnostjo pojava endogenosti neodvisnih spremenljivk (Greene 2005a 2005b; Hynninen et al. 2009; Munich in Svejnar 2009; Wang in Ho 2010). Z namenom dobiti bolj dosledne ocene, smo uporabili tudi preoblikovanje izvirnega modela stohastične meje za panelne podatke po Wangu in Hoju (2010). V bistvu sta onadva rešila težavo z odstranjevanjem posameznih fiksnih učinkov pred oceno s preprostimi preoblikovanji, torej z odstranitvijo časovno spremenljive neučinkovitosti in časovno nespremenljivih posameznih učinkov. Da bi lahko izračunali indeks tehnične učinkovitosti, smo uporabili cenilko pogojnih pričakovanj oziroma pogojno pričakovanje u_{it} na vektorju preoblikovanega ε_{it}:

$$E(u_{it} \mid \tilde{\varepsilon}_{i\bullet}) = h_{it}\left[\mu_{**} + \frac{\phi\left(\frac{\mu_{**}}{\sigma_{**}}\right)\sigma_{**}}{\Phi\left(\frac{\mu_{**}}{\sigma_{**}}\right)}\right] \tag{8}$$

ki je ocenjen pri $\tilde{\varepsilon}_{i\bullet} = \hat{\tilde{\varepsilon}}_{i\bullet}$ in pri čemer velja, da je $\tilde{\varepsilon}_{i\bullet} = \tilde{y}_{i\bullet} - \tilde{x}_{i\bullet}\beta$ $(x_{i\bullet} = (1/T)\sum_{t=1}^{T} x_{it}, x_{it\bullet} = x_{it} - x_{i\bullet})$, medtem ko Φ predstavlja kumulativno funkcijo gostote standardne normalne distribucije.[33]

Glavni rezultat te naloge kaže na večjo težo iskalcev zaposlitve v procesu ujemanja v primerjavi z objavljenimi prostimi delovnimi mesti, kar ni neobičajno, še posebno, če upoštevamo dejstvo, da prosta delovna mesta, ki jih objavljajo uradi hrvaškega zavoda za zaposlovanje, v resnici sploh niso razpoložljiva prosta delovna mesta v gospodarstvu. Specifikacija modela, ki vključuje tako zaloge kot pretok brezposelnih, ter tistega, ki vključuje zgolj zaloge, kaže na obstoj stalnega donosa na obseg, medtem ko specifikacija modela samo s pretoki brezposelnih kaže na to, da model predstavlja zniževanje donosov na obseg.

Pokazalo se je, da se glavni predmet analize, torej učinkovitost procesa ujemanja, s časom povečuje glede na pomembne regionalne razlike. Različne strukturne značilnosti trga dela vplivajo na učinkovitost skupaj sspremenljivkami, ki jih ustvarjajo nosilci ekonomske politike.. Tako imajo, na primer, regionalna stopnja brezposelnosti in delež delavcev brez izkušenj ter nizko usposobljeni delavci v skupini brezposelnih največji negativni vpliv na učinkovitost ujemanja. Po drugi strani pa imajo delež primarnega sektorja in visoko usposobljeni delavci v skupini skupnega števila brezposelnih največji pozitivni vpliv na proučevanem regionalnem trgu dela. Kakovost storitev regionalnih zavodov za zaposlovanje se kaže v številu visoko usposobljenih delavcev, ki so zaposleni v zadevnem regionalnem uradu HZZ na enega brezposelnega, kot tudi v stopnji pokritja ALMP, kar naj bi kazalo na kakovostno razporeditev resursov in kakovostno osebje – oboje ima pozitiven vpliv na učinkovitost procesa ujemanja. Poleg tega je čisti dobiček *na prebivalca* kot kazalnik nihanja povpraševanja tudi dokazal, da ima pozitiven vpliv na učinkovitost ujemanja. Na splošno velja, da ustrezne vrednosti pri oceni koeficienta tehnične učinkovitosti kažejo na manjšo porazdelitev med regionalnimi uradi, vse dokler segmentacija regij (od najmanj do najbolj učinkovite) ostaja bolj ali manj enaka.

Da bi ugotovili, ali na Hrvaškem obstajajo kakršne koli pomembne krizne implikacije za učinkovitost procesa ujemanja na regionalni ravni, smo ocenili model za dve ločeni dobdobji, in sicer za obdobje pred krizo in za obdobje krize. Rezultati kažejo, da obstaja nekaj pomembnih razlik tako med obema obdobjema kot glede na prvotno oceno. Z namenom, da bi omogočili bolj dosledno oceno, smo uporabili tudi preoblikovani izvirni model stohastične meje za panelne podatke. Preliminarni rezultati osnovnega preoblikovanega modela vendarle kažejo, da v primerjavi z izvirnim modelom panel stohastične meje ni pomembnih razlik v ocenjenem koeficientu srednje tehnične učinkovitosti, nasprotno pa velja za vrednosti tehnične

[3] Za več podrobnosti si oglejte Wang in Ho (2010).

učinkovitosti. Te rezultate pa bi sicer morali sprejeti z zadržkom, saj model vključuje le nekaj spremenljivk, ki bi lahko vplivale na učinkovitost ujemanja.

STRUKTURALNA BREZPOSELNOST NA HRVAŠKEM – KAKO POMEMBNO JE POKLICNO NEUJEMANJE?

Prispevek se začne s predpostavko, da je razlog visoke in vztrajne brezposelnosti na Hrvaškem neujemanje veščin/poklicev na trgu dela, oziroma da se veščine in znanja ponujene delovne sile (brezposelno prebivalstvo) ne ujemajo z veščinami in znanjem, ki jih iščejo delodajalci (povpraševanje). To pomeni, da je glavna predpostavka ta, da je najpomembnejši vzrok brezposelnosti na Hrvaškem strukturne narave. Posledično se torej poraja glavno vprašanje raziskave, in sicer v kolikšni meri je pričujočo raven brezposelnosti mogoče pripisati strukturnemu (poklicnemu) neujemanju oziroma za koliko bi upadla (poklicna) brezposelnost, če bi bilo neujemanje odpravljeno. Zato so osrednje domneve raziskave naslednje:

D.5: Na hrvaškem trgu dela obstaja neujemanje med brezposelnostjo in prostimi delovnimi mesti nglede na poklic.
D.6: Poklicno neujemanje je krivo za velik delež brezposelnosti na Hrvaškem.
D.7: Velikost neujemanja je različna na različnih podtrgih (poklicne skupine).

Z namenom, da bi zadevo preučili, smo uporabili metodo funkcije ujemanja na podlagi modela, ki ga je prvič uvedel Dur (1999). Ta študija poleg agregatne funkcije ocenjuje tudi razčlenjene funkcije ujemanja, ki temeljijo na združevanju (podobnih) poklicev in ocenjevanju funkcij ujemanja, ki izrecno vključujejo indeks neujemanja za različne podtrge. V študiji so prav tako namesto stopenj izobrazbe, ki jih uporablja Dur (1999), kot približek za veščine uporabljeni poklici. Glede na to, da poklici običajno zajemajo veščine, ki jih zahteva prosto delovno mesto, označujejo poklici veščine iskalca zaposlitve veliko bolj kot stopnja izobrazbe.

Čeprav pomembne, so študije o neujemanju veščin, izobrazbe in poklicnega neujemanja v nekdanjih tranzicijskih državah redke. To je predvsem rezultat pomanjkljivosti ustreznih podatkov (Kucel et al., 2011). Poleg tega večina študij, ki so bile izvedene na tem področju, po navadi pokriva obdobje prehoda iz šole v službo in le občasno razlikuje med vertikalnim in horizontalnim neujemanjem (glej npr. Farčnik in Domadenik, 2012; Kogan in Unt, 2005; ali Roberts, 1998). Nekoliko nedavnih študij na temo tranzicije iz centralno načrtovane ekonomije v tržno ekonomijo pa vendarle ponuja pomemben vpogled v to, kako je lahko prišlo do neujemanja v nekaterih državah (Bartlett, 2012; Jeong, Kejak in Vingradov, 2008; Kucel et al., 2011; Lamo in Messina, 2010). Edina raziskava, ki je ocenila določeno neujemanje veščin za Hrvaško, je bila do nedavnega Obadićeva (2004), medtem ko je Matković (2011, 2012) pred kratkim nakazal, da na hrvaškem trgu dela obstaja horizontalno neujemanje med področjem izobrazbe in pridobljeno zaposlitvijo.

Podatki, ki smo jih upoštevali v tem članku, so mesečni podatki Hrvaškega zavoda za zaposlovanje (HZZ) za obdobje od januarja 2004 do decembra 2011. Da bi lahko odkrili obstoj

neujemanja na trgu dela, smo vse poklice razdelili na devet obširnih poklicnih skupin:[4] (i) zakonodajalci, višji uradniki in upravitelji, (ii) strokovnjaki; (iii) tehniki in povezani strokovnjaki, (iv) uslužbenci, (v) storitveni delavci in prodajalci v trgovinah in na tržnicah, (vi) usposobljeni delavci v kmetijstvu in ribištvu, (vii) obrtniki in delavci v povezanih poslih, (viii) strojniki v tovarnah in delavci na tekočih trakih ter (ix) osnovni poklici.

Model, uporabljen v tretjem delu disertacije, temelji na postopku, ki ga je uvedel Dur (1999) in pravzaprav izhaja iz dela Jackmana in Roperja (1987). Domnevno je agregatni trg dela sestavljen iz števila povsem ločljivih podtrgov, ki se razlikujejo glede na tip poklica. To pomeni, da iskalci zaposlitve, ki sodijo v poklic *i*, ne morejo (ali nočejo) iskati zaposlitve v drugem poklicu. Enako velja za prosta delovna mesta – prosto delovno mesto, ki sodi v poklic *i*, nikoli ne zasede iskalec zaposlitve, ki tega poklica nima. Zato je agregatna funkcija ujemanja zgolj vsota funkcij ujemanja na celotnem trgu dela:

$$M = \sum_i M_i = kU^{\alpha}V^{\beta}\sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}. \qquad (9)$$

Izraz 9 kaže, da je agregatno število zasedenih delovnih mest (zadetkov) odvisno od zalog agregatne brezposelnosti in prostih delovnih mest, parametra učinkovitosti *k* in distribucije brezposelnosti in prostih delovnih mest v vseh podtrgih (poklicih). Izraz $\sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}$ v izrazu 9 je enak vrednosti 1, če je za vsak podtrg (poklic) *i* delež brezposelnih, ki sodi v podtrg *i* v agregatni brezposelnosti (U_i/U) enak deležu prostih delovnih mest, ki sodijo v podtrg *i* v agregatnih prostih delovnih mestih (V_i/V). Če je ta člen v resnici enak vrednosti 1 oziroma če so razmere na trgu dela na vsakem podtrgu enako ugodne (krizne), se tako stanje imenuje **popolno strukturalno ravnotežje** (Dur, 1999, glede na Jackmana in Roperja, 1987). Razlika med resnično brezposelnostjo (U) in brezposelnostjo v popolnem strukturnem ravnotežju (U_S) pomeni kazalnik neujemanja na trgu dela:

$$U - U_S = U \cdot \left(1 - \sum_i \left(\frac{U_i}{U}\right)^{\alpha}\left(\frac{V_i}{V}\right)^{\beta}\right) = U \cdot mm, \qquad (10)$$

pri čemer je *mm* kazalnik neujemanja, ki si ga lahko razlagamo kot delež skupne brezposelnosti, ki jo lahko pripišemo neujemanju. Pomembnost neujemanja je na splošni ravni brezposelnosti očitno odvisna od razporejenosti tako brezposelnosti kot prostih delovnih mest v vseh podtrgih (poklicih), pa tudi od velikosti določenega podtrga.

Da bi ocenili, koliko (skupne) brezposelnosti lahko pripišemo poklicnemu neujemanju v obdobju od januarja 2004 do decembra 2011, smo uporabili funkcijo ujemanja, ki je izpeljana v izrazu 9. Empirični model je videti takole:

[4] Na podlagi Mednarodne standardne klasifikacije poklicev (ISCO). Vojaški poklici so izpuščeni iz analiz, saj v tej skupini v nekaterih obdobjih (mesecih) ni bilo registriranih brezposelnih ali prostih delovnih mest.

$$\log M_t = const. + \sum_j \lambda_j \log k_{j,t-1} + \alpha \log U_{t-1} + \beta \log V_t + (1-\xi)\log \sum_i \left(\frac{U_{i,t-1}}{U_{t-1}}\right)^{\alpha} \left(\frac{V_{i,t}}{V_t}\right)^{\beta} + \varepsilon_t, \quad (11)$$

pri čemer je uveden indeks *t* zaradi razlikovanja med različnimi časovnimi obdobji (meseci). Kot je razvidno iz izraza 11 je kazalnik neujemanja vključen izrecno v funkcijo ujemanja. Parameter k_t v izrazu 11 pomeni nabor spremenljivk, ki lahko vplivajo na vedenje pri iskanju tako brezposelnih oseb kot delodajalcev, torej na proces ujemanja. V tem primeru uporabljamo (linearni) časovni trend, da bi testirali spremembe vedenja pri iskanju, ki so povezane z neopaženimi značilnostmi. Poleg tega uporabljamo delež števila uporabnikov nadomestila za brezposelnost v skupni brezposelnih, da bi kontrolirali za različno vedenje iskalcev zaposlitve pri iskanju.

Model v tej nalogi je bil ocenjen z uporabo nelinearne cenilke najmanjših kvadratov (angl. non-linear least squares estimation), vendar zaradi možne sotočasnosti model ocenjujemo tudi z uporabo nelinearne dvostopenjske cenilke instrumenalnih spremenljivk najmanjših kvadratov (angl. nonlinear two-stage least squares instrumental variable estimation), in sicer ob upoštevanju potencialne endogenosti spremenljivk, ki merijo brezposelnost, prosta delovna mesta in delež števila prejemnikov nadomestila za brezposelnost v skupni brezposelnih. Poleg eksogenih in odloženih endogenih spremenljivk kot dodatne instrumente uporabljamo logaritme indeksa gradbenih del, delež povprečne neto in povprečne bruto plače ter razpon med obrestnimi merami za kratkoročna posojila in obrestnimi merami za depozite v tuji valuti za podjetja. Ocene vključujejo mesečne slamnate spremenljivke, s čimer vsako leto kontroliramo za število različnih delovnih mest in odtokov. Glede na to, da imamo podatke o toku zasedenih delovnih mest po poklicih, ocenjujemo funkcijo ujemanja ne le na agregatni ravni, ampak tudi za vsakega od potrgov, ki so določeni v predhodnem poglavju – *pisarniški in proizvodni poklici* – z uporabo iste metode kot za agregatno funkcijo.

Glede na pridobljene rezultate se zdi, da poklicno neujemanje nima pomembnega vpliva na agregatni tok zasedenih delovnih mest oziroma na proces ujemanja na celotnem trgu dela. Ko preiskujemo trg dela glede na njegove podtrge oziroma podobne poklicne skupine, poklicno neujemanje vendarle (pomembno) pozitivno vpliva na proces ujemanja na trgu pisarniških poklicev, medtem ko negativno (zanemarljivo) vpliva na podtrg proizvodnih poklicev. Poleg tega ima za celotni trg dela, kot tudi za vsakega od podtrgov (poklicne skupine), delež prejemnikov nadomestila za brezposelnost v skupini brezposelnih negativen vpliv na proces ujemanja, medtem ko časovni trend nanj vpliva pozitivno, kar kaže na to, da Hrvaška sčasoma

beleži vedno večjo učinkovitost ujemanja na trgu dela. V večini primerov tudi domneve o konstantih donosih obsega ni mogoče zavreči. Kljub temu je delež skupne (agregatne) brezposelnosti, ki ga lahko pripišemo poklicnem neujemanju, ocenjen od 1 do 6 odstotkov, odvisno od časovnega obdobja. Ta številka je prenizka, da bi lahko z njo pojasnili visoko in trdovratno stopnjo brezposelnosti na Hrvaškem. Delež brezposelnosti, ki se pripisuje neujemanju na različnih podtrgih, se zelo razlikuje, saj njegova vrednost sega od 2 do 20 odstotkov na podtrgu pisarniških poklicev in zgolj do 1 odstotek pri proizvodnih poklicih. Če na hrvaškem trgu dela ne bi bilo (poklicnega) neujemanja, bi stopnja brezposelnosti upadla za približno 0,2 do 0,8 odstotnih točk. Splošni zaključek je torej ta, da poklicno neujemanje nekoliko vpliva na proces ujemanja na (poklicnih) podtrgih, medtem ko njen vpliv na ravni splošne brezposelnosti ni preveč pomemben.