Essays on Topical Labour Market Issues: Evidence from Hungary

by
Lajos Tamás Szabó

Submitted to
Central European University
Department of Economics and Business

In partial fulfillment of the requirements for the degree of
Doctor of Philosophy

Supervisors:
Andrea Weber
Róbert Lieli

Budapest, Hungary

10.14754/CEU.2021.05

CENTRAL EUROPEAN UNIVERSITY
DEPARTMENT OF ECONOMICS AND BUSINESS

The undersigned hereby certify that they have read and recommend to the Department of Economics and Business for acceptance a thesis entitled **"Essays on Topical Labour Market Issues: Evidence from Hungary"** by Lajos Tamás Szabó.
Dated: September 27, 2021

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Chair of the Thesis Committee:

DocuSigned by:
Julius Horvath
Julius Horvath

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Co-Advisor:

Robert Lieli

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Co-Advisor:

Andrea Weber

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Internal Examiner:

Sergey Lychagin

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
External Examiner:

Rudolf Winter-Ebmer

10.14754/CEU.2021.05

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

External Member:

DocuSigned by:
Balázs Reizer
E3B85E5DCFC4427...

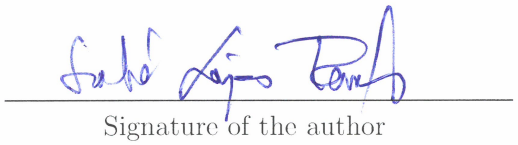
Balázs Reizer

10.14754/CEU.2021.05

CENTRAL EUROPEAN UNIVERSITY
DEPARTMENT OF ECONOMICS AND BUSINESS

Author: **Lajos Tamás Szabó**
Title: **Essays on Topical Labour Market Issues: Evidence from Hungary**
Degree: **Ph.D.**
Dated: **October 4, 2021**

Hereby I testify that this thesis contains no material accepted for any other degree in any other institution and that it contains no material previously written and/or published by another person except where appropriate acknowledgement is made.



Signature of the author

10.14754/CEU.2021.05

I dedicate my thesis to the memory of my grandparents.

10.14754/CEU.2021.05

DISCLOSURE OF CO-AUTHORS CONTRIBUTION

Title of paper: The Transmission of Ethnic Prejudice to Labour Market Discrimination - The Role of Small Firms

Co-author: Gábor Kertesi and János Köllő

The nature of the cooperation and the roles of the individual co-authors and approximate share of each co-author in the joint work: Idea of the paper comes from Gábor Kertesi and János Köllő. I contributed to the detailed empirical strategy and implemented the econometric estimations. We shared the tasks during the literature review and the interpretation of the results. I wrote the first English draft of the paper.

10.14754/CEU.2021.05

Abstract

In my thesis I present the indirect effect of the Hungarian public work programme on wages, the effect of the labour market tightness on wages and the importance of the composition of local labour markets in employment discrimination. In every chapter I use Hungarian micro databases. The conclusion of the first chapter is that the public work programme has a negative effect on the private sector wage. This is because the programme increases the labour supply since the majority of public workers were inactive before the programme. In the second chapter I find that the labour market tightness has a positive effect on private sector wages. The third chapter (co-authored with Gábor Kertesi and János Köllő) shows that the employment gap between Roma and non-Roma depends not only on local prejudices but also on the composition of the local economy.

Chapter 1 - The Effect of Public Work Programme in Hungary on Private Sector Wages

I estimate the effect of the public work (PW) programme in Hungary on private sector wages by using the difference in the public worker share in small homogeneous labour markets. My results show that the PW programme has a negative effect on private sector wages due to the increasing labour supply that was induced by the programme. To date, the public work (PW) programme has been the major active labour market policy tool since 2011 in Hungary. Between 2011-2017 Hungary spent 0.58% of GDP on PW programmes, which was the largest fund for direct job creation among OECD countries. A large portion of the public work funds was distributed among those districts which were below the country average development level. As the PW employment share was not even among districts, I can use this as a variation to identify the indirect effect of the programme on the private sector. I estimate the effect of public work programme on the private sector wage using a fuzzy regression discontinuity design. The treatment variable is the share of

public workers in a district-occupational cell. According to my estimations, for the period 2013-2017 the private sector wage level is lower by 0.5% among the elementary occupations when the public worker share increases by 1 percentage point. The total wage effect is equal to almost one-year wage growth between 2013-2017.

Chapter 2 - The Effect of Tightness on Wages at the Regional Level in Central Europe

In this paper, I estimate the effect of tightness (i.e., the ratio of vacancies to unemployment) on wages in two Central European countries, Hungary and Slovakia. The estimation exercise is relevant for at least two reasons. Firstly, it tests the implications of the Mortensen–Pissarides model on Central European data. Secondly, wages are a major driver of inflation and are important from other macroeconomic policy perspectives. My main contribution is to identify the effect of tightness on wages from regional heterogeneity. More precisely, I instrument tightness by the distance of a district from the Austrian border, interacted with a dummy that marks the opening of the Austrian labour market to these countries in 2011. I find a positive effect of tightness on wages in the two countries, which is in line with the conclusion of the model. In Hungary a 1% increase in tightness leads to a 0.08% increase in wages, while in Slovakia the coefficient is somewhat larger. Nevertheless, in both countries the increase in tightness caused roughly one half of the wage increase between 2009-2017.

Chapter 3 - The Transmission of Ethnic Prejudice to Labour Market Discrimination - The Role of Small Firms

co-authored with Gábor Kertesi and János Köllő

The Roma is Europe' largest and poorest ethnic minority. We analyse the employment gap between Roma and non-Roma adults in local labour markets to test the hypothesis that ethnic prejudices against a minority have a more substantial labour market impact if the proportion of small firms is high in the local economy. At small firms, the application process is less formal and there is, presumably, larger room for arbitrary decisions which can lead to discriminatory practices. We conduct the exercise using data from the 2011 census in Hungary. We use the vote share of the then far-right "Jobbik" party as a measure of general anti-Roma sentiment in a given district, and instrument it with the prevalence of

10.14754/CEU.2021.05

foreign currency mortgage debts, a well-documented independent trigger of Jobbik support. Our results show that Jobbik votes or high share of small firms alone do not lead to significantly lower Roma employment probability while the interaction of these two factors does. The employment probability of Roma is 11 percentage point smaller in the districts, where the small firm share and Jobbik vote share is considerably larger than the country average.

10.14754/CEU.2021.05

Acknowledgments

Foremost, I am highly indebted to my supervisors, Andrea Weber and Róbert Lieli for their continuous help and guidance during the years of my studies. They were always available for discussions about my research topics. This support was essential for me to write the theses.

My co-authors Gábor Kertesi and János Köllő deserve special recognition. During our joint work, I learned a lot about how to structure serious research and how to cooperate in a research project. Based on the comments and questions of the examiners my theses improved a lot. I am grateful to Rudolf Winter-Ebmer and Sergey Lychagin for their work.

I am thankful to Gábor Békés, Márta Bisztray, Attila Lindner, György Molnár, Dániel Prinz, Ádám Szeidl who commented the previous versions of my papers.

The stimulating atmosphere at the Economics Department also helped a lot in my research. I would like to express my sincere appreciation to my professors. I am especially grateful for László Mátyás for his essential comments on my work.

My colleagues at the Central Bank of Hungary also helped my work with their useful comments. Especially Álmos Telegdy, Győző Gyöngyösi, Ádám Reiff and Péter Gábriel. I am also indebted to a friend and colleague, Olivér Rácz with whom we talked a lot about labour market issues and he was always open to listen to my newest results. He suggested the topic of my second chapter as well.

I would like to thank the participants of the 12th South-Eastern European Economic Research Workshop, the 22nd IZA Summer School in Labour Economics, the 25th and 26th International Panel Data Conference and the Annual Conference of the Hungarian Society of Economics for their useful comments.

I learnt a lot from discussions with my fellow PhD students, István Boza, Luca Drucker, Gergely Hajdu and Gábor Révész. Gábor also helped me if I had technical problems with Python.

Balázs Kertész, a friend and fellow PhD student helped my work when I got stuck with

10.14754/CEU.2021.05

Matlab and I could discuss my results with him. Thank you!

I am very much indebted to Ágoston Reguly, a friend and fellow PhD student, with whom we talked a lot during our first years about homework and class materials at the 'Harry Potter-stairs' and on the rooftop. Later, he also gave advice on my research ideas.

My family deserves the utmost gratitude. My parents made it possible that I could learn during my earlier studies and they supported me throughout the years.

My grandparents would probably be proud of me. My paternal grandpa, (Lajos Szabó) who died unjustly early. I learned a lot from my maternal grandpa (János Pintér) how to be persevering and to be always cheerful even during tribulations. My maternal grandma (Etelka Tóth) gave an example of how to be humble and forbearing. And my paternal grandma (Ilona Gémes), who motivated me to start my PhD studies and inspired me a lot. I dedicate my thesis to their memories.

Last but by no means least, I thank my wife for her patience and unconditional trust throughout the years. She has encouraged and supported me through all the ups and downs during these years.

10.14754/CEU.2021.05

Contents

10.14754/CEU.2021.05

List of Tables

10.14754/CEU.2021.05

List of Figures

10.14754/CEU.2021.05

Chapter 1

The Effect of Public Work Programme in Hungary on Private Sector Wages

"Nothing is more dangerous than to stop working. It is a habit that can soon be lost, one that is easily neglected and hard to resume."
Victor Hugo

1.1 Introduction

Policy interventions can have an effect not only on eligible households or individuals but also on non-participants. For instance, international food aid affects local prices (Levinsohn and McMillan (2011)), cash transfers increase the consumption of non-participant households (Angelucci and De Giorgi (2009)), penalties in a conditional welfare programme increase classmates' compliance (Brollo et al. (2020)), conditional cash transfer has an indirect effect on crime (Chioda et al. (2016)), tuition policy has a smaller impact on college enrollment if indirect effects are taken into consideration (Heckman et al. (1998)). Active labour market policies (ALMP) are likely to have indirect effects as well. To illustrate, Hujer et al. (2006) examine the effect of vocational training on general conditions on the labour market and Imbert and Papp (2015) examine the indirect effect of an Indian public work programme on the private sector. Other types of indirect effects have also been

documented (e.g., the effect of a public work programme on food security by Beegle et al. (2017)).

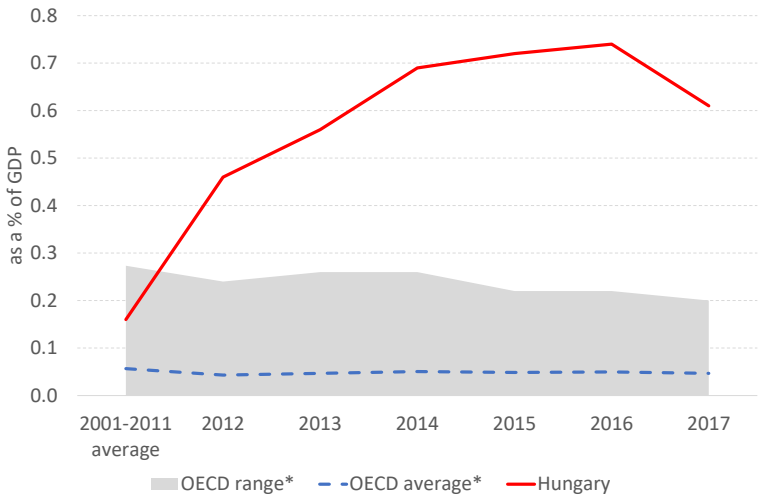
As argued by Angelucci and De Giorgi (2009), understanding a policy's indirect effect is important for several reasons. If a program is widely used, then indirect effects may be even greater than direct ones. Fletcher and Marksteiner (2017) also argue that the full social impact of an intervention should take into consideration the possible indirect effects as well. Furthermore, indirect effects may represent a good opportunity to study the effects of labour supply shocks in general. Finally, the existence of indirect effects have implications for policy design. Although there is a large literature on ALMPs, their indirect effects are still much more rarely documented.

In this paper, I investigate whether the Hungarian public work (PW) programme affected non-participants, specifically the wages of low-skilled private sector workers. The PW programme is a large active labour market policy in Hungary, with potentially sizeable indirect effects. The main goal of the programme is to give job opportunities to discouraged workers, other inactive groups and unemployed people, so that they can, with time, transition to the primary labour market and find a job there. This goal is consistent with the goals of many ALMPs as described by Kluve (2016).

The Hungarian PW programme is a good case study for analysing the indirect effects of an ALMP. Among the OECD countries, Hungary has spent the largest amount on direct job creation (see Figure 1.1). The total cost of the programme was 0.58% of the GDP between 2011-2017. The PW programme provides short-term job opportunities to inactive people mainly in low-skilled jobs; consequently, indirect effects can be expected to affect low-skilled workers. The maximum number of months is limited in the programme. The wage in the programme is considerably less than the minimum wage, which is an incentive for participants to find a job in the private sector.

As the public worker share is not evenly distributed among districts and occupations, I can use this as a variation to identify the indirect effect of the programme on the private sector. In the Hungarian PW programme, those districts receive considerably more funds, which are below the country's average development level. Development is measured by a "complex indicator", which averages several standardised objective socio-economic factors (e.g. average house price, urbanity index). If the value of the complex indicator is below 46.68 then the district is eligible for extra funds. Close to the cutoff the share of public workers is considerably higher below than above the cutoff. The cutoff rule enables me to use a quasi-experimental research design, specifically a fuzzy regression discontinuity design (RDD) around the threshold to estimate the effect of the programme.

Figure 1.1: The public spending for direct job creation in OECD countries (as a % of GDP)



Note: *The OECD average and range was calculated without Hungary. Source: OECD stats.

The main identification assumptions for the RDD are as follows. Firstly, the expected value of the potential outcome without treatment must be continuous as a function of the running variable. This assumption guarantees that in a small neighbourhood of the cutoff value the districts are similar apart from the treatment and any discontinuity in the average outcome is only due to the treatment. This assumption is supported by the fact that there is no significant difference in low-skilled wages around the cutoff before the programme. Secondly, the running variable cannot be manipulated by the districts to receive the programme. Since the complex indicator is calculated from 24 objective socio-economic factors the districts cannot achieve this. These two assumptions make it plausible to regard variation in public worker share near the cutoff as if it were from a randomised experiment (Lee and Lemieux (2010)). Since all districts are eligible for some PW funds and the threshold rule affects only the intensity not the participation of the programme fuzzy RDD can be used to identify the effect.

The main results of the paper are the following. I find that in the elementary occupational group the average wage is lower by 0.5% between 2013-2017 if the share of public workers increase by 1 percentage point in the treated districts around the cutoff, i.e. where the value of development indicator is just slightly lower than the country average. The

negative wage effect is consistent with Layard et al. (1991)'s job competition channel. As roughly half of the public workers are from the inactive population, they increase the labour supply as they start searching for a new job in the private sector. This leads to lower wages among the low skilled in those districts where the share of public workers is high. On the other hand, the results do not support the other so-called "better alternative" channel (Calmfors and Forslund (1991)) in which ALMP increase private sector wage.

Several placeboes and robustness checks suggest that the wage effect is due to the programme and not other factors. Firstly, before the programme, there is no systematic difference between the left and right-hand side of the cutoff. Secondly, there is no sign of composition effect. Thirdly, there is no effect for arbitrarily chosen placebo cutoff values.

I do not find any significant employment effect around the cutoff. The reason for this can be the fact that in the short run the low-skilled workers' employers cannot adopt in the capital so they cannot employ more workers; they just perceive the increased labour supply.

The main threat to identification is the fact that simultaneously with the introduction of the PW programme the transfer system was also reformed. The total amount of social transfers dropped from 6.2% of GDP in 2010 to 3.9% of GDP in 2017. This change is also a strong incentive for inactive people to participate in the labour market. On the other hand, this policy change was not related to the complex indicator. Therefore the RDD setup overcomes this issue because one expects that this effect is similar on the two sides of the cutoff. More specifically, a placebo RDD exercise also shows that around the cutoff there is no significant change in the per capita transfers.

My research has several contributions to the pertaining literature. Firstly, my paper fits into the broadly defined policy evaluation literature going back to Ashenfelter (1987), LaLonde (1986) etc. Within this literature, I specifically contribute to the research on the effectiveness of ALMPs by documenting the indirect effect of the Hungarian PW programme. The broad overview of ALMPs can be found in Card et al. (2017). The most closely related papers in the literature are Wray et al. (2018), Imbert and Papp (2015), Berg et al. (2018) and Zimmermann (2012). The first one is a simulation of a hypothetical PW for the US; the last three assess the Indian PW programme. Although all four papers focus on the indirect effects of PW the countries examined are quite different from Hungary. Moreover, the programmes are different in key aspects from the Hungarian one. For instance, in Hungary, the PW wage is considerably less than the minimum wage, while in the case of the above-mentioned programmes it is equal. This can be the main reason why I find a negative spillover effect while other studies find a positive.

Secondly, I contribute to the existing literature on the Hungarian PW programme. These studies deal with e.g. the employment probabilities of participants (e.g., Molnár et al. (2014), Cseres-Gergely and Molnár (2014)), the labour market career path of participants before the programme (Köllő (2015)) or attitudes to the programme on behalf of participants, municipalities, decision-makers (Koltai et al. (2018)). None of the studies examines the spillover effect of the PW programmes on the private sector.

Thirdly, there is another strand of literature dealing with spillover effects from public sector wages in general to the private sector. There are articles using individual data to assess the spillover effect (Jacobsen (1992), Telegdy (2018)) and macro data is also used (Lamo et al. (2012), Demekas and Kontolemis (2000)). In my research I concentrate on a subgroup of low-skilled employees, not the whole public sector and the PW programme is a special type of employment. Still, I analyse the spillover from the public to private sector.

Lastly, I use a very high quality and comprehensive administrative dataset, which covers every employee in Hungary. This enhances the internal validity of the results. The studies covering the indirect effects of PW programmes (Imbert and Papp (2015), Berg et al. (2018), Zimmermann (2012)) use survey data with less complete coverage.

The paper is organized as follows. In section 1.2 I present two possible mechanisms, which can explain the effect of PW programmes on the private sector wage. I briefly summarize the relevant literature in Section 1.3. In Section 1.4 I discuss the institutional background of PW programmes and present some descriptive statistics. In Section 1.5 I carry out the estimation and discuss the results.

1.2 Possible mechanisms

I describe two possible channels through which PW affects private sector wage. The empirical exercise in my paper tests the relative strength of these two channels against each other in Hungary using the data of the PW programme since 2011.

1.2.1 Job competition channel

In the first channel the labour supply grows, which decrease the private sector wage. Approximately half of the public workers come from inactivity (see Section 1.4.3). The goal of the PW programmes is to help the inactive and long-term unemployed to find a job in the private labour market by offering them practice. To reach this goal participation

in the PW programme is limited, which is also a pushing factor to the primary labour market. The increasing labour supply leads to lower wages in those districts, where there are more public workers. Layard et al. (1991) called this as the job competition channel.

Table 1.1: Flows from PW to the private sector

	t-2	t-1	t
1)	Inactive	PW	Private
2)	Unemp	PW	Private
3)	Private	PW	Private

There can be 3 types of flows in which the PW is the previous step before the private sector employment (Table 1.1). In the first channel before the PW the individual was inactive. This channel increases the labour supply in the long run since a new participant appeared in the labour market (for more details see Section 1.4.3). The other two flows, when someone was unemployed or employed in the private sector, does not increase the labour supply since the PW employment was a temporary episode in the individual's working history. In these flows, PW can be considered as a cyclical tool to help to overcome a short-term unemployed period. Therefore, in these flows, PW does not increase the labour supply in the long run.

1.2.2 The "better alternative" channel

The other channel has a different implication. Calmfors and Forslund (1991) argues that active labour market policies (such as relief work, youth employment programmes, recruitment subsidies, training etc.) increase the private sector wage. Calmfors and Forslund (1991) illustrate this with the example of Sweden, where these programmes were near-substitutes of regular employment and the wage was higher than the unemployment benefit (in the case of on-the-job programmes the wage was equal to the original wage). This setup is a favourable alternative to unemployment, which induce wage increase.

Although the PW wage is lower than the minimum wage (see Table A.12 in Appendix), we know from anecdotal evidence that for some PW jobs less effort is needed than on the primary labour market. There can be employees for whom this lower effort-lower wage package is more desirable than the private sector. In this case, their reservation wage is higher for a private sector job. This implies that the labour supply declines and private sector wage increases. We do not know how many people are with these preferences, therefore the strength of this channel is unknown.

Calmfors and Lang (1995) argues that both channels can be present. If the programme is not effectively targeted then wage pressure can be present. On the other hand, if the programme is sufficiently targeted to the long term unemployed then the wage-declining effect would dominate. Therefore there is at least one channel, which implies a negative and another, which implies a positive wage effect. I cannot disentangle the two channels in my empirical strategy. I can only measure the resultant effect.

1.3 Literature

In labour economics there is a long history of studying labour market policies. For instance, evaluating training programme effects on earnings (e.g. Ashenfelter (1987), LaLonde (1986), Heckman et al. (1987)), pattern of displaced workers' earning losses (e.g. Jacobson et al. (1993)) or impact of minimum wages on other wage (e.g. Gramlich (1976), Card and Krueger (1994)).

The evaluation of ALMPs is a growing subset of this literature. The main aim of the active labour market policies is to increase the participants' employment probability and decrease aggregate unemployment (Kluve (2016)). Apart from the employment probability goal, increasing earnings, improving job quality and prolonging job duration can be the target of ALMPs' as well. In the US the main objective is often rising wages, while in Europe the employment outcomes are in focus (Kluve (2016)). More similar to a regular job, the more effective the ALMP is (Sianesi (2008)). There is also a documented connection between the length of an ALMP and its effectiveness. For instance, short-term subsidised jobs help participants to find a regular job, on the other hand, the longer the subsidised job is, the smaller the positive effect is (van Ours (2004)).

There are four main types of ALMP: job search assistance, labour market training, private sector employment incentives, and public sector employment (Kluve et al. (2007)). For instance, the studies on ALMPs deal with the employment probability changes of participants (e.g. Jaenichen and Stephan (2007), Caliendo et al. (2005), Bergemann et al. (2017)), job duration and wage growth due to the programme (e.g. Connolly and Gottschalk (2009)), the effect of unemployment benefit sanctions (e.g. Arni et al. (2013)), the link between training programmes and unemployment duration (e.g. Lee and Lee (2005)), the increasing employment probability after participating in a wage subsidy programme (Leduc and Tojerow (2020)), the effect of training on job mobility (Zweimüller and Winter-Ebmer (2003)), the employment effect of wage subsidy programme (Betcherman

et al. (2010)).

A meta-analysis of ALMP-studies can be found in Card et al. (2017). The authors summarize the results of more than 200 articles. In general, they find that ALMPs are more effective in medium and longer terms. They also find that ALMPs are more effective during slow growth and higher unemployment periods. On the other hand, according to Escudero et al. (2019)'s meta-analysis ALMP's have more positive impacts during economic booms which means that ALMP's are more effective in case of an expanding labour market. A possible explanation for this discrepancy can be the different set of countries, which the two paper examines. While Escudero et al. (2019) cover only Latin-American countries Card et al. (2017) assess a wider selection of countries of which only 10% are Latin-American.

There are two main strands of the literature on ALMP from the perspective of the direction of the effects. First, there is literature evaluating the programme effect on participants. Not surprisingly this is the larger part of the literature, and the studies covered by Card et al. (2017) focus on the effect of ALMPs on participants. The effects estimated in this literature are sometimes referred to as partial equilibrium effects. Second, there is literature studying spillover effects on other groups, and a smaller literature looking at effects on the whole (local) labour market. The market-wide effects are referred to as general equilibrium effects. They can be important if the program is run at a large scale (Angelucci and De Giorgi (2009)) and includes a large share of the population. My research focuses on the general equilibrium effect and does not deal with the effect on participants.

One of the first microeconometric studies about spillover effects is Levine (1993). He finds a significant positive effect on employment probabilities due to the increase in unemployment insurance for individuals who were not insured. Later, Albrecht et al. (2005) examine the effect of a Swedish adult educational programme, not just partial but general equilibrium effects. For the latter, they use an equilibrium search model with heterogeneous worker skills. Interestingly they find that equilibrium effects are 1.5-2 times greater than partial effects. Blundell et al. (2004) identify equilibrium effects of a complex job assistance and wage subsidy programme in the UK.

Public work programmes are quite common in emerging countries (e.g. Langa et al. (2019), Galasso and Ravallion (2004), Berg et al. (2018)) but they can be found in developed countries (e.g. Azam et al. (2012), Heinrich et al. (2013)) as well. As discussed by Kluve (2016) PW participants are mainly from the most disadvantaged individuals and the programme can serve as a social policy tool to keep these people close to the labour market. These properties are also true for the Hungarian labour market. Besides the employment goals, PW programmes have other objectives, which are not just about labour

market outcomes. There can be local development objectives by creating new infrastructure, which contributes to the local economy and help to reduce the regional differences (Kálmán (2015)). Other purpose can be poverty reduction of the most vulnerable households (Escudero et al. (2019), Koltai et al. (2018), Molnár et al. (2014)). These objectives can be also found among the goals of the Hungarian PW programmes.

The literature discusses several theoretical arguments for and against the PW programmes. PW programmes can ensure work experience, which can be an advantage during a job search. On the other hand, full-time and not flexible public work can be an obstacle during job search if the public worker does not have enough time to find a job or the employer does not let the worker for a job interview (Kálmán (2015)). There could be a substitution effect if an existing job is filled with a public worker. In this case, there is no new job creation. The crowding out effect emerge if there are too many public workers and private sector jobs are not filled due to the public work programmes (Kálmán (2015)). This would be the case if the second channel would be strong enough (see Section 1.2). There could be an effect on participants' individual risk management (Gehrke and Hartwig (2018)) as well.

The effectiveness of PW programmes is a relevant and popular topic in the literature. There are several positive results when PW improves the job-finding rate and increases employment (e.g. Vodopivec (1999) for Slovenian, Heinrich et al. (2013) for US PW programme). The PW programme also increases the participants' income (e.g. Azam et al. (2012) for Latvia, Tcherneva (2013) for Argentina, Escudero (2016) for Peru). The PW programmes also seem to be an effective tool to reduce unemployment (e.g., Galasso and Ravallion (2004) for Argentina, Eichler and Lechner (2002) for Germany). On the other hand, negative effects are also documented. For instance, the Peruvian PW programme increased the employment probability of participants but they found lower quality jobs (e.g. informal jobs, working excessive hours) (Escudero (2016)). There are cases when other ALMPs are more effective than PW programmes (e.g., Escudero et al. (2019)). Csoba and Nagy (2012) also find that the Hungarian PW in 2010 was less effective than wage subsidy and training programmes. O'Leary (1997) also finds a negative effect of the Hungarian PW programme in the 1990s. The PW participants' career path before the programme can be also interesting. Köllő (2015) finds that in Hungary employment rate of public workers was well below the country average and they worked significantly less than the non-participants before the programme. According to the estimation of recent studies (Bakó et al. (2014) and Cseres-Gergely and Molnár (2014)) the job-finding rate of the Hungarian public workers was around 10-22% and it decreased over time. In their meta-analysis Card et al.

(2017) find that the PW programmes have negligible or even negative direct effect on all time horizons.

There are some papers, which focus on the effect of PW programmes on the private sector. Wray et al. (2018) simulated the effect of a hypothetical PW programme in the US and get higher private sector wage in the long run. A recent set of empirical studies focus on the effect of the Indian PW programme (NREGS) on the wage of the private sector. Zimmermann (2012) uses household survey data to assess the effect by RDD. She finds a significant positive effect on the private sector wage of women but no effect on men. She does not find any effect on private sector employment. Berg et al. (2018) use difference-in-difference estimation and get 4.3% higher wages in the private sector for the treated districts. Imbert and Papp (2015) use difference-in-difference estimation and find that NREGS increased the private sector wage by 4.7% but there was a 1.5% decrease in privates sector employment. NREGS is an effective (and costly) tool to enforce the minimum wage in the rural labour market because in NREGS the wage equals the minimum wage (Berg et al. (2018) and Imbert and Papp (2015)). In Hungary, the PW wage is considerably lower than the minimum wage to incentivise participants to find a job in the primary labour market and the jobs are mainly available not in agriculture. Although the before-mentioned papers are about the general equilibrium effects, they assess a PW programme with a quite different setting than the Hungarian one. This makes it interesting to analyse the effect of the Hungarian PW on non-participants.

1.4 Institutional background and data

According to the Ministry of Interior, the main aim of the PW programme is to help the participants to find a job in the primary labour market. In addition, the local authorities want to reach settlement development and operational goals using PW programmes. Furthermore, it has a poverty reduction and value-added generating role as well. These goals are in line with those which are mentioned by Escudero et al. (2019). According to Koltai et al. (2018)'s survey, the PW employers experienced a significant improvement in the public workers' attitude toward work and their basic competencies. Based on the survey during the PW there was a large progress in the employees' skills like communication, conflict management, problem-solving, adaptability and time management. This helped the public workers find a job in the primary labour market. Koltai et al. (2018) do not estimate causal relationship due to lack of sophisticated data.

1.4.1 Short description of PW-programmes

There were PW programmes before 2011 in Hungary but their magnitude was lower and the regulation was quite different. Since 2011 there are 3 main types of public work schemes (based on Bördős (2015)):

- Model programmes 'Start' (micro-regional): maximum duration is 12 months with 8 hours working time per day. These programmes are mainly organised by local municipalities. Managers of these programmes receive additional professional assistance and consulting during the planning and implementation phases. (Mód (2013), Kulinyi (2013)). Typical works can be, among others, agricultural projects, repair of the public road network, eliminate illegal waste dumps, use of organic and renewing energy etc. On average this type of funding amounted to 43% of the total funding between 2013-2017.

- Long-term public works programmes: maximum duration is 12 months. The typical working time is 6-8 hours per day. This was the main source for the non-special importance districts. The Ministry of Interior gives more funds for Long-term public work programmes in those counties, where the number of micro-regional model programmes is low or they do not exist at all. On average this type of funding amounted to 37% of the total funding between 2013-2017.

- National public works programmes: these programmes are organised by state-owned corporations (e.g. Hungarian Railways - MÁV, fire service, national parks, forest management plants etc.), for tasks including flood control or maintenance works in public transport infrastructure. On average this type of funding amounted to 21% of the total funding between 2013-2017.

The share from the total funding of these programme types did not change much during 2013-2017. There were other subcategories but they varied across years and did not have significant funding. The organiser of the PW can decide on the type of work (e.g in a village the mayor can choose from road maintenance, agricultural projects etc.). The public workers' wage is the same in the whole country and in every type of programme. It is less than the minimum wage (see Table A.12 in Appendix).

PW employers can be the central government, local municipalities, churches, social cooperatives and some specified businesses (see details in Appendix A.2). In PW the yearly days of the holiday are less than in a normal job. It is 20 days regardless of the employee's

age (in other types of jobs it increases by the age of the employee). This stricter rule is also an incentive to find a job in the primary labour market. Those who get unemployment benefit should accept the PW regardless of their educational level. Otherwise, they lose the unemployment benefit. Previously jobseekers were forced to accept the work only if it fitted their educational level (Bördős (2015)).

A typical PW job is a street cleaner or a kitchen helper. In these kinds of occupations, the skill improvement is in time-management (to get to the job on time) or in social skills (e.g. conflict management). At the first glance, these skills look very trivial for those, who have stable jobs, but roughly half of the public workers were out of the labour force for a long time. For them to acquire these elementary skills is essential to find a job in the private sector. Other typical PW jobs are agricultural occupations, for instance, vegetable grower, grapes and fruit grower, forestry worker. In these jobs, they can learn special occupational-related knowledge, which can be used during the job search and in a new private sector job. There are some white-collar jobs in the PW as well. For instance, general office administrator. The two-digit level occupations, where the public work share is the highest can be found in Table A.13 in Appendix.

1.4.2 Fundamental subsidising rules

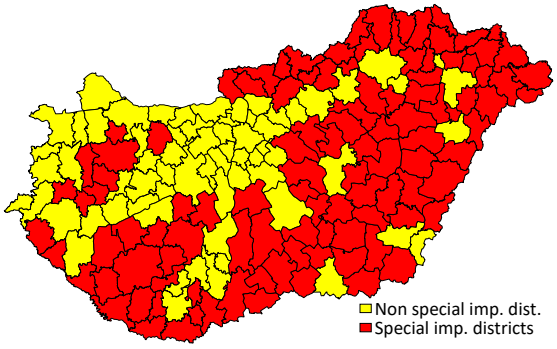
The Hungarian government categorised the districts according to their development. Those districts, which are below the country average development level can apply for more funds in the PW programmes. Only those districts can participate in the 'micro-regional model programmes', which were considered as special importance districts[1]. A district is special importance (*kedvezményezett*) if the complex indicator is below the country average (46.68). An average district contains 1-4 towns and some villages or just a larger city. The average population in a district is 56 thousand people.

The complex indicator is the average of socio-demographic indicators, housing indicators, local economic indicators, infrastructural and environmental indicators (see details in Appendix A.1.3).

The special importance districts (Figure 1.2) got more funds for PW programmes than the others. The less developed a district is the more PW funds it gets (see Figure 1.3). There is a clear discontinuity in per capita PW-cost around the country average (Figure

[1] *311/2007. Korm. rendelet* later *290/2014. Korm. rendelet*

Figure 1.2: Special importance districts



Source: 290/2014. Korm. rendelet.

1.4). The main difference is due to the micro-regional model programmes, which amounted to roughly 40% of the total costs on the country level. These programmes are only available for special importance districts.

Although the *290/2014. Korm. rendelet* is the base regulation there is another regulation[2], which supplement this rule. According to this, those settlements, where the registered unemployment rate is 1.75 times higher than the country average can be considered as special importance settlements. Based on this Gyula and Komló districts can be considered as special importance districts (they lost this status in 2017) although their complex indicator is greater than the country average. That is why I exclude these districts from the regressions.

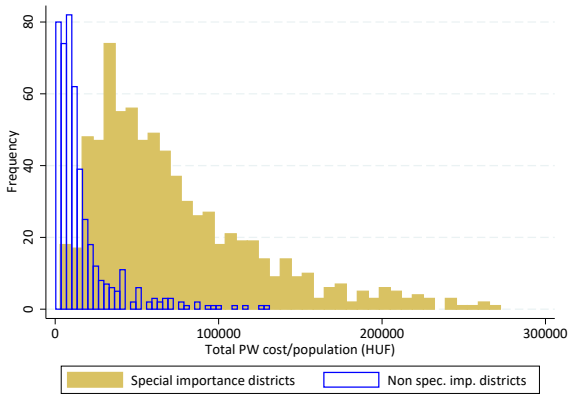
Parallel with the introduction of the PW programmes the transfer system was reformed considerably (for details see Appendix A.3). The type of social transfers and the total amount paid was cut back remarkably. The total social transfers (without sick leave and pension payments) decreased from 6.2% of GDP in 2010 to 3.9% of GDP in 2017 (source: CSO). The decrease was independent of the complex indicator, which helps to disentangle the effect of PW from the social transfer change.

1.4.3 Database and descriptive statistics

The database of the Hungarian State Treasury (MÁK) contains every individual, for whom the employer paid pension contribution. Those who are employed in the public work scheme

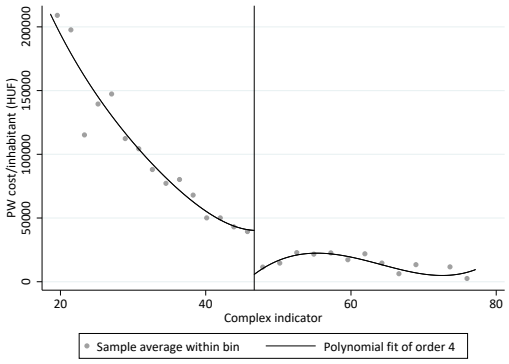
[2] *105/2015. Korm. rend.*

Figure 1.3: The total costs of PW-programmes/population for districts



Note: pooled of years 2011-2017. Source: Ministry of Interior and own calculations.

Figure 1.4: The per capita PW-cost and the complex indicator in 2015



Note: binscatter. Without Komló and Gyula districts. Source: Ministry of Interior and own calculations.

can be separated in the database since September 2011. I transformed this database into a district and two-digit occupational level database. I averaged the private sector wages in every district two-digit occupational cell weighting by the employment time (see the calculation of the private sector wage in Appendix A.1.1). It gives 40 occupational categories per district on average. The unit of observation are these district two-digit occupational cells (see descriptives in Table A.10 and A.11 in Appendix). A district occupational cell represents a small homogeneous labour market. By using them the idiosyncratic variation in individual wages averages out. The technical advantage is the considerably smaller data set, which implies faster calculation time.

The budget for the PW programmes increased considerably between 2011 and 2017.

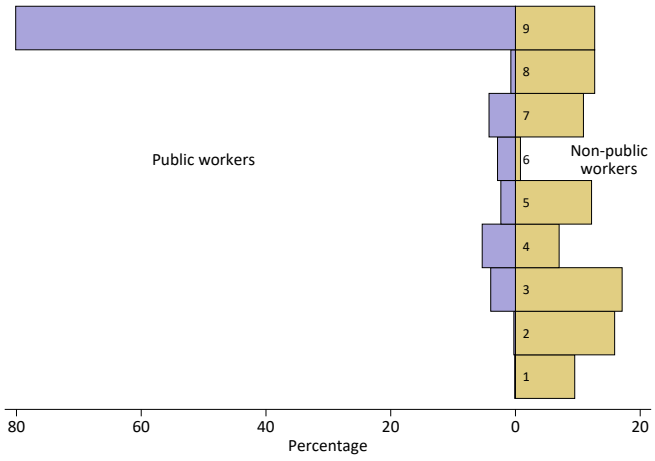
Table 1.2: PW headline statistics

	Total expenditure of PW		Public workers	
	in billion HUF	as a share of GDP	FTE	as a share of LFS FTE
2011	66.5	0.23%	22 000	0.6%
2012	132.9	0.46%	99 000	2.8%
2013	17.5	0.56%	125 000	3.5%
2014	224.4	0.69%	184 000	5.0%
2015	252.7	0.73%	199 000	5.1%
2016	267.6	0.75%	218 000	5.5%
2017	266	0.68%	181 000	4.4%

FTE: full-time equivalent, LFS FTE: Labour Force Survey, full-time equivalent, without those, who work abroad. Sources: cost: the budget of Hungary, GDP: KSH, FTE: MÁK, LFS: KSH

At the peak, it was as much as 0.75% of the Hungarian GDP. The full-time equivalent (FTE) number of public workers grew accordingly. It reached its peak in 2016 when there were 218 thousand public workers, which was 5.5% of the total employment (Table 1.2). The large amount of funding and the high share of public workers makes this programme suitable to look for general equilibrium effects.

Figure 1.5: The occupational distribution of public workers and non-public workers

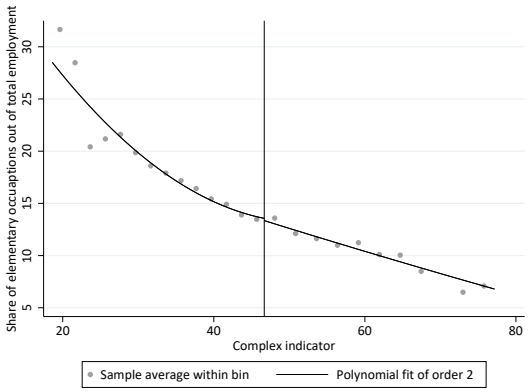


Note: Average of years 2012-2017. Occupational categories: 1 Managers, 2 Professionals, 3 Technicians and associate professionals, 4 Office and management, 5 Commercial and services occupations, 6 Agricultural and forestry occupations, 7 Industry and construction industry occupations, 8 Machine operators, assembly workers, drivers of vehicles, 9 Elementary occupations not requiring qualification.

The occupational distribution of public workers and non-public workers differs a lot (see Figure 1.5). The vast majority of public workers are employed in elementary occupations,

which does not require any qualification (occupational category 9). The share of these occupations is around 80% in every year. The second largest is the Office and management (customer services) occupation category (occupational category 4), in which on average 5% of public workers are employed. The other categories are less than 5%. Due to this, I expect the effect only in the elementary occupations category workers. There is no difference in the share of elementary occupation (category 9) workers around the cutoff before the programme (Figure 1.6).

Figure 1.6: Share of elementary occupation in the total employed by districts



Note: binscatter of 2009-2011. Without Gyula and Komló districts.

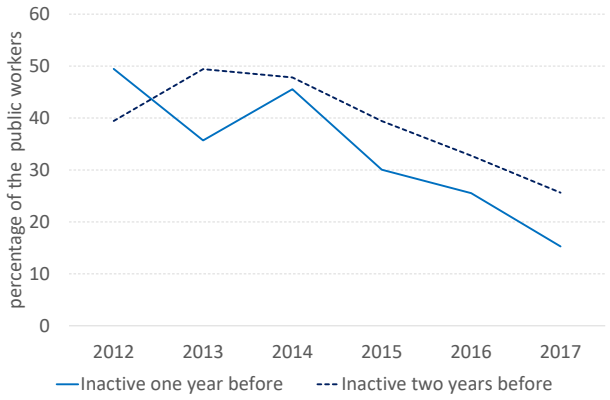
Between 2012-2014 almost half of the public workers was inactive one year before the programme. This proportion declines after 2014. The pattern is the same in the case of those, who were inactive two years before the PW programme (Figure 1.7). This phenomenon clearly illustrates that the PW programme indeed increased considerably the labour supply, which can affect private sector wages.

1.5 Empirical analysis

I would like to measure the spillover effect of the public work (PW) programme in Hungary on private sector wages. In the most ideal thought experiment some districts would be randomly chosen, where public work is implemented. Some of the public workers become capable of filling private vacancies, which increases the labour supply in the treated districts, leading to lower wages in the treated districts than in the non-treated ones.

The identification issue is that the PW program is not randomly allocated to districts and it was in fact implemented in all districts. One could still compare wages across sectors

Figure 1.7: The share of those, who were inactive before the PW programmes (24-57 years old)



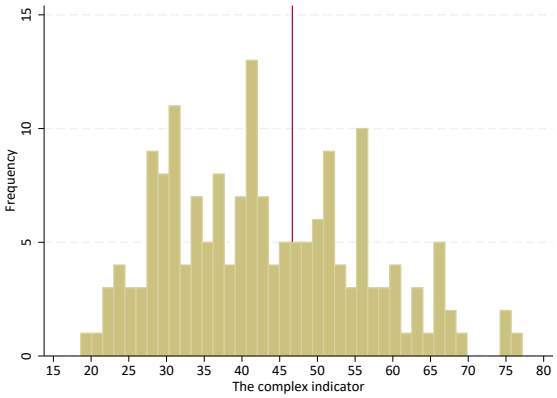
where PW participation is high versus where it is low, but this comparison is misleading because participation is endogenous, i.e., it is correlated with economic conditions that affect wages. However, I can isolate some exogenous variation in participation using a fuzzy RD design as explained below.

1.5.1 The Fuzzy RDD setup

My empirical strategy exploits the fact that, while the programme was introduced in a non-random manner, the least developed districts got considerably more funds and the share of public workers is also higher in these districts. The allocation mechanism was based on a development indicator. According to the government decree, those districts are special importance districts, where the development level, measured by the complex indicator, is below the country average. This rule allows the use of regression discontinuity design. In the RDD below the cutoff, the policy is implemented, above the cutoff, there is no change in the policy (or vice versa). Since only 40% of the total funds are distributed in this way, the difference below and above the cutoff is not the treatment status rather the treatment intensity.

There are two fundamental assumptions for RDD to be valid. Firstly, districts cannot precisely manipulate the assignment variable. This assumption holds due to at least two reasons. The assignment variable (complex indicator) is calculated based on several socioeconomic variables, which cannot be manipulated by the districts. Furthermore, based

Figure 1.8: The distribution of the complex indicator among districts



on the histogram of the complex indicator there is no sign of bunching around the cutoff (Figure 1.8). The variation that RDD isolates can be considered randomised as a consequence that districts have very limited or no control over the complex indicator (Lee and Lemieux (2010)).

The other fundamental assumption of RDD is that districts that were just underdeveloped enough to receive more funds and districts that were just too developed not to receive extra funds are similar to each other in terms of unobserved characteristics. This assumption guarantees that the differences in outcomes between the two districts are due to the PW programme (Lee and Lemieux (2010), Zimmermann (2012)). This assumption holds since there is no discontinuous change in observed covariates around the threshold (see Figure A.3 in Appendix).

Using the notation of Calonico et al. (2017) in the fuzzy RDD the observed outcome is:

$$Y_i = \begin{cases} Y_i(1), & \text{if } X > c \\ Y_i(0), & \text{if } X < c \end{cases}$$

where

- i is the index for district-occupational cells (see the calculation in Appendix A.1.1), I pool the years between 2013-2017,
- $Y_i(1)$ is the outcome for a randomly chosen population unit if it is treated,
- $Y_i(0)$ is the outcome for a randomly chosen population unit if it is not treated,
- X is the running variable (or assignment variable), which is the complex indicator,

- c is the cutoff value (46.68).

In my estimations, the main outcome variable is the full-time equivalent average wage of a district-occupational cell in the private sector in elementary occupations (category 9).

The treatment intensity changes at the cutoff:

$$\lim_{\varepsilon \searrow c} Pr(D = 1|X = c + \varepsilon) \neq \lim_{\varepsilon \nearrow c} Pr(D = 1|X = c + \varepsilon) \tag{1.1}$$

The causal parameter that can be identified as the treatment effect at the cutoff:

$$\tau = \frac{\lim_{\varepsilon \searrow c} E(Y|X = c + \varepsilon) - \lim_{\varepsilon \nearrow c} E(Y|X = c + \varepsilon)}{\lim_{\varepsilon \searrow c} E(D = 1|X = c + \varepsilon) - \lim_{\varepsilon \nearrow c} E(D = 1|X = c + \varepsilon)} \tag{1.2}$$

where

- Y is the outcome variable the log full-time equivalent average wage of the private sector for district-occupational cells,
- D is the public worker share in a given district-occupational cell,
- Z is the instrument, a dummy variable indicating whether the complex indicator is smaller than 46.68 or not.

Districts below the cutoff are allocated a significantly larger PW budget. Based on Calonico et al. (2017) the treatment effect is identified nonparametrically using kernel-based local polynomials on both sides of the cutoff.[3]

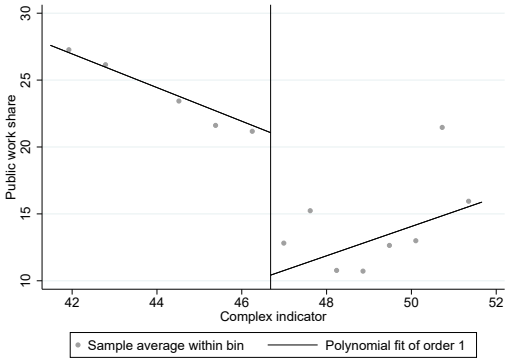
There is a clear discontinuity in the public worker share i.e., the treatment intensity of a given-district occupational cell at the cutoff (Figure 1.9). I will use this discontinuity to identify the causal effect. As districts immediately below the cutoff and above the cutoff are presumably similar, this jump represents a plausibly exogenous variation in program participation. Figure 1.10 shows that there is a corresponding jump in Y.

I restrict the sample to a neighbourhood of c and estimate the equation:

$$Y = \rho D + \beta_0 + \beta_1(X - c) + \beta_2(X - c)^2 + \epsilon \tag{1.3}$$

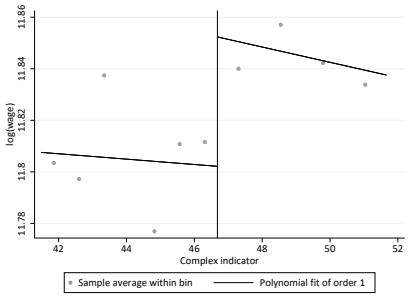
[3]I use the Stata `rdrobust` command for the estimation (see the detailed description of the command in Calonico et al. (2014) and Calonico et al. (2017)).

Figure 1.9: The share of public workers in occupational category 9 and the complex indicator



Note: binscatter. The plotted line represents the local level estimator based on the original data. Sample: 2013-17, without Komló and Gyula districts. Share of public workers=(the number of public workers)/(the total number of workers)·100 in a distric-occupational cell.

Figure 1.10: The log(private sector fte wage) in occupational category 9 and the complex indicator



Note: binscatter. The plotted line represents the local level estimator based on the original data. Sample: 2013-17, without Komló and Gyula districts.

using $Z = \mathbb{I}(X < c)$ as an IV for D. Thus the first stage is:

$$D = \delta Z + \gamma_0 + \gamma_1(X - c) + \gamma_2(X - c)^2 + \eta \tag{1.4}$$

and the second stage is:

$$Y = \rho \hat{D} + \beta_0 + \beta_1(X - c) + \beta_2(X - c)^2 + \epsilon \tag{1.5}$$

Using this method I essentially implement the Wald-type estimator:

$$\frac{\text{jump in wage at the cutoff}}{\text{jump in public work share at the cutoff}} \tag{1.6}$$

1.5.2 Main results

My estimates show that from the left of the cutoff the wages are 0.5% lower if public work share increase by 1 percentage point (Table 1.3). This is in line with the first mechanism in Section 1.2.

Table 1.3: Fuzzy RD estimates using local polynomial regression for log private fte wage in occupational category 9, main specification

		(1)	(2)	(3)
Robust	Coef.	-0.00545***	-0.00520**	-0.00504*
	St.error	(0.00177)	(0.00256)	(0.00264)
Observations		2,595	2,595	2,595
Time horizon			2013-2017	
Left BW		3.6	5.2	9.2
Right BW		3.6	5.2	9.2
Obs. on the left		195	315	630
Obs. on the right		180	270	465
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table 1.4: The first stage estimation in occupational category 9, main specification

		(1)	(2)	(3)
Robust	Coef.	9.979***	10.253***	10.51***
	St.error	(2.387)	(2.997)	(3.267)
Observations		2,595	2,595	2,595
Time horizon			2013-2017	
Left BW		3.6	5.2	9.2
Right BW		3.6	5.2	9.2
Obs. on the left		195	315	630
Obs. on the right		180	270	465
Order of polynomial		0	1	2

The table contains the first stage estimation of fuzzy RD. The outcome variable is the proportion of public workers in a district-occupational cell, the running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

The first stage results show that in elementary occupations there is a 10 percentage point difference in the share of public workers between the left and the right side of the cutoff (Table 1.4).

To put the results into context it is worth mentioning that between 2013-2017 the average yearly inflation rate was 0.8%, therefore these results could be interpreted as real wage differences. The annual wage growth was 5.8% on average in the private sector, the annual minimum wage growth was 6.6% on average between 2013-2017. This means that in the 2013-2017 period the effect equals almost one-year wage increase in the treated districts for those who work in elementary occupations.

To assess the external validity of the results one has to take into consideration that during this period there was an economic boom in Hungary with an emerging labour shortage. It is still a question that during a recession or sluggish economic growth how these results would change.

Besides the wage effect, it is worth examining whether there is a change in labour demand. Based on the same calculations there is a positive parameter estimate although it is not significant (Table 1.5). In the short run the low-skilled workers' employers cannot adopt in the capital so they cannot employ more workers (e.g. in an orchard the employer does not need more workers for harvesting in the short run because of the fixed number of trees).

Table 1.5: Fuzzy RD estimates using local polynomial regression for log employment in occupational category 9, main specification

		(1)	(2)	(3)
Robust	Coef.	0.0456	0.0359	0.0493
	St.error	(0.0339)	(0.0416)	(0.0447)
Observations		2,595	2,595	2,595
Time horizon			2013-2017	
Left BW		2.8	5.3	9.6
Right BW		2.8	5.3	9.6
Obs. on the left		165	345	645
Obs. on the right		105	285	555
Order of polynomial		0	1	2

The outcome variable is the log employment in private sector, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

1.5.3 Discussion

Table 1.6: Effect of PW programmes on private sector (literature)

Country	Short description of the programme	Paper	Results on private sector	Note
India	duration: up to 100 days/year, $w_{PW} > w_p$ and $w_{PW} = w_{min}$, mainly agricultural jobs, 4.5% of population participated	Azam (2012)	$\oplus w$, $\oplus emp$ effect	analysis restricted to casual workers
		Imbert and Papp (2015)	$\oplus w$, $\ominus emp$ effect	crowd out in private sector work
		Zimmermann (2020)	no wage effect, $\oplus emp$ effect	
		Muralidharan et al. (2020)	$\oplus w$, $\oplus emp$ effect	implement wage floor, PW is a real outside option
Yemen	duration: 51 days, $w_{PW} > w_p$, 0.6% of population participated	Christian et al. (2015)	$\oplus w$, $\ominus emp$ effect	
Liberia	duration: 40 days, $w_{PW} > w_p$, 0.4% of population participated, only one opportunity to participate	Wodon (2012)	no effect	due to high labour surplus and limited size of the programme
US	$w_{PW} > w_{min}$ 4.5% of population participates	Wray et al. (2018)	$\oplus w$, $\oplus emp$ effect	just a simulation, not a real programme

Note: w_{PW}: public work wage, w_p: private sector wage, w_{min}: minimum wage, emp: employment, $\oplus$: positive effect, $\ominus$: negative effect

There are very few papers, which deal with the effect of a PW programme on private sector wage (Gehrke and Hartwig (2018), Kálmán (2015)). Those who cover this question mainly find a positive wage effect (see Table 1.6). My result is a negative wage effect, which is (according to my current understanding) unprecedented in the literature. What could be the reason for this difference? There are several differences between the Hungarian and the previously analysed programmes, which is explained in the following section.

Firstly, in the Hungarian programme, the wage is lower than the minimum wage (not to mention the private sector average wage, see Table A.12 in Appendix). Therefore based on the wage the PW job is not a real outside option for workers. Gehrke and Hartwig (2018) emphasise that if the PW wage is larger than the private sector wage and the employment of the PW is also considerable then upward wage pressure will be present on the private labour market. In Hungary, the first condition is missing therefore wage pressure is not likely.

Secondly, Muralidharan et al. (2020) find that after the programme the participants' reservation wage increased significantly. Based on the Labour Force Survey (LFS) the reservation wage of the Hungarian PW participants did not change much. Between 2012-2017 the mean change in reservation wage for public workers after participating in the

programme is HUF -123 (EUR -0.34), and the median change is HUF 0.[4] This fact also shows that the Hungarian PW did not increase the participants' bargaining power.

Thirdly, several articles emphasise that PW programmes help to enforce minimum wages (e.g. Imbert and Papp (2015)), where the implementation of this rule is otherwise poor. This contributes to the positive wage effect. This is not the case in Hungary because the minimum wage is really binding (e.g. Bíró et al. (2020)).

Moreover, Koltai et al. (2018) find that the Hungarian PW programme indeed helps to improve some non-cognitive competencies of the participants (e.g. communication, conflict management, problem-solving, time management). Furthermore, the programme contributed to building self-competence. These are basic competencies, which are essential in getting and keeping a job but hardly in helping to improve bargaining power with the employer. To put it differently, the PW programme helps participants to take the first steps in the labour market but they have to improve their skills in their first job. The PW programme "give basic skills to improve further skills".

The total average time spent in the programme over the period 2011-2017 is 604 days (the median is 412). The annual average is between 70-247 days (see Table 1.7), which is larger than the other programmes covered in Table 1.6. The programme starts in September 2011 which is why the average value is considerably lower compared to other years.

Table 1.7: Annual average time PW programme

Year	Mean	p50
2011	70.4	61
2012	177.8	153
2013	155.1	122
2014	191.2	173
2015	220.6	234
2016	247.4	279
2017	238.9	270

Based on the literature and on my results the following argument can be made on the connection between the PW and private sector wages. Let $w_p(L_0^S)$ denote the wage of the private sector in period 0 and $\frac{\partial w_p}{\partial L^S} < 0$. If $w_{PW} > w_p(L_0^S)$ then the labour supply for the private sector decreases ($L_0^S > L_1^S$) because it is worth working in the PW rather than in

[4]Here I cannot show more details because the LFS sample is not representative on the district level.

the private sector. Due to this wages in the private sector will increase ($w_p(L_0^S) < w_p(L_1^S)$). This phenomenon was documented in the literature.

If $w_{PW} < w_p(L_0^S)$ then PW is not a real outside option for private sector workers. If the public workers come from inactivity and after participating in the programme try to find a job in the private sector the labour supply will increase ($L_0^S < L_1^S$), which will lead to a decline in private wages ($w_p(L_0^S) > w_p(L_1^S)$). This is what I have found using the Hungarian data.

To sum up several authors (e.g. Muralidharan et al. (2020), Gehrke and Hartwig (2018)) conclude that if the wage of the PW is higher than in the private sector and the PW programme is sufficiently large there is an upward wage pressure in private sector. The Hungarian PW is quite large but the wage is below not only the market wage but also the minimum wage. Therefore my results are not contradictory to the current findings on this topic rather they supplement it.

1.5.4 Placebo regressions and robustness checks

In the case of RDD design placebo tests help to justify that the effect is due to the policy change and not other factors. That is why I make some placebo tests as well.

Firstly, I used the before programme period (2009-2012). The coefficient is not stable using a different order of polynomial and not significant (Table 1.8). Based on the scatterplot there is no spike around the cutoff in the pre-period (Figure A.2 in Appendix). This confirms the results in the main specification because before the programme private sector wages were very similar close to the cutoff among the elementary occupations.

Secondly, I use those sectors, where the share of public workers was very small or nil (occupational category 1-4). To make sure that there are no occupations where the wage is for the low-skilled, I use those where the average wage was above the median wage in 2009. Using this restriction guarantees that the occupational categories are selected before the programme. The coefficients are close to zero and not significant (Table 1.9).

There are other robustness checks in Appendix A.4.

The main threat to identification is the fact that the transfer system was modified simultaneously with the introduction of the PW. On the other hand, the cutting back was uniform across districts so the threshold, which exists for the PW programme does not have any role in the transfer system reform. The RDD estimations confirms this (Table 1.10) argument.

My results show that the PW programme has indirect effects on those who do not par-

Table 1.8: Sharp RD estimates using local polynomial regression for log private fte wage for occupational category 9, placebo

		(1)	(2)	(3)
Robust	Coef.	-0.0334	-0.0554	0.0438
	St.error	(0.0304)	(0.0351)	(0.0587)
Observations		1,782	1,782	1,782
Time horizon			2009-2012	
Left BW		2.7	7.0	7.1
Right BW		2.7	7.0	7.1
Obs. left of the cutoff		115	326	336
Obs. right of the cutoff		72	256	256
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table 1.9: Sharp RD estimates using local polynomial regression for log private fte wage for occupational category 1-4, placebo

		(1)	(2)	(3)
Robust	Coef.	-0.00201	-0.00286	0.0178
	St.error	(0.0345)	(0.0464)	(0.0534)
Observations		13,547	13,547	13,547
Time horizon			2013-2017	
Left BW		4.0	7.5	9.4
Right BW		4.0	7.5	9.4
Obs. left of the cutoff		1245	2812	3195
Obs. right of the cutoff		1140	2262	2936
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample contains those district-occupational cells, where the average wage was above the median wage in 2009, without Gyula and Komló districts. Occupational categories: 1 Managers, 2 Professionals, 3 Technicians and associate professionals, 4 Office and management (customer services) occupations. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table 1.10: Sharp RD estimates using local polynomial regression for change in per capita transfers

		(1)	(2)	(3)
Robust	Coef.	-0.225	-0.220	0.363
	St. error	(0.436)	(0.490)	(1.029)
Observations		1,211	1,211	1,211
Time horizon			2011-2017	
Left BW		4.0	11.9	10.6
Right BW		4.0	11.9	10.6
Obs. left of the cutoff		112	385	350
Obs. right of the cutoff		91	287	273
Order of polynomial		0	1	2

The outcome variable is the change in per capita transfers in thousand HUF, the running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample contains every district except for Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

ticipate in the programme. This is important because if someone wants to assess the whole welfare impact of the programme this should be taken into consideration. To precisely calculate the welfare impacts of the PW programme an analysis on how does the PW programme altered the job-finding rate of participants is necessary. There are studies, which measure the job-finding rates of public workers (e.g. Bakó et al. (2014), Cseres-Gergely and Molnár (2014)) but none of these deal with the counterfactual status. My research documents the indirect effect of the programme, which is a niche in the literature, especially in the Hungarian context. To summarize the total welfare effects of PW is beyond the scope of my paper.

The cost and benefit analysis of the PW is a very important aspect of the programme. The full analysis is out of the scope of my paper but I can give a short overview what can be the steps to be able to judge the programme. The direct cost of the PW is available from the budget of Hungary (see Table 1.2 in my paper). Since the decrease in transfers was parallel with the programme and was on purpose to incentivise the inactive to find a job, the saving on this should be taken into account. The main question is how did the programme affect the participants' job finding possibilities. This question can be a topic of another paper. Furthermore, my results can be used as valuable input when someone compares privates sector wages for those who came from PW with those who were unemployed before. The direct effect can be measured by comparing two employees' wages, out of whom one was a public worker the other was unemployed before their current

work. In this way, one can estimate how effective was the programme for the participants or they would be better off by just searching for a job by themselves. This estimation procedure would be another interesting paper. To calculate the real counterfactual low skilled private sector wage, it should be considered higher due to the indirect effect of the PW programme, which I calculated in this study.

1.6 Conclusion

In this paper, I have evaluated the effect of public work programmes in Hungary on the private sector. I have found that a 1 percentage point increase in the public work share among the elementary occupations decreases the private sector wage by 0.5%. This negative effect is unprecedented in the literature. The reason for this is the different institutional setting of the Hungarian programme, namely the lower public work wage. The fact that the participants' reservation wage did not increase after the programme also contributes to this result. I have not found any employment effect, which is probably due to the short time horizon, which I have examined.

To estimate the indirect effect I have used the allocation mechanism of the programme. A large proportion of the PW budget is allocated using the development status of the districts. Those districts, which are above the country average got significantly less financial support from the central government, which results in fewer public workers. I can use this difference for a fuzzy RD design.

My results can be used as valuable input for a whole programme evaluation to assess the direct and indirect effects. Especially it is useful when someone compares privates sector wages for those who came from PW with those who were unemployed before. If someone wants to calculate the real counterfactual low skilled private sector wage, it should be considered higher due to the indirect effect of the PW programme.

A further research focus can be the analysis of the effect on participants. Especially on their job-finding rate. Although there are some results about the public workers' employment probability an analysis with control groups is missing. Another area of the research could be a full cost-benefit analysis of the programme.

10.14754/CEU.2021.05

Chapter 2

The Effect of Tightness on Wages at the Regional Level in Central Europe

"for the labourer is worthy of his hire"
Luke 10:7

2.1 Introduction

Estimating migration effects on wages in both sending and receiving countries is a popular and important topic in labour economics. There is a large amount of evidence that the number of newcomers has a negative effect on native workers' wages (e.g. Altonji and Card (1991), Card (2001), Monras (2020)), especially among the low-skilled employees. On the other hand, there are studies, which find a non-significant (e.g. Boustan et al. (2010)) or even positive effect (e.g. Dustmann et al. (2012)). The situation in the sending countries is less covered. The few existing papers (Mishra (2007), Aydemir and Borjas (2007), Dustmann et al. (2015)) find that emigration has a positive effect on wages in the sending countries due to the decreasing labour supply.

In 2011 every administrative obstacle was removed from the Hungarians to work in Austria. The data of the Austrian authorities show that the number of Hungarians tripled during 5 years and the Hungarian workers concentrate along the Austrian-Hungarian border. In some parts of these areas, the share of Hungarians out of the total number of employees reaches 35%. This negative labour supply shock makes it possible to estimate the effect of tightness (the ratio of vacancies to unemployment) on wages in Hungary. If

a Hungarian employee starts working in Austria it means one new vacancy in Hungary, which increases the labour market tightness. If a Hungarian unemployed finds a job in Austria the tightness also grows.[1]

From a theoretical standpoint, the Mortensen-Pissarides model (Mortensen (1982), Pissarides (2000)) predicts that the tightness has a positive effect on wages. There are very few empirical papers estimating this effect (Harmon (2013)) and the results are not conclusive. The identification issue is the endogeneity of tightness in the wage equation.

To overcome the endogeneity issue I use instrumental variables (IVs) to estimate the effect of tightness on wages. In this paper, I use annual district level data from Hungary and Slovakia. Districts can be considered as local labour markets. An average district has a bigger town and some villages or smaller towns. The data availability for the two countries is different, therefore I consider the Slovakian estimate as a robustness check to the Hungarian results. My IV is the interaction of a district's geographical distance to the Austrian border with a dummy variable that indicates the opening of the Austrian labour market in 2011 (and after). The commuting cost to Austria is low in the districts along the western border. Due to commuting from these regions, the labour supply is lower, so the tightness is higher.

There are potential threats to the validity of the instruments. Firstly, tightness is correlated with development, and the distance from Austria is also correlated with the development level of the districts. To overcome these issues I control for development by using regional fixed effects. Furthermore, I use only the North-western districts, which are the most developed in Hungary. In this way districts with similar development level are in the sample. Another potential threat to validity can be the increase in the trade between Austria and Hungary, which can affect labour market outcomes as well. According to trade data, there was not any extensive change in trade after 2011 and the share of Hungarian exports to Austria did not change much either.

Estimating a panel IV model, I obtain positive parameter estimates for the tightness effect with a reasonable magnitude. If tightness in Hungary grows by 1% then wages increase by 0.08%. The average annual tightness growth rate was 32% during the sample period, which according to my estimation caused a 2.5% wage increase. This measure is considerable since the yearly average change in wages was 5.6% between 2009-2017.

[1]In principle, inactive people can also go to work in Austria, in which case tightness does not change. On the other hand, this is not likely to be a large flow.

Robustness checks show that the result is quite stable but it concentrates on the blue-collar occupations, which is intuitive since 75% of Hungarian employees in Austria work in blue-collar jobs.

As a robustness check, I use Slovakian data as well. The number of Slovak workers in Austria also rose considerably after 2011 and they also concentrate in regions along the border. The parameter estimate for the tightness is somewhat larger but the quantitative conclusion is similar to the Hungarian case. In both countries, roughly half of the wage growth was due to the tightness increase during the 2009-2017 period.

The paper makes three contributions to the existing literature. Firstly, I empirically estimate the tightness coefficient in the wage equation and I confirm the prediction of the Mortensen–Pissarides model. My contribution is to directly identify the effect of tightness on wages from regional heterogeneity using data from two Central European countries.

Secondly, I contribute to the existing literature on the wage effects of emigration. The larger part of this literature focuses on the wage effect in the receiving countries, while a smaller part concentrates on the sending countries. My research fits into the last category.

Thirdly, my results can be used in policy making, for instance in the case of monetary policy or designing the state budget. Since wages are major determinants of cost-push inflation, the effect of tightness on wages is important in an inflation-targeting monetary policy framework. The personal income tax is one of the largest income of the state budget that is another reason why tightness has a role in public policy.

The rest of the paper is organized as follows. In Section 2.2 I summarize a modified version of the Mortensen–Pissarides search and matching model focusing on the wage equation. I briefly summarize the related literature in Section 2.3. I elaborate on the identification method in Section 2.4. The data sources and the variables which I use and the estimated equations can be found in Section 2.5. I summarize my results in Section 2.6.

2.2 Model setup

I briefly summarize a modified version of Mortensen–Pissarides model (Pissarides (2000)) or as also known the search and matching theory based on Roshchina (2016). For the detailed model see Appendix B.4.

In this setup, the firms can only produce using capital and labour together. The jobseekers look for an unfilled vacancy. If a vacancy and an unemployed is matched, a

productive job is created. It is costly (in time and in other resources) both for the firm and for the unemployed to find a suitable match. This searching time generates frictional unemployment. One of the key concepts of this model is that the probability of matching depends on the ratio of vacancies to the number of unemployed. This ratio is called labour market tightness. In this model, job creation and destruction are independent of market shocks, that is why there are unemployed who are in search of new jobs.

The labour supply is the sum of employed and unemployed. For the jobseeker, the return on being unemployed is the unemployment benefit plus the expected value of finding a job. For the employee, the return on employment is equal to his wage and the expected value of losing the job.

The labour demand consists of the filled jobs and the vacancies. Each firm has a flow revenue from the production, which is given and they can only decide on the number of posted vacancies. For the firm, the flow return on a vacancy is the expected gain of finding a suitable worker and the cost of posting the vacancy, while the value of a filled job is the profit (the difference between revenue and wage) plus the expected value of the job becoming vacant.

The wage is determined during a Nash bargaining method. When a job seeker fills a vacancy both the worker and the firm is better off and a surplus is generated. The total surplus is divided between the worker and the firm. The equilibrium wage is:

$$w = \beta(y + \gamma_0\theta) + (1 - \beta)z \tag{2.1}$$

where

- β is the bargaining power of the worker,
- y is the production of the firm,
- γ_0 is the cost of an open vacancy, i.e. the cost of the time and resources (e.g. advertising costs) used to find a suitable employee,
- θ is the labour market tightness,
- z is the unemployment benefit, i.e. the outside option of the worker.

This means that the wage is the convex combination of the unemployment benefit and the firm's surplus. The firm's surplus is the sum of the output and the expected cost savings if the firm fills the vacancy. If tightness grows, the probability of filling a vacancy

diminishes, and consequently, it will be more costly not to fill it. It follows from this mechanism that with the increase in tightness the wage also grows. It is also worth mentioning that labour market conditions only affect the wage through θ. Therefore, unemployment (rate) alone does not affect wages, and it is only the vacancies to unemployment ratio which matters. This is because wages are determined in the Nash bargaining process after the firm meets the job seeker. Tightness determines not only how long a vacancy is open, but also the expected cost to search for an employee. I estimate equation (2.1) by panel IV method.

My focus is on the tightness parameter but it is worth noting that there are modified versions of Mortensen-Pissarides model (e.g. Shimer (2005), Hall and Milgrom (2008), Diamond (2011), Ortego-Marti (2017)). These papers argue that the unemployment and vacancies are more volatile in the US data than in the model and present different modifications to the model.

2.3 Literature review

My research connects to several strands of literature. Firstly, it fits into the recent body of literature, which documents the effect of labour market tightness on different labour market outcomes. In my paper, I show how tightness affects wages, which is a niche in the literature. Secondly, my paper also contributes to the empirical literature on how emigration affects wages. Although, I do not have a direct measure of the number of workers emigrating from Hungary (at least not on district level), I have an indirect measure via labour market tightness.

Labour market tightness is the ratio between vacancies and unemployment. There are papers that examine how these two components separately affect wages. A growing body of empirical literature focuses on the connection between characteristics of vacancies and wages. For instance, Faberman and Menzio (2018) find that the wage decreases if the number of applicants increases. On the other hand, Marinescu and Wolthoff (2020) argue that by controlling for job titles wage is positively related to the number of applicants. There are also different results on the connection between wages and the duration of vacancies. While Faberman and Menzio (2018) find that wages are positively related to the duration of vacancies, Mueller et al. (2018) shows that vacancy durations are positively related to wages in the raw data but by controlling for firm and worker characteristics the connection becomes negative.

In their seminal work Blanchflower and Oswald (1995) argue that local unemployment has an effect on wages, which is considered as an 'empirical law of economics'. In their work, they use the unemployment rate for locations and industries in the US. They find that if unemployment decreases by one per cent then wages increase by 0.1 per cent. The authors find similar results in their later work (Blanchflower and Oswald (2005)) as well. My paper differs from their work in several aspects. Firstly, the wage curve can be considered as an empirical rule of thumb, not a causality relationship. My identification strategy makes it possible to estimate a causal relationship between tightness and wages. Secondly, I use the ratio of vacancies over unemployment instead of the unemployment rate. Furthermore, my specification makes it possible to test directly the implication of the Mortensen-Pissarides model. There exist wage curve estimations for Hungary as well. The authors find similar results as Blanchflower and Oswald (1995) (e.g. Delteil et al. (2004), Kertesi and Köllő (1997), Kertesi and Köllő (1999), Csáfordi (2014)).

Literature on the connection between wages and unemployment finds that the longer someone is unemployed the lower the wage he earns after finding a new job and the new job is more unstable (Arulampalam (2001), Stewart (2007), Boheim and Taylor (2002), Ortego-Marti (2017)).

Nobilis (2011) estimates the relationship between labour market tightness and wage dynamics in Hungary between 2000-2009. He uses the level and change of unemployment and the hazard rate of inflow and outflow to unemployment. He does not use vacancies because the data is available from 2009. His identification rests on variation across occupational groups, while I use more sophisticated data (district-occupational level data). He overcomes the wage-unemployment endogeneity issue by using the lags of unemployment, while I use the distance measure and a time dummy as an IV. He finds that a 10 per cent increase in unemployment leads to a 0.5 percentage point lower annual wage growth. The magnitude is similar to my estimation but the sign is negative, which is not surprising since he uses unemployment while I use the vacancy per unemployment ratio. To identify the tightness effect on wages I use a novel IV method and a more detailed data set not just for wages but vacancies as well. Our results do not contradict each other rather supplement it.

A recent set of empirical studies examines the impact of tightness on different labour market outcomes. Antczak et al. (2016) find that tightness had a positive significant effect on job creation. Modestino et al. (2016) argues that labour market tightness has an effect on skill requirements, while Muehlemann and Strupler Leiser (2018) finds that search costs are positively associated with labour market tightness. Roshchina (2016) finds that using

Brasilian data employment is more sensitive to wage changes than to changes in tightness. There is inconclusive evidence between the connection of wages and tightness. Harmon (2013) finds ambiguous results about the sign and the magnitude of the parameter of tightness in the wage equation and concluded that according to theory it should have been positive, so further research is needed. In my paper, I empirically demonstrate that tightness indeed has a positive effect on wages.

My research can be connected to Welch (1979)'s results as well. He finds that the larger a new cohort in the labour market, the smaller the starting wage is. I find that there is an effect only in that occupational category, where the relative size of public workers is the largest. To draw a parallel with Welch (1979)'s work the cohort is the occupational category in my work. What is different though is that Welch (1979) estimates the effect on own wages, while I concentrate on indirect effect.

My paper also contributes to an emerging empirical literature on the effect of migration on wages. The larger part of the literature deals with the effect on wages in the destination countries. Most of these papers find a negative effect of immigration on the native's wage (see the early works by Altonji and Card (1991), Card (2001), Angrist and Kugler (2003), Borjas (2003), more recent ones by Dustmann et al. (2017), Edo and Rapoport (2019), Monras (2020)) but there are some evidence on very little (e.g. Card and Lewis (2007)) or no effects at all (Dustmann et al. (2005)). In their meta-analysis Dustmann et al. (2016) find that the literature on the impact of immigration is inconclusive. An exhaustive meta-analysis of forced displacement (Verme and Schuettler (2021)) shows that roughly half of the studies find a non-significant effect, while the remaining part identifies a negative effect on wages, especially in the case of low-skilled workers. The other large part of this literature focuses on the wage gap between migrants and native workers (see. e.g. Elliott and Lindley (2008), Hofer et al. (2017), Smirnykh and Polaykova (2020), Longhi (2020), Botello-Peñaloza (2021)). There is evidence that the fluctuation in the destination country's GDP has a considerable effect on migrant numbers (McKenzie et al. (2014)).

My paper fits into the smaller body of literature focusing on the effect in the sending countries. One of the earliest empirical papers about this topic is by Mishra (2007). She uses the US and Mexican censuses between 1970-2000 to identify the effect of Mexican emigration to the US. She finds that emigration has a strong and positive effect on Mexican wages. Aydemir and Borjas (2007) also uses censuses from these countries and Canada and they find that a 10% decrease in the labour supply induces a 3-4% increase in wages. Mishra (2007) concludes to the same magnitudes. Another article, which is in strong connection with my research is by Dustmann et al. (2015). They use Polish LFS data

between 1998-2007 to identify the effect of emigration on Polish wages. They found that mostly intermediate-level skilled workers left the country and the wages of this skilled group increased the most. They found zero effect in the low-skilled group and a slightly positive in the high skilled group. The authors also emphasise that from 1998 to 2007 the emigrant share increased from 0.5 to 2.3% and in some regions to 5.6%, which was a considerable change in the emigration process. In these three papers, there is exact data on the number of emigrants with their previous place of residence. Since I do not have this type of data I have to use another measurable factor. Dustmann et al. (2017) uses the distance from the German border to instrument the number of Czech workers in Germany. I use the distance from the Austrian border and the opening of the Austrian labour market as an IV for tightness. The negative labour supply shock makes it possible to estimate the effect of tightness on wages.

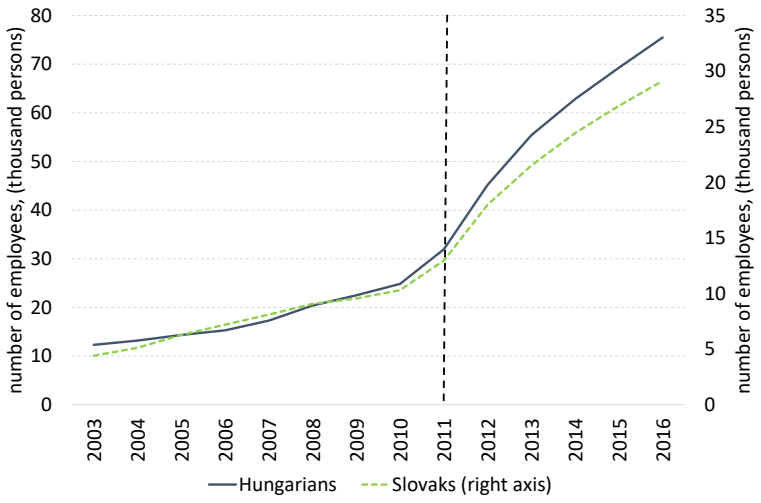
2.4 Identification method

I would like to estimate the effect of labour tightness on wages. The main issue here is that not only tightness has an effect on wages, but wages also affect tightness. If tightness grows, it indicates more competitive labour demand, which results in higher wages. On the other hand, growing wages mean that the outside option (unemployment benefit) is less desirable. Higher wages can attract inactive people to the labour market. Firstly, these people become unemployed and later can find a job. This process results in an expanding number of unemployed, which means that tightness decreases.

In the most ideal thought experiment some districts would be randomly chosen, where an exogenous negative labour supply shock happens (e.g. a decrease in retirement age or an increase in compulsory school leaving age). Due to this shock the labour market tightness increases (e.g. some unemployed and some workers become retired therefore the number of unemployed falls). This increase has an effect on wages, which can be measured because there are districts, where there is no such change.

The external negative labour supply shock is the opening of the Austrian labour market in 2011 for the newly joined members of the European Union. After 2011 every administrative obstacle was removed from the citizens of the newly joined member states to work in Austria. In an ideal case, I would have a database on the Hungarian workers' origin in Austria on the district level. In this case, I can easily calculate how large was the labour supply shock in each Hungarian district due to the opening of the Austrian labour market.

Figure 2.1: Number of Hungarian and Slovak citizens, who work in Austria



Source: Austrian Social Security Database.

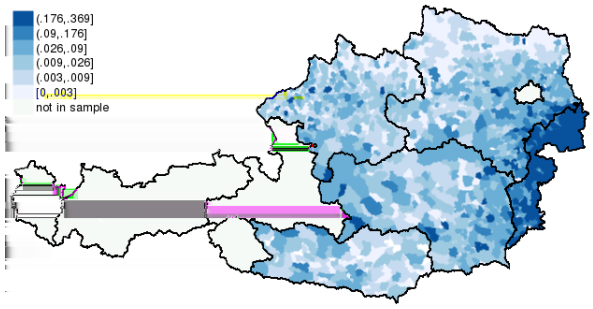
Since I do not have this information I use the distance from the Austrian border as an instrumental variable. Living closer to Austria means that the cost of commuting is smaller. The exact IV is the interaction of the distance and the after 2011 dummy.

In 2011 the dynamics of the number of Hungarians who work in Austria rose considerably (see Figure 2.1). Based on the Austrian Social Security Database the highest share of Hungarian employees is along the border (Figure 2.2). Although the place of residence is not known in this Database, one can suppose that closer to the border Hungarians commute since living expenses are lower in Hungary.

The Hungarian Labour Force Survey contains some of the employees in other countries. It contains those emigrated workers who can be considered as commuters. They have a household member in Hungary who can answer the LFS questionnaire instead of the emigrated worker. The LFS does not contain those, who (temporarily) migrated to another country with their whole family. Based on the LFS in 2011 there were 20.8 thousand Hungarians who worked in Austria, which was 32% of the commuters. In 2015 the number of commuters to Austria increased to 58 thousand, which was 43% of the covered commuters in the LFS. 75% of those, who were commuters to Austria lived in Western-Danubia and

Central-Danubia regions,[2] which are the closest to Austria. This fact point towards that my IV is strong in the Western part of Hungary, which is also confirmed by the estimation results. For more details on the commuters in the Hungarian LFS see Bodnár and Szabó (2014).

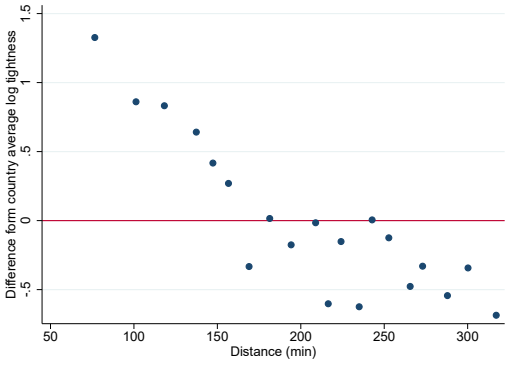
Figure 2.2: Proportion of Hungarian workers in Austria by municipality 2011-2015



Source: Schmieder (2019) p. 95. (Austrian Social Security Database)

The decreasing number of the Hungarian labour force resulted in rising labour market tightness. The difference between the district level and the country average tightness is the largest in districts close to the Austrian border. Tightness is higher than the country average in these districts (see Figure 2.3).

Figure 2.3: Deviation from the country average in tightness and distance from Austria (2011-2017)



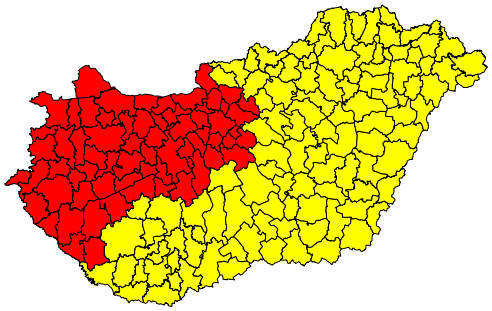
Note: binscatter. Source: NES.

[2]The LFS does not have a district level decomposition, it is not representative on this level, that is why I cannot use it as a key variable in my research.

The number of Slovak citizens has also been growing rapidly since the labour market opening in 2011. According to the Austrian Social Security database, the number of Slovak citizens, who worked in Austria was around 10 thousand at the beginning of 2011 and it tripled by the end of 2016 like in the Hungarian case.

There can be potential threats to the IV's validity. The distance from Austria is correlated with development since the more developed districts are in the western part of the country in Hungary (and in Slovakia as well). In the developed districts wages are also higher. Therefore, I have to control for development for which I use regional fixed effects. Another type of control is the number of selected districts for the estimation. In the main specification, not the whole country is included, only those districts, which are closer to Austria than 3 hours. This means that only the north-western districts are included (see Figure 2.4). These districts are more similar to each other in development than the rest of the country. In fact, they are the most developed regions of the country. The big development difference is between the east, northeast part of the country and these districts.

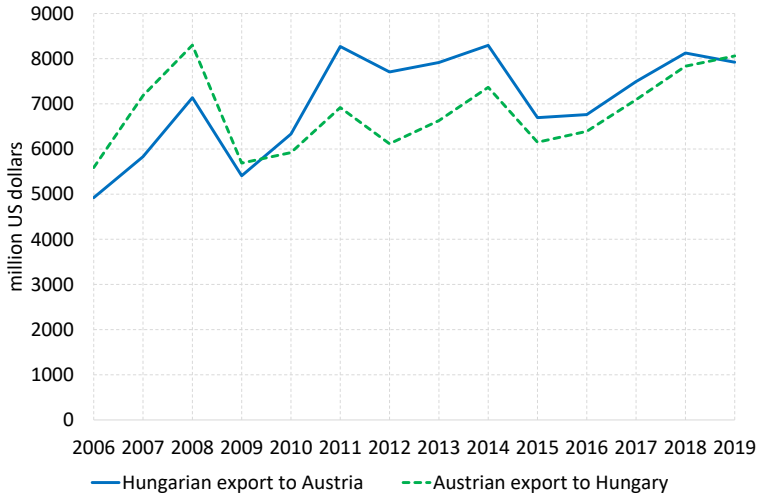
Figure 2.4: Districts included in the main specification



Red: included districts, yellow: not included districts.

Another threat could be that after 2011 the trade increased rapidly between Austria and Hungary, which can affect the Hungarian wages. The change after 2011 is not considerably larger than in any other change between 2006-2019 (see Figure 2.5). The boost in trade after 2009 is due to the recovery after the financial crisis. After Hungary joined the EU in 2004 every trade barrier was removed between the two countries so there has not been any administrative change on trade since then. Between 2006-2019 on average the share of Austrian exports to Hungary out of the total Austrian export was 3.1%, while the share of Hungarian exports to Austria out of the total Hungarian export was 5.6%. These shares did not change much during 2006-2019.

Figure 2.5: Trade between Hungary and Austria



Including goods and services. Source: UNCTAD.

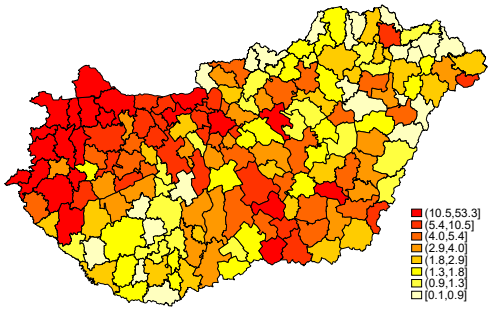
2.5 Estimation results

2.5.1 Description of the Hungarian data

There have been considerable changes in the Hungarian labour market since the financial crisis a decade ago. The number of unemployed has decreased significantly and vacancies have increased. On the other hand, these changes did not take place evenly across regions of the country. The western parts are characterised by a considerable labour shortage, while in the east the number of vacancies has not grown much. In the meantime, there have been other structural changes as well. In 2011 Austria (and other member states) opened its labour market to the recently joined EU-member states. The local labour market for those, who live close to the Austrian border, expanded a lot. This change exacerbated the labour shortage in the western parts of the country. Although the overall labour market situation seems to be improving, the spatial pattern has not changed much.

Calculating the tightness, I use data from the National Employment Service (NES). Both unemployment and vacancy statistics are available on a settlement level, so I could aggregate them to district (*járás*) level (Figure 2.6). There is a visible connection between tightness and private sector wages on district level (see Figure 2.6 and 2.8). There are 175

Figure 2.6: The logarithm of tightness on district level (2012)



Note: average district level tightness. Source: NES.

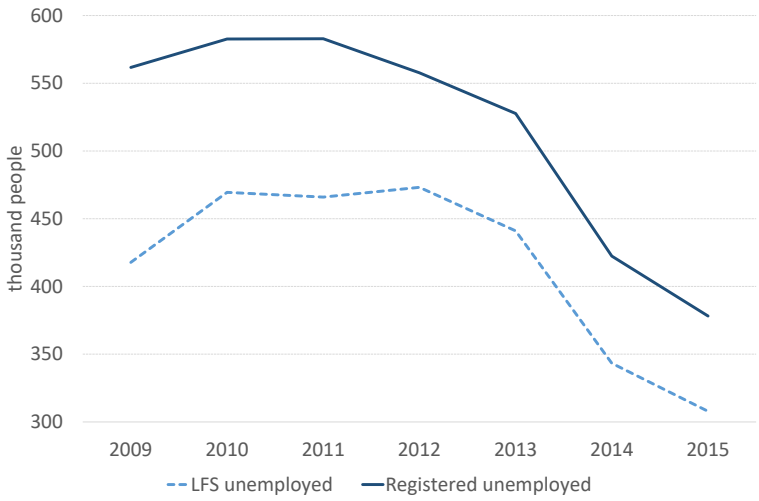
districts in Hungary, with the capital city considered as one district. It is monthly data, which I average annually. Firms must report their vacancies to the Employment Service, although there is no sanction if they do not do so. I use only non-subsidized vacancy data, as I would like to measure the effects of market forces (therefore, the vacancies of the public employment programme are excluded). The vacancies are available on a one-digit occupational level, which I can use to construct occupational level tightness.

The unemployment data is the number of those who have registered at the local job-centre. The highest education level of job seekers is available, which can be used when calculating the occupational level tightness (see the details of the calculations in Appendix B.1.2). The number of registered unemployed is not the same as those in the Central Statistical Office (KSH) reports using the ILO definition (LFS unemployment). On the other hand, the dynamics of the two time series are rather similar (see Figure 2.7). LFS unemployment is not available neither on a settlement nor on a district level. Therefore, for district level tightness I can use only the NES's data.

The outcome variable is the district-two digit occupational level average wage. The source of this data is the Hungarian State Treasury (MÁK) administrative dataset, which contains every individual, for whom the employer paid pension contribution. I averaged the private sector wages in every district two-digit occupational cell weighting by the employment time (see the calculation of the private sector wage in Appendix B.1.1). It gives 40 occupational categories per district on average. A district-occupational cell represents a small homogeneous labour market. By using them the idiosyncratic variation in individual wages averages out. The technical advantage is the considerably smaller data set, which implies faster calculation time.

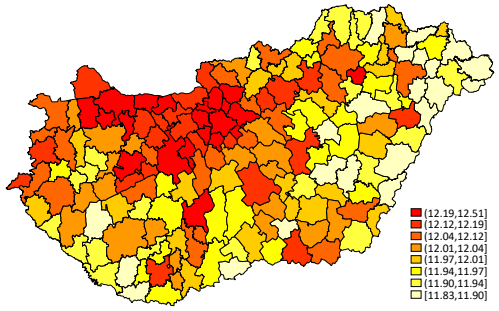
The distance from the Austrian border can be measured in several ways. I downloaded

Figure 2.7: The LFS and registered jobseekers



Source: NES and CSO.

Figure 2.8: Average log private sector gross wages on district level (2012)



the distance of the district capitals from Vienna and Graz (from the page rome2rio.com). It contains not only the distance in km but also in travelling time using different means of transport (car, train and bus). These are the two main cities not far from the Hungarian border. I defined the distance from the Austrian border as the minimum distance from these two cities by car using travelling time. It can be defined as the average of these distances or simply using only one city distance but these are highly correlated measures therefore it does not change the estimations significantly (see descriptive statistics in Table 2.1). For robustness check, I use different distance measures (see details in Appendix B.2).

Table 2.1: Summary statistics for districts in Hungary (2009-2017)

Variable	Mean	Std. Dev.	Min.	Max.
Tightness (%)	7.2	12.8	0.1	185.4
High skilled (%)	30.2	7.3	15.3	55.3
min(Vienna, Graz) time by car (min)	203.9	67.3	53	328
Population (thousand persons)	56.4	133.7	8.5	1759.4

Source: KSH, NFSZ, rome2rio.com.

2.5.2 Estimated equations

I estimate the following equations:

$$\ln(wage_{ijt}) = \beta_0 + \beta_1 \ln(tight_{ijt}) + \rho X + u_{ijt} \tag{2.2}$$

where

- i is the index for district-occupational cells,
- j is the index for districts,
- t is the year index,
- $wage_{ijt}$ is the average wage in private sector for district-two digit occupational cells (for the calculation details see Appendix B.1.1),
- $tight_{ijt}$ is the tightness for district - one digit occupational cells (for the calculation details see Appendix B.1.2),
- X other covariates (year and county FE's, share of high skilled in a district).

My main outcome variable is the private sector average wage in a given district-occupational cell. Since the tightness is endogenous in the wage equation I estimate the first stage as well.

The first stage is the following:

$$\ln(tight_{ijt}) = \alpha_0 + \alpha_1 dist_j + \alpha_2 post2011_t + \alpha_3 post2011_t \times dist_j + \delta X_{it} + v_{ijt} \tag{2.3}$$

where the variables are the following:

- X_{it} - other covariates (FE's, high skilled)
- $dist_j$ - distance from the Western border (in minutes by car)
- $post2011_t = 1$ if $year > 2010$, 0 otherwise.

In the literature, the wage equation almost always contains the level of education. I have this data from the 2011 Census, so it does not change over my sample period. The composition of the highest educational level changes slowly in a given district. There can be other types of important factors, which do not or only slowly change over time, e.g. the average experience level of workers. For these factors, one can include county level fixed effects as well.

I also include time fixed effects, as wages grow steadily over time. Since the regulations on the unemployment benefit are the same across the country and they usually change yearly, time fixed effects also capture the unemployment benefit, which is in Equation (2.1).

2.5.3 Main results

In the first stage equations, the coefficient of the $distance \times after2011$ variable is negative (see Table 2.3). This is intuitive since it means that the farther a district from Austria, the smaller the tightness after the opening of the Austrian labour market.

The coefficient of the tightness in the main specification means that if the tightness increase by 1% the wages grow by 0.08% (see Table 2.2). Therefore, if the tightness rises by 32% (average annual tightness growth rate between 2009-2017) the wages expand by 2.5%. This measure is considerable since the yearly average change in wages was 5.6% between 2009-2017.

2.5.4 Robustness checks

Apart from the main specification I make some robustness checks to see how stable the results are.

Firstly, I split the sample according to the one-digit occupational categories. In the case of white-collar occupations, there is only one category, where the coefficient of tightness is significant (Table 2.4). The magnitude is quite similar to the main specification. In other categories, the coefficient is close to zero and have large standard errors. Among the five blue-collar categories four has significant coefficient (Table 2.5). The magnitude of the

Table 2.2: Main IV specification

	(1)
VARIABLES	lnw
lntight	0.0794**
	(0.0344)
Observations	22,639
No. of district-occupational cells	2,830
Time horizon	2009-2017
County FE	Yes
Year FE	Yes
R-overall	0.13

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, the county and year FE. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table 2.3: First stage of the main IV specification

	(1)
VARIABLES	lnw
distance × after2011	-0.00794***
	(0.00156)
distance	-0.00274
	(0.00316)
Observations	22,639
No. of district-occupational cells	2,830
Time horizon	2009-2017
County FE	Yes
Year FE	Yes
R-overall	0.56
H_0 : distance × after2011=0	
χ^2	25.82
p-value	0.0000

The dependent variable is the log tightness in a district-one digit occupational cell. The independent variable is the distance from the Austrian border and its interaction with the after2011 dummy. Other covariates are the share of high skilled workers, the county and year FE. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

coefficients is also similar to the main specification. These results are not surprising since most of the Hungarians work in blue-collar occupations in Austria (see Figure 2.9). Of course, we do not know what kind of work they had in Hungary. There are rumours that white-collar Hungarians work in blue-collar jobs in Austria. This could be the reason for the one significant parameter among the white-collar categories.

Table 2.4: Robustness check for white-collar occupational categories

Occ. category	1	2	3	4
lntight	-0.00521	-0.00619	0.116**	0.0247
	(0.108)	(0.0799)	(0.0458)	(0.0206)
Observations	2,272	4,510	4,646	1,195
No. of dist.-occ. cells	275	522	521	155
Time horizon		2009-2017		
County FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Distance		< 180		
R-overall	0.31	0.22	0.27	0.77

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, county and year FE's. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Occupational categories: 1 Managers, 2 Professionals, 3 Technicians and associate professionals, 4 Office and management (customer services) occupations. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Secondly, I change the distance from the Austrian border. In these cases, the point estimates are quite similar to the main specification (Table 2.6).

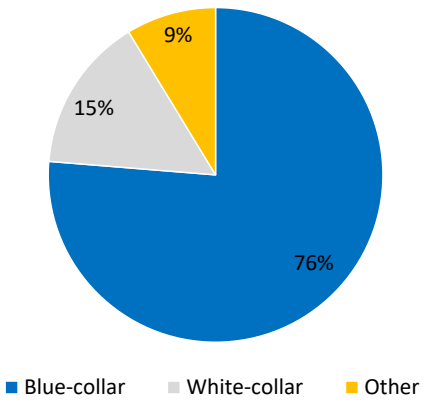
The difference between average wages can be due to a change in the composition of workers. To filter out this effect I recalculated the average wages from 2009 to 2017 using only those, who worked in 2009. The coefficient of tightness is quite similar to the main specification (Table 2.7) therefore composition effects can be ruled out.

Table 2.5: Robustness check for blue-collar occupational categories

Occ. category	5	6	7	8	9
lntight	-0.0221	0.0708**	0.126***	0.104***	0.0852***
	(0.0234)	(0.0350)	(0.0475)	(0.0311)	(0.0255)
Observations	1,304	1,323	3,501	2,233	1,655
No. of dist.-occ. cells	199	215	457	268	218
Time horizon			2009-2017		
County FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Distance			< 180		
R-overall	0.56	0.39	0.23	0.38	0.61

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, county and year FE's. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Occupational categories: 5 Commercial and services occupations, 6 Agricultural and forestry occupations, 7 Industry and construction industry occupations, 8 Machine operators, assembly workers, drivers of vehicles, 9 Elementary occupations not requiring qualification. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Figure 2.9: Hungarian workers' occupational categories in Austria (2015)



Source: Austrian Social Security Database. Other: civil servant, apprenticeship, marginal worker, werkvertrag/freier dienstvertrag.

Table 2.6: Robustness check with different distances

	(1)	(2)
lntight	0.0797	0.0596**
	(0.129)	(0.0234)
Observations	7,608	41,373
Number of district-occupational cells	948	5,159
Distance	< 120	< 240
Time horizon	2009-2017	
County FE	Yes	Yes
Year FE	Yes	Yes
R-overall	0.13	0.16

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, the county and year FE. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 120 and 240 minutes respectively. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Robustness check for those who worked in the private sector in 2009

	(1)
lntight	0.0742**
	(0.0341)
Observations	22,399
Number of district-occupational cells	2,823
Distance	< 180
Time horizon	2009-2017
County FE	Yes
Year FE	Yes
R-overall	0.16

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, the county and year FE. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. The average wages in each year are calculated for those, who were employed in 2009 in the private sector. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

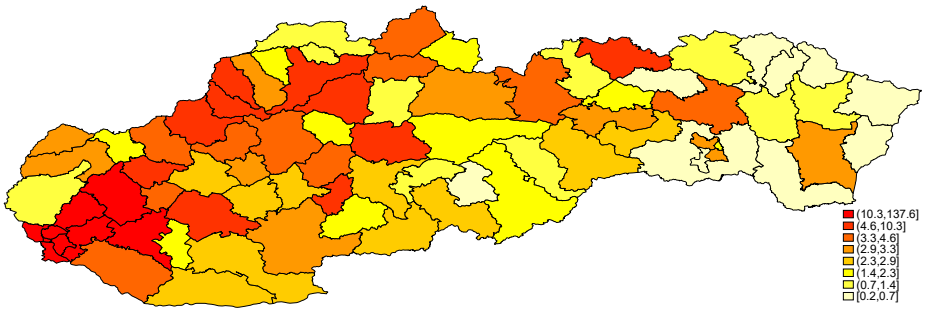
2.5.5 Robustness check using Slovakian data

It seems reasonable to check this IV setup in other countries. Slovakia joined the EU at the same time as Hungary, so the labour market opening affected the two countries at the same time. Moreover, it has got also a common border with Austria and the distance magnitudes between Vienna and Slovakian towns is similar to the Hungarian counterparts.

There were similar economic patterns in the case of Slovakia as in Hungary. The financial crisis hit the Slovakian economy severely, the GDP dropped by more than 5% in 2009. The number of unemployed rose significantly in 2009 and the increasing pace last for 2012. Since 2013 a considerable decline can be observed. The number of vacancies at the Central Office of Labour also decreased in 2009. This was also true for the job advertisements on the largest Slovakian job search portal. After some stagnation, the labour demand started increasing around 2013. The regional differences are notable in Slovakia as well. In the East and South-East parts of the country, the improvement in the labour market conditions was slower than in the Western part of the country. The opening of the Austrian labour market affected the country in the same way as Hungary.

As in the Hungarian case I use annual data, the available time span is between 2009 and 2017. For the unemployment, I use the registered unemployment data.

Figure 2.10: Tightness in Slovakia (2015)

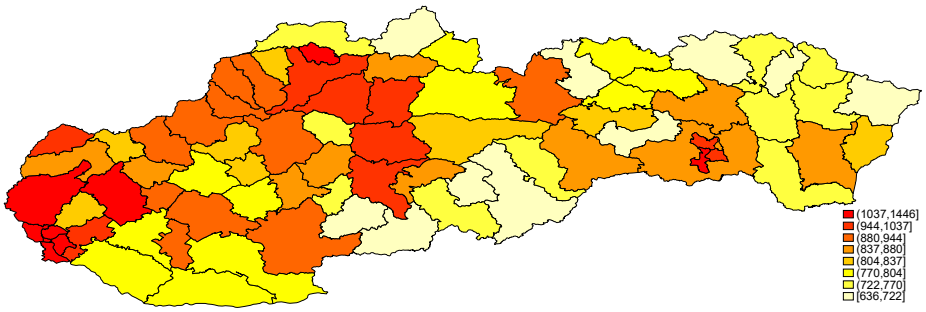


Source: own calculations based on ÚPSVaR and SOSR data

I created the district (*okres*) level vacancy data using two data sources. The district level vacancy data comes from the Central Office of Labour, Social Affairs and Family (*ÚPSVaR*). Unfortunately during the examined period, there were frequent undocumented changes to the vacancy data methodology so for time series purposes this data alone is not suitable. On the other hand, there is another vacancy data from the Statistical Office

of the Slovak Republic but this data is only on a regional level. I divided the regional vacancy data into districts using the weights coming from the first mentioned data source. In this way, I got district level vacancy numbers, which show the level, the dynamics and the spatial distribution as correctly as possible (see Figure 2.10).

Figure 2.11: Wages in Slovakia (2015)



Source: SOSR

Unfortunately, I did not find any occupational level wage data for district level on my sample period (see Figure 2.11). I consider the Slovakian example as a robustness check instead of a full analysis because there are several exercises, which I cannot perform on the Slovakian data (see descriptive statistics in Table 2.8).

The proportion of those who have higher education comes from the 2011 Census. The distances of the district capitals and Vienna are from the page rome2rio.com as in the case of Hungary.

Table 2.8: Summary statistics for Slovakia, 2009-2017

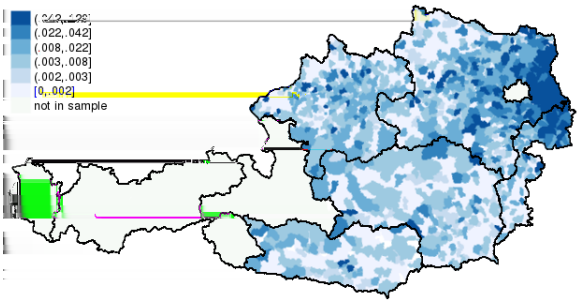
Variable	Mean	Std. Dev.	Min.	Max.
Wage (€)	818.9	177.2	465.6	1517
Tightness (%)	9.2	22.2	0	164.1
Distance from Vienna (min)	198.2	96.7	52	390
Population (thousand persons)	68.3	36.4	12.5	169.4

Note: summary statistics for districts. Source: SOSR, ÚPSVaR.

Figure 2.12 illustrates the validity of the IV in case of Slovakia. In Austria, the highest per cent of Slovak employees work along the border. This suggests that these workers commute from Slovakia to Austria (although there is no data on place of residence in the Austrian Social Security Database).

The sign of the estimated coefficients are the same as in the Hungarian case (see Table 2.9). On the other hand, the magnitude is somewhat larger, the coefficient is 0.33. This

Figure 2.12: Proportion of Slovak workers in Austria by municipality 2011-2015



Source: Schmieder (2019) p. 95. (Austrian Social Security Database)

Table 2.9: IV specifications for Slovakia

	(1)	(2)	(3)
	lnw	lnw	lnw
lntight	0.334***	0.229***	0.427**
	(0.125)	(0.0782)	(0.188)
Observations	378	171	468
Number of districts	42	19	52
Time horizon		2009-2017	
Region FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Distance	<180	<120	<240
R-overall	0.43	0.58	0.37

The dependent variable is the district level log private sector wage. The independent variable is the log tightness on the distric level. Other covariates are the share of high skilled workers, the region and year FE. The instrumental variable is the distance from the Austrian border and its interaction with the after2011 dummy. The sample contains those districts, for which the distance to Vienna is less than 180, 120 and 240 minutes respectively. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

means that in the case of a 1% increase in tightness the wage increases by 0.33%. The yearly average wage growth between 2009-2017 was 4%, the yearly average tightness growth was 7.1% during the same period. Although the coefficient is larger than in the Hungarian case using the yearly average wage and tightness growth the quantitative conclusion is the same. Namely, the tightness growth caused roughly one half of the wage increase during the sample period.

Since the available Slovakian data is not as detailed as the Hungarian I cannot do as many robustness checks as in the Hungarian case. I only checked how sensitive is the result to the change in the distance from the Austrian border. The results show that the tightness

parameter has larger changes if I increase the distance, the parameter also increases. This result is different from the Hungarian estimates. But one should take into account that the Slovakian data is not so rich, therefore the comparison can be done cautiously.

The results of the estimation exercise on Slovak data show that the effect of tightness on wages is similar to the Hungarian case. This suggests that tightness has got a similar impact on one of the most important components of cost-push inflation in both countries.

2.5.6 The results from policy perspective

From my paper, we learned that the labour market tightness has an effect on wages. There are several macro policies, where wages play a crucial role. I briefly demonstrate this in three examples. For instance, for the monetary policy, it is important to know how does labour market tightness affect wages because wages are one of the most important cost-push inflation factors. In this way, my results help to forecast inflation and conduct monetary policy in an inflation targeting framework.

Another important policy application is the planning of the state budget. The personal income tax is one major part of the state's income that is why wage dynamics are important in planning the budget. A higher level of tightness suggests higher personal income tax revenue. If the government wants to reform the personal income tax the future of wage dynamics helps to assess the possible impact of the policy change.

In GDP forecasting wages also play a crucial role. Wage dynamics is an important element of consumption forecasting, which is a major part of GDP. A reliable GDP forecast is an essential part of any kind of macro policy.

2.6 Summary

In this paper, I have analysed the effect of tightness on wages in two Central European countries. I used annual district level data to have variation across space and time. For the identification, I applied an instrumental variable method, since tightness is endogenous in the wage equation. My IV variable was the interaction of the distance between a district and the Austrian border and a time dummy. The Austrian labour market was fully opened to the new member states in 2011. This induced a negative labour supply shock both in Hungary and Slovakia. Since commuting is only a viable option for those who live close to the western border, my main specification includes those districts, which are close to the border. In this way districts with similar development level are in the sample. I concluded

that tightness has a positive effect on one of the main part of cost-push inflation in two Central European countries. In Hungary and Slovakia, this effect is significant and the coefficients are positive although somewhat different. For further research, it is worth examining whether my results are robust to other countries as well. It would be also interesting whether using other types of labour supply shocks can give similar estimations for the effect of tightness on wages.

10.14754/CEU.2021.05

Chapter 3

The Transmission of Ethnic Prejudice to Labour Market Discrimination - The Role of Small Firms

"I charge thee in the sight of God, and Christ Jesus, and the elect angels, that thou observe these things without prejudice, doing nothing by partiality."
Timothy 5:21

3.1 Introduction

Roma is Europe' largest and poorest ethnic minority and they are the largest minority in Hungary as well. According to raw data from 2011, the employment rate of the Roma population was lower by 38 percentage points than that of the non-Roma in Hungary. Previous results show that the lower educational level of the Roma and other easy-to-observe compositional differences account for a large part of the gap, but significant unexplained residual remains (Kertesi and Kézdi (2011)).

We take one step further in understanding how the residual gap evolves by exploiting a unique episode of Hungarian political history: the temporary rise of an openly anti-Roma far-right political party (*Jobbik*) around the general election of 2010. The appearance of Jobbik encouraged the public expression of negative judgments on the Roma; in a way,

it did not occur before and after[1]. Ample anecdotal evidence, case studies and survey data (Székelyi et al. (2001), Sík et al. (2016), Bernát (2018), Váradi (2014), Orosz et al. (2018), Kende et al. (2020)) suggest that prejudice and discrimination have always been present in the Hungarian labour market and the Hungarian society at large. Still, it proved practically impossible to measure their distribution across local communities. The rise of Jobbik brought a "moment of justice" when these differences became visible for a while. Therefore we use Jobbik's share in the 2010 popular votes as a proxy for anti-Roma bias in the populace of small geographical areas.

Our key hypothesis is that anti-Gypsyism in the workplace does not necessarily transmit to employer discrimination. Firm size matters. In small businesses, the owners have a stronger motivation to adapt to the racial preferences of the employees, and they also have a broader scope for action. Big firms may find it challenging to discriminate against minority applicants since their hiring process is more formal, and the risk of prosecution is higher. Others can join labour litigation, which is a severe reputation risk for a big company (Holzer (1998)). Large firms also use personal referrals less frequently than small ones (see Holzer (1987a), Burks et al. (2015), among others). In a small firm, interpersonal relations are more intense, and the hiring process is less formal. A small entrepreneur can easily make arbitrary hiring decisions based on characteristics other than the qualification and skills of the applicant. If the majority of insiders share racial bias, the employer is more likely to decide according to their preferences. Not to do so threatens with conflicts between members of the small staff, which can induce a decrease in productivity and profits. In big enterprises, a similar risk may be present on the level of one unit or another, but the effect on the entire firm is comparably lower. In brief, in a small firm, incumbent workers' aversion to minority applicants is more likely to transmit biased hiring decisions.

The scope for testing this hypothesis is limited by data availability. We exploited an episode of Hungary's recent political history when anti-Roma sentiments and open hate speech were encouraged and represented by a political party. Local support for this party was associated with a wider ethnic employment gap in (and only in) districts with a high share of small firms.

We find that popular votes for the Jobbik generated a wider gap if and only if, small firms had a high share in local employment. The employment gap is highest in local

[1]There has been a visible change in the communication of Jobbik since 2011. The party gradually got rid of its open anti-Roma rhetorics and relocated itself to the centre-right of the political landscape.

labour markets, where the proportion of small firms and the fraction of Jobbik voters are simultaneously high. If 30% of the votes went for Jobbik in 2010, and the share of small firms was 40% in a given district, the residual employment gap was 50% (or 11 percentage points) higher than the country average.

Becker (1971) predicts, if there are two similar factors of production, one is cheap, and the other is expensive, there will be entrepreneurs who would specialize in the cheaper one (minority workers) and, in the long run, this may equalize the prices. Relatively high minimum wages can set a barrier to this mechanism, but it can work to some extent. In the final part of this paper, we present an exercise, which shows that the Hungarian case is very far from what Becker predicts.

We contribute to the existing literature in several ways. First, our results draw attention to the importance of the local economy's composition, which helps or hinders the transmission of prejudice to employment discrimination. Second, we exploit a unique opportunity to measure the spatial heterogeneity of discriminatory practices across the country. Last but not least, we contribute to a better understanding of the social exclusion of the Roma, Europe's most significant ethnic minority.

The paper is organised as follows. In Section 3.2 we review the related literature. In Section 3.3 we present the key variables and data sources. The econometric specification can be found in Section 3.4. We carry out the estimation in Section 3.5. We discuss the results in Section 3.6.

3.2 Literature review

Following Becker (1971)'s seminal work about taste-based discrimination and Arrow (1972)'s critique of this approach, many empirical studies have been written about the ethnic and racial wage gaps (e.g. Smith (2000), Charles and Guryan (2008), Asali and Gurashvili (2020)). Our analysis looks at disadvantages in terms of employment: a problem that undoubtedly hits harder the Roma minority than wage discrimination. Kertesi and Kézdi (2011) (p. 582) found a small wage disadvantage (4% for male workers in 2007) using Hungarian data after controlling for education, age and residence.[2] Similar to this result,

[2]Studying the ethnic wage gap would be difficult for technical reasons anyway. On the one hand, data are scarce. On the other hand, due to their low educational level, most Roma workers earn around the minimum wage, similar to their low-educated non-Roma counterparts. After several hikes in the minimum

residual racial wage differences were found smaller than residual employment gap between French workers with French parents and French workers with at least one African parent, by Aeberhardt et al. (2010).

Research on the ethnic employment gap has so far been less intense. Several studies used field experiments, in which scholars sent resumes to firms with native and non-native names. They found that the applicants with native names get positive callbacks more frequently than those with non-native names (see e.g. Bertrand and Mullainathan (2004), Baert et al. (2015)). Dasgupta et al. (2020) conduct lab-in-field experiments to separate taste-based and statistical discrimination for Roma employees in Slovakia. They found that discrimination is common during the job application phase (extensive margin) and also in the workplace, in situations like promotions and wage offers (intensive margin). Furthermore, they also found extensive margin discrimination to be significantly stronger. During job applications, taste-based discrimination is more frequent. We add new insights to this literature by using a full Census database, which indeed covers all workers in Hungary.

Social network ties and their utilization can lead to ethnic employment gap as well. In earlier works authors argue (Granovetter (1973), Wilson (1987), Holzer (1987b), Elliott and Lindley (2008), Ioannides and Loury (2004)) that those, who are poor or belong to a discriminated minority get informal referrals less frequent because they have less strong social network connections. In a local labour market, where the share of firms, who use informal referrals more often, this factor is more relevant for minority job seekers. Newer literature has slightly different views. Pedulla and Pager (2019) find that black and white job applicants utilize their social networks at the same frequency but for blacks, this information channel works less often because they know significantly less appropriate referrers. This means that minority job seekers are less likely to hear about specific job openings through network-based (informal) than formal channels. Therefore if a firm relies more on informal channels during recruiting less information gets to minority workers. Small firms are more likely to use informal channels than large ones. Furthermore, Smith (2005) find evidence that minorities reluctant to pass on information about vacancies among low-income black Americans. Another type of literature finds that referrers tend to be same-race (Silva (2018)). For instance, 86 per cent of black and white workers who found their latest job through a personal contact in Boston, Los Angeles, and Atlanta used a same-race contact

wage, starting with 2001, the ethnic wage gap most probably disappeared.

(Green et al. (1999)).

Another strand of literature stresses the peculiarities of small firms in which interpersonal relations and personal contacts play a much bigger role than in larger firms (Holzer (1987a), Tanova (2003)). The employers of small firms use referrals more often than big companies. There are several reasons for this. Firstly, large firms "are expected to be more objective because of their large-scale organisation" (Baert et al. (2018)) and they use more standardised recruitment methods. Furthermore, since they have a larger HR department they can arrange a higher number of interviews so they rely less on statistical discrimination (Arrow (1972)). This fact also means that large companies have more information about the unobserved characteristics of the applicants so they know the true distribution more precisely (Baert et al. (2018)). There is empirical evidence of a negative association between firm size and hiring discrimination, for instance in Germany, Sweden, and the United Kingdom (Carlsson and Rooth (2007), Kaas and Manger (2012), and Wood et al. (2009)). On the other hand, Baert et al. (2018) does not find any evidence for an association between firm size ethnic discrimination in hiring. These empirical studies use correspondence testing, in which the targeted firms are located in just a few local labour markets or focus on a particular segment of the labour market. By reviewing a broader literature on discrimination, Lang and Kahn-Lang Spitzer (2020) also find that several studies deal with discrimination but their focus is narrowed to a certain group (e.g. employees at a given firm, participants of an experiment etc.). This makes it harder to draw a broader conclusion about discrimination in the labour market in general. In our study, we exploit the variation in the whole country to have a broader perspective on discrimination.

Discrimination is costly. Hedegaard and Tyran (2018) find that during the hiring process, prejudice has a significant impact, although it varies how costly it is. They used a field experiment in Denmark to find out whether employer decisions are affected by ethnicity during the hiring process if the productivity of the applicant is known. Their results suggest that animus-driven prejudice has a considerable effect, but the decision is also responsive to the price of discrimination (the difference in the productivity of minority and non-minority workers). A striking example of productivity-lowering effects of ethnic rivalries is provided by Hjort (2014) case study where team members belonging to different tribes were not willing to cooperate in a Kenyan plant. But other results also exist. Price et al. (2013) find that NBA players in the same team do not discriminate on the court based on race. They think this is due to employees (basketball players) work in a highly visible setting and they have strong incentives to cooperate efficiently.

3.3 Data and key variables

3.3.1 Data sources

Our main source is the Census, which covers the whole residential population of Hungary in October 2011. (See Table C.8 in Appendix for a full list of Census-based variables used in the estimations). In our estimations, we use mainly the Census. It has several advantages to use this data source. Firstly, since it covers the whole universe of the Hungarian population we can use it to analyse the research question in local labour markets. Furthermore, it is the most precise database of ethnicity. Moreover, it contains a large variety of control variables, which are strongly connected with the employment outcome (e.g. educational level).

We also use the 2010 parliamentary elections database. Since the administrative districts and the electoral districts differ from each other, we calculated the votes for party lists on the administrative district level.

To address the connection between partisanship and prejudices, we use several country-wide surveys. The primary source is the TÁRKI Omnibusz Survey, which covers 1000 persons representing the adult population of Hungary based on gender, age group, type of settlement, and educational level (TÁRKI (2019)).

In the following subsections, we introduce the most important variables used in the estimations.

3.3.2 Roma in Hungary

Roma people migrated from India to Europe around 700 years ago (Barany (2001)). Today they constitute the largest (and most impoverished) minority in the continent, the members of which are relatively easy to identify based on skin colour. According to Barany (2001), they account for 10% of the population in Slovakia and Bulgaria and 4-7% in Hungary, Macedonia, and Romania. Some of them speak a dialect of Romani, but they are typically fluent in the language of their country of residence. In Hungary, the vast majority speaks Hungarian as a mother tongue. The Hungarian Roma settled down for ages, and the idea that they are travellers is no more than a romanticized image (Kertesi and Kézdi (2011)).

The Census has two questions on the respondent's first and second ethnic identity. We considered someone as Roma if at least one of his/her ethnicity is Roma. The population share of Roma people based on these definitions amounted to 3.1%.

In the 1980s, the vast majority of the Roma males were steadily employed (Kertesi and Kézdi (2011)). Their employment ratio started to decline in the last years of the communist system and settled down at a low level after the economic transition (Table 3.2).

According to Kertesi and Kézdi (2011), the Roma employment gap amounted to about 40 percentage points for both men and women after the transition. The most crucial factor behind this difference is the low level of education of Roma people (Table 3.2). The significant drop in Roma employment was mostly explained by a general decline in the demand for low-skilled labour after the post-communist transition.

3.3.3 Sympathy for Jobbik and its relation to anti-Roma prejudice

The Hungarian electoral system is a mixed-voting one. The citizens have two votes: one for the constituency candidate and one for the party list. There were 176 constituencies that elected one member each. A further 146 seats were distributed proportionally to the popular votes (the party lists). There were 64 levelling seats, which is a compensatory tier of the system. Those votes counted here, which were cast to non-winning constituency candidates.

We use the popular votes to measure party preferences because voters take into account the personal qualities of the local candidate, not just the official communication of the nominator party. Therefore, the party lists can be considered as a more standardized "political product". Since the districts are not the same as the electoral districts, we recalculate the votes for party lists to the district level and divide the Jobbik's party list votes by the total party list votes. Jobbik won 16.67% of the popular votes in the 2010 general election (see the district level distribution on Figure C.2 in Appendix).

According to survey results from years around the 2010 elections (Table 3.1), Jobbik voters and sympathizers identified with offensive anti-Roma stereotypes more than the supporters of other parties.

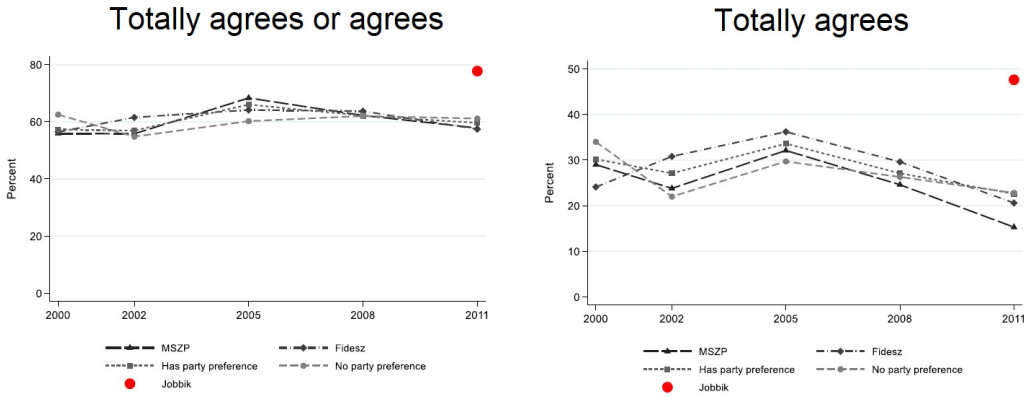
As shown in Figure 3.1, agreement with one of the harshest of these stereotypes ("Crime runs in the blood of Gypsies") was rather evenly distributed across party sympathy until 2008-2009. The distribution changed when Jobbik became widely known in the country. The outstanding role of the party as a magnet collecting prejudiced voters faded away after 2010, due to a gradual change in its communication. The period of the election and the Census thus provides a unique opportunity to approximate prejudice using electoral data.

Table 3.1: The prime-age (18-60 years) voters[a] attitudes towards Roma people by partisanship, (2009, 2011)

Prejudices question	The share of those, who agrees out of[b]	Apr-June 2009[c]	Apr-May 2011[d]
"The increase of Roma population endanger the safety of the society"	the non-voters, %	58	–
	the voters, %	61	–
	the a Jobbik-voters, %	88	–
	the a FIDESZ voters, %	62	–
	the MSZP voters, %	57	–
"Crime runs in the blood of Gypsies "	the non-voters, %	48	61
	the voters, %	48	58
	the a Jobbik-voters, %	67	77
	the a FIDESZ voters, %	48	54
	the MSZP voters, %	49	56
"It is favourable that there are still places of amusement, where Romas are not allowed to enter."	the non-voters, %	28	45
	the voters, %	31	48
	the a Jobbik-voters, %	52	67
	the a FIDESZ voters, %	31	45
	the MSZP voters, %	27	44

a Out of those 18-60 years old, who chose a party to cast vote to
b In the percentage of those, who answered the question (out of "no-reply" and "don't know" and chose "totally agree" and "somewhat agree" out of "totally disagree", "somewhat disagree", "somewhat agree" and "totally agree").
c Source: Tárki, Medián Választáskutatás, voting intetion. N = 1965
d Source: Tárki Omnibusz, voting intetion, two appended cross-sectional database, N = 2027

Figure 3.1: Crime runs in the blood of Roma – Agreement by party sympathy



Source: TÁRKI Omnibusz surveys.

3.3.4 Small firm density

We use two data sources to calculate the number of workers employed in small firms: the Business Register (*GSZR*) and the Wage Survey (*Bértarifa-felvétel*). The latter covers all firms above 20 employees on the establishment (site) level; therefore, district-level figures can be easily calculated. However, the Wage Survey includes only a random sample of firms with less than 20 employees, so we draw their data from the Business Register. We assume that enterprises with less than 20 employees have premises only in the district where they have their headquarters. Using these two data sources, we calculated the small firm proportion for 2011. We considered companies with at least 2 and less than 30 employees as small firms. The share of small-firm employees varies in a wide range across the country, with a mean of 31% and a standard deviation of 8%, (see Figure C.3 and C.4 in Appendix).

3.3.5 Hard-currency debts

At the beginning of the 2000s, state-supported mortgage loans for families became popular in Hungary. Since the financing of these loans was rather expensive for the state budget, the government gradually terminated the subsidy of this banking product. Parallel to the reduction of the government-supported program, low-interest foreign currency-denominated (FX) loans appeared in the supply of Hungarian banks. These loans were paid and had to be paid back in HUF, but the instalment changed according to the exchange rate. The most popular denomination was in CHF (97% of all loans), while the remainder was denominated in EUR and JYP. When the 2008 crisis reached Hungary, the HUF significantly depreciated against the main currencies, leading to a sharp increase of non-performing loans. In 2008, the NPL rate stood at 3% in the household sector. It rose to 11% by the end of 2011 (MNB (2012)). Household indebtedness amounted to 40% of the total GDP out of which FX-loans accounted for half of the total at the end of 2011 (MNB (2020)).

Saving the debtors was a vital message of Jobbik in the election campaign. The party emphasized the responsibility of the banks and urged a solution to the increased burden of debtors (payment relief, debt restructuring). Given the possibility that there is a two-way relationship between the ethnic employment gap and sympathy for the extreme right-wing, we instrument the votes on Jobbik with the degree of indebtedness of the local population – a factor that contributed to the rising popularity of the party. According to Gyöngyösi and Verner (2018), Jobbik successfully used the credit-debtor conflict to attract voters. They showed that a ten percentage points unanticipated debt-to-income shock raised the vote

share of the far-right by 2.1 percentage points between 2006 and 2010. This marginal effect explained one-fifth of the rise in the far-right vote share. The authors experimented with alternative explanations for the boom in the far-right votes (extremist attitudes, different exposure to minorities and immigrant groups, foreign currency debtors' naiveté etc.) but did not find any significant result. They concluded that the unanticipated exchange rate shock and the indebtedness in foreign currencies was one of the main factors of the increased popularity of the Jobbik in the 2010 elections.

We have data on the amount of foreign currency-denominated debt of individuals from the BISZ Central Credit Information Plc. The FX-loans are converted to HUF on the 31 December 2012 middle exchange rate. We use the total debt to population ratio as an IV variable. The mean of the total loan per population is HUF 85 thousand and the standard deviation is HUF 44 thousand. (See more on the descriptives in Table C.9 in the Appendix.)

3.3.6 Local labour markets

There are 175 districts (*járás*) in Hungary, which can be considered as local labour markets. According to the commuting data of the Census 2011, on average 85% of the employees in a district live in the same district, apart from the agglomeration of Budapest, where this value is 72%.

3.3.7 Sample restrictions

There is an enormous difference between Roma and non-Roma people based on educational level and labour market activity (Table 3.2 and Figure C.1 in Appendix). The population pyramid is also different: the average age and the life expectancy is lower among the Roma population than among the non-Roma (see Figure C.5 and C.6 in Appendix).

From our analysis, we exclude people with high school, bachelor's, or master's degree. We have chosen this restriction because of the tiny number of Roma people who hold general secondary or higher educational attainment. Among the 15-60 years old Roma people those, who have a high school or higher degree is 6.5%, while in the non-Roma population it is 54%. We restrict the sample to those 15-60 years old. Following the ILO-OECD definition, we considered employed those who worked at least one hour a week before the reference date of the Census. In this way, informal employment is also used because the question about labour market status is the same in the Census as in the LFS. We

Table 3.2: Labour market status and educational attainment of the Hungarian population of prime-age (15-60 years old) by ethnicity

	Non-Roma	Roma
labour market status %		
Employed	65	27
Unemployed	9	22
Not in the labour force	26	51
Total	100	100
Educational attainment %		
Incomplete primary	1	20
Completed primary	18	60
Vocational secondary	27	14
General secondary	34	5
College or higher	20	1
Total	100	100

Source: Census 2011.

restricted the attention to dependent employment, that is, excluding the self-employed, fostered workers (participated in the public work scheme), helping family members and casual workers.

3.4 Econometric specifications and simulation

3.4.1 IV estimation

We estimate the following linear probability model:

$$\begin{aligned} e_{ij} = \beta_1 r_{ij} + \beta_2 r_{ij} \cdot V_j + \beta_3 r_{ij} \cdot S_j + \\ + \beta_4 r_{ij} \cdot V_j \cdot S_j + \theta_j + X_{ij}\gamma + u_{ij} \end{aligned} \tag{3.1}$$

where

- i is the individual, j is the district (*járás*),
- e_{ij} is the employment status of the individual (1 if employed, 0 otherwise),
- r_{ij} is the Roma nationality dummy (1 if Roma, 0 otherwise),
- V_j is the votes for Jobbik in district j (proportion of total votes),

- S_j is the proportion of employed people in small firms (with 2-30 employees),
- θ_j district FE,
- X_{ij} are the individual level controls; and
- u_{ij} is the error term.

We estimate the linear probability models separately for men and women. According to our hypothesis, the labour market discrimination against the Roma people is high in those districts, where the proportion of votes cast to Jobbik is high and the small firm employment share is also large. We expect a negative and significant β_4 parameter.

The OLS estimation can suffer from endogeneity bias: the vote share of Jobbik can be high because the employment rate of Roma people is low in a given district. For those who believe that Roma people do not like to work, the employment gap yields a justification and a motivation to join the extreme right-wing. To overcome this issue, we instrument the vote share of Jobbik with FX indebtedness, which is measured by the total debt to population ratio. FX indebtedness is measured at the local labour market, therefore we do not measure the individual level connection between indebtedness and Jobbik vote share, rather our IV is a measure for contextual and individual level effect, which cannot be separated (Gyöngyösi and Verner (2018)). Our IV measures a local average fear from a drop in economic and living conditions. Simonovits et al. (2019) find that in the last two general elections local economic conditions had a substantial effect on incumbent support. This was especially strong during the 2010 election, which was right after the Great Recession. They found that the "effect of local unemployment is unlikely to be explained by an aggregation of dissatisfaction among the unemployed". We choose FX indebtedness as an IV (and not another economic variable) because this has the strongest relation to Jobbik, due to the party's communication before the elections and this measure overcome the reverse causality.

The main threat to the identification can be that foreign indebtedness is correlated with some naivité of the population and that might again be correlated with the stance against minorities. This is the violation of the exclusion restriction, which is also addressed by Gyöngyösi and Verner (2018). They write: "Foreign currency debtors' naiveté presents another concern, and we use several proxy variables to control for this possibility. Foreign currency debtors might be more gullible than domestic currency borrowers. They might be more easily convinced to choose foreign currency denominations, and they are also more easily influenced by populists. Using individual level survey we first show that foreign

currency debtors and local currency debtors are similar in terms of observable characteristics, which is in line with the literature analyzing foreign currency borrowing. We also use several zip code level proxies for naiveté, and find that the results are robust to the inclusion of these control variables." (Gyöngyösi and Verner (2018), p. 3.)

In the IV setting, we estimate the first stage for every variable, where the vote share of Jobbik is present, i.e. $r_{ij} \cdot V_j$ and $r_{ij} \cdot S_j \cdot V_j$. These first stage equations are the following:

$$r_{ij} \cdot V_j = +\alpha_1 r_{ij} \cdot L_j + \delta_1 r_{ij} \cdot S_j \cdot L_j + \theta_j + X_{ij}\gamma_1 + u_{ij} \tag{3.2}$$

$$r_{ij} \cdot S_j \cdot V_j = \alpha_2 r_{ij} \cdot L_j + \delta_2 r_{ij} \cdot S_j \cdot L_j + \theta_j + X_{ij}\gamma_2 + u_{ij} \tag{3.3}$$

where

- L_j is the total debt to population ratio in district j.

The second stage is Equation (1).

Fist stage equations are presented in the Appendix Table C.12. The own instruments ($r_{ij} \cdot L_j$ for $r_{ij} \cdot V_j$ and $r_{ij} \cdot S_j \cdot L_j$ for $r_{ij} \cdot S_j \cdot V_j$) are strong and significant for both men and women. The F-statistics are high and significant. Alternative first stage estimation can be found in Appendix C.1.3.

3.4.2 Simulation

Based on the parameter estimates in the IV second stage, we calculated the predicted employment probability differences for those Jobbik-small firm bins, which are above the mean. For the Jobbik vote share these bins are 20-25%, 25-30% and for small firm shares (20-30%, 30-40%, 40-50%). (See the cross-plot of Jobbik vote shares and small firm proportion in Appendix Figure C.7).

$$P(emp|X, Roma = 1) - P(emp|X, Roma = 0) = \beta_1 + \beta_2 V_j + \beta_3 S_j + \beta_4 V_j \cdot S_j \tag{3.4}$$

Using this probability difference (Equation 4) we show the difference in the employment probability between a Roma and a non-Roma person with the same demographic and socioeconomic attributes. Based on our hypothesis, the difference should grow with a simultaneous increase in the support for Jobbik and the share of small firms.

3.5 Results

Table 3.3: The linear employment probability model age 15-60, without high school, estimated by IV

	Men	Women
Roma	-0.504**	-0.785***
	(0.245)	(0.197)
Roma × Vote	1.435	2.646***
	(1.167)	(0.933)
Roma × Small	1.613*	2.129***
	(0.889)	(0.634)
Roma × Vote × Small	-8.439**	-9.909***
	(4.275)	(2.995)
Observations	1,222,154	945,335
R-squared	0.179	0.149
Controls	YES	YES
District FE	YES	YES
IV F-stat (R × V)	238.5	253.3
IV F-stat (R × V × S)	241.5	330.5

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
IV: foreign currency debt/population in a district.
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 3.3 the parameter of β_4 is negative and significant as we expect. The interaction term cannot be interpreted in itself. As the share of Jobbik votes and the small firm proportion increases the gap between the Roma and non-Roma employment also grows. If the small firm share is larger at a given prejudices level then more employers will be sensitive to the insider employees' prejudice. The employers try to avoid economic loss due to ethnic conflicts at the firm therefore the Roma workers' employment probabilities are worse. Examining from the other direction if the prejudices level is higher at a given small firm share then more employers can expect higher prejudices from insider workers, which leads to worse employment probabilities for Roma people.

In Table 3.4 the rows show the vote shares of Jobbik; the columns show small firm proportions. We calculate the employment gap for those bins, which contain at least 5

observations (districts). The calculated differences are significant. The employment gap increases if the small firm proportion grows at a given Jobbik vote share. Similarly, the gap widens as the Jobbik vote share grows at a given level of small firm density. At the country average level of Jobbik vote and small firm share the employment gap is -23 percentage point. This is the average difference between the employment probability of Roma and non-Roma who work in the same local labour market has the same education level and are similarly based on other observable factors. If we fix the small firm share and increase the Jobbik vote share the employment probability for Roma is getting lower (the columns of Table 3.4 shows this direction). If the Jobbik vote share is fixed and we calculate the employment gap for districts, where the small firm share is larger, we get a wider employment gap for Roma employees (rows of Table 3.4). The largest employment gap is 34 percentage points, which is larger by 47 percentage or 11 percentage points than the country average. This verifies our hypothesis, namely that small firm proportion and Jobbik vote share together can lead to lower employment probabilities for Roma. The results for women shows a smaller difference from the country average but the pattern is the same (see Table C.13 in Appendix).

Table 3.4: The predicted employment gaps of Roma men depending on small firms and Jobbik votes in the district

			Small firm proprtoion		
			20-30%	30-40%	40-50%
Vote share of Jobbik	20-25%	Estimate	-0.25	-0.28	-0.30
		Sd. error	(0.01)	(0.02)	(0.03)
	25-30%	Estimate	-0.29	-0.34	–*
		Sd. error	(0.03)	(0.04)	

*Less than 5 districts in the cell.
The predicted national average employment gap is -.23 at the average district value of Jobbik (18.8%) and the average district small firm employment share (31.2%).
Age 15-60, without a high school or college/university attainment, comparing to non-Roma men with similar individual attributes, IV method.
District level clustered standard errors in parentheses.

Our results would be probably different if labour was in short supply. In the time of the Census (September 2011), there was not a considerable labour shortage in Hungary. On the other hand, if the timing of the whole paper would be in e.g. 2019 it is possible that we could get smaller gaps.

3.6 Discussion

We find that a higher share of prejudiced people in the community is conducive to a broader employment gap between the majority and the minority in local economies, where prejudice more easily transmits to discrimination. The resulting burden on Roma employment is heavy. Still, it could be lighter if some employers would 'specialize' on minority workers enforced to lower their reservation wages in response to their little chance of finding a job. As Becker (1971) predicts, if there are two similar factors of production, one is cheap, and the other is expensive, there will be entrepreneurs who purchase the cheaper one and, at the end of the day, equalize the prices.

Relatively high minimum wages in Hungary (a Kaitz index of 49.8% in 2011)[3] set a barrier to this mechanism, but it can work to some extent. We try to find its traces within the limits of data availability. While we have no data on ethnic composition within enterprises, we can measure the degree of segregation on the level of industry-settlement cells (two-digit industry code and more than 3100 settlements), which can be considered as the best approximation of an enterprise based on available data.

We first calculate an exposure index (ERN) using the following formula:

$$ERN_j = \sum_{i=1}^{I_j}(1 - r_{ij})\frac{R_{ij}}{R_j}, \text{ so that } 0 \leq ERN_j \leq 1 - r_j, \tag{3.5}$$

where

- i is the firm (settlement-sector cell), j is the district,
- I_j is the number of firms in area j,
- R_{ij} is the number of Roma workers in firm i area j,
- R_j is the number of Roma workers in area j,
- r_{ij} is the fraction of Roma workers among all workers in firm i area j,
- r_j is the fraction of Roma workers among all workers in area j,
- $(1 - r_{ij})$ is the fraction of non-Roma workers among all workers in firm i area j,

[3]Fazekas et al. (2013), p. 392.

- $(1 - r_j)$ is the fraction of non-Roma workers among all workers in area j.

The ERN of Roma workers to non-Roma workers measures the chance of an average (randomly chosen) Roma worker in area j for working with a non-Roma worker. Formally, ERN_j is equal to the fraction of non-Roma workers in settlement-sector cell averaged over firms, where the average is taken with weights that are equal to the share of the firm in the Roma employment of the area (see Kertesi and Kézdi (2013), pp. 27. for an application to school segregation in Hungary).

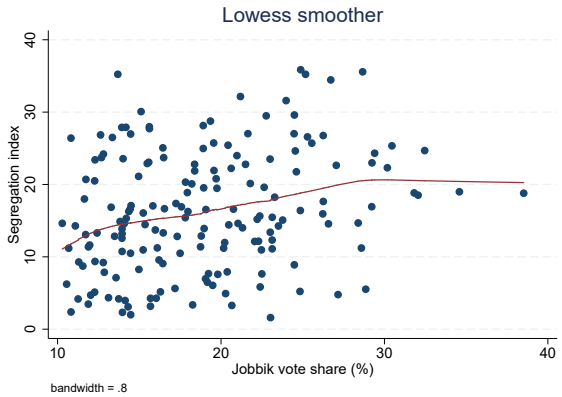
The minimum value of the exposure index is zero. In this case, no contact is possible between Roma and non-Roma workers within a firm because the employees in all firms are either all-Roma (when $(1 - r_{ij}) = 0$) or all-non-Roma (when $r_{ij} = 0$). ERN has its maximum when the fraction of Roma employees in each firm is equal to their fraction in the district's population, i.e. $r_{ij} = r_j \ \forall i$ in j.

A drawback of the exposure index is that its value depends on the overall fraction of minority workers in the area; therefore it can hardly be used to compare regions. Normalization yields a segregation index with values between 0 and 1:

$$S_j = \frac{(1 - r_j) - ERN_j}{1 - r_j}, \text{ so that } 0 \leq S_j \leq 1. \tag{3.6}$$

Higher levels of the index indicate higher levels of segregation. Intuitively, the segregation index shows the fraction of contact possibilities that are made impossible by separation. The maximum of S_j is one when the ERN is zero.

Figure 3.2: Segregation index and Jobbik vote shares by district and locally weighted regression



We calculate the segregation index for each district. There is a positive relationship

between Jobbik vote shares and the segregation index (see Figure 3.2), suggesting that the hypothesis of more substantial separation in response to more substantial prejudice cannot be excluded. Nevertheless, we are very far from an equilibrium in which the employment probabilities are equalized.

Based on our results one policy action can be some kind of subsidy for small firms if they employ Roma people. This policy can result in a twofold outcome. Not only the Roma employment can increase but also it is a possibility to moderate prejudices due to the real-life experience of working with Roma. In a more diverse workplace environment, Roma and non-Roma ethnicity can work together and mutual fears can dissolve (see Allport (1954)).

A second policy action can be the support of Roma people to increase their educational level. For those who are below compulsory school age, extra attention is needed at schools or special scholarships can incentivise pupils to learn harder. For those, who are above 18 years special programmes are necessary to support their studies to get a profession.

3.7 Conclusion

Composition effects can explain a significant part of the employment gap between Roma and non-Roma people in Hungary. We looked at the remaining part, assuming that in an environment overshadowed by prejudice, incumbent majority workers will dislike having Roma colleagues. The fear of conflicts may result in discriminatory hiring practices even on the part of non-prejudiced employers. Such an outcome is more likely in small firms, where the manager knows the workers personally, is aware of their preferences, and the firm-level cost of dissatisfaction or quit of a few workers is higher. The scope for testing this hypothesis is limited by data availability. We exploited a unique episode of Hungary's recent political history when anti-Roma sentiments were encouraged and represented by a political party. Our results show that if both small firm share and prejudices are large in a local labour market the size of the employment gap is almost 50% higher than the country average.

10.14754/CEU.2021.05

Bibliography

Aeberhardt, Romain, Julien Pouget, Denis Fougere, and Roland Rathelot (2010, 06). Wages and employment of french workers with african origin. *Journal of Population Economics 23*, 881–905.

Albrecht, James, Gerard J. van den Berg, and Susan Vroman (2005, February). The Knowledge Lift: The Swedish Adult Education Program That Aimed to Eliminate Low Worker Skill Levels. IZA Discussion Papers 1503, Institute of Labor Economics (IZA).

Allport, Gordon W (1954). *The nature of prejudice*. Addison-Wesley Publishing Company.

Altonji, Joseph G. and David Card (1991, January). The Effects of Immigration on the Labor Market Outcomes of Less-skilled Natives. In *Immigration, Trade, and the Labor Market*, NBER Chapters, pp. 201–234. National Bureau of Economic Research, Inc.

Angelucci, Manuela and Giacomo De Giorgi (2009, March). Indirect effects of an aid program: How do cash transfers affect ineligibles' consumption? *American Economic Review 99*(1), 486–508.

Angrist, Joshua D. and Adriana D. Kugler (2003, June). Protective or counter-productive? labour market institutions and the effect of immigration on eu natives. *Economic Journal 113*(488), 302–331.

Anosova, Daria, Konstantin Sonin, Alf Vanags, and Anna Zasova (2013, June). Structural or Cyclical? Unemployment in Latvia Since the 2008-09 Financial Crisis. CEPR Discussion Papers 9525, C.E.P.R. Discussion Papers.

Antczak, Elzbieta, Ewa Galecka-Burdziak, and Robert Pater (2016, May). Spatial labour market matching. Working Papers 2016-009, Warsaw School of Economics, Collegium of Economic Analysis.

Arni, Patrick, Rafael Lalive, and Jan C. van Ours (2013). How effective are unemployment benefit sanctions? looking beyond unemployment exit. *Journal of Applied Econometrics 28*(7), 1153–1178.

Arrow, Kenneth J. (1972). Some mathematical models of race discrimination in the labor market. In A. H. Pascal (Ed.), *Racial Discrimination in Economic Life*, NBER Chapters, pp. 187–204. Lexington, MA: D.C. Heat.

Arulampalam, Wiji (2001). Is unemployment really scarring? effects of unemployment experiences on wages. *The Economic Journal 111*(475), F585–F606.

Asali, Muhammad and Rusudan Gurashvili (2020). Labour market discrimination and the macroeconomy. *Economics of Transition and Institutional Change 28*(3), 515–533.

Ashenfelter, Orley (1987). The case for evaluating training programs with randomized trials. *Economics of Education Review 6*(4), 333–338.

Attanasio, Orazio, Peter Levell, Hamish Low, and Virginia Sánchez-Marcos (2018). Aggregating elasticities: Intensive and extensive margins of women's labor supply. *Econometrica 86*(6), 2049–2082.

Aydemir, Abdurrahman and George Borjas (2007). Cross-Country Variation in the Impact of International Migration: Canada, Mexico, and the United States. *Journal of the European Economic Association 5*(4), 663–708.

Azam, Mehtabul (2012, May). The Impact of Indian Job Guarantee Scheme on Labor Market Outcomes: Evidence from a Natural Experiment. IZA Discussion Papers 6548, Institute of Labor Economics (IZA).

Azam, Mehtabul, Céline Ferré, and Mohamed Ihsan Ajwad (2012, July). Did Latvia's Public Works Program Mitigate the Impact of the 2008-2010 Crisis? IZA Discussion Papers 6772, Institute of Labor Economics (IZA).

Baert, Stijn, Bart Cockx, Niels Gheyle, and Cora Vandamme (2015, 05). Is there less discrimination in occupations where recruitment is difficult? *Industrial and Labor Relations Review 68*, 467–500.

Baert, Stijn, Ann-Sofie Meyer, Yentl Moerman, and Eddy Omey (2018, 06). Does size matter? hiring discrimination and firm size. *International Journal of Manpower 39*.

Bakó, Tamás, Zsombor Cseres-Gergely, Judit Kálmán, György Molnár, and Tibor Szabó (2014). People at the edge of the labour market and the budget (A munkaerőpiac peremén lévők és a költségvetés). Mta-kti, MTA-KTI.

Barany, Zoltan (2001). *The East European Gypsies: Regime Change, Marginality, and Ethnopolitics*. Cambridge University Press.

Becker, Gary S. (1957 [1971]). *The Economics of Discrimination*. Economic Research Studies. University of Chicago Press.

Beegle, Kathleen, Emanuela Galasso, and Jessica Goldberg (2017). Direct and indirect effects of malawi's public works program on food security. *Journal of Development Economics 128*, 1 – 23.

Benedek, Dóra, Péter Elek, and János Köllő (2015). Tax avoidance, tax evasion, black and grey employment. In *The Hungarian Labour Market 2013*, pp. 161–184. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Berg, Erlend, Sambit Bhattacharyya, Durgam Rajasekhar, and Ramachandra Manjula (2018). Can public works increase equilibrium wages? Evidence from India's National Rural Employment Guarantee. *World Development 103*(C), 239–254.

Bergemann, Annette, Laura Pohlan, and Arne Uhlendorff (2017). The impact of participation in job creation schemes in turbulent times. *Labour Economics 47*(C), 182–201.

Bernát, Anikó (2018, 12). A magyarországi romák társadalmi integrációja a 2010-es években (the integration of hungarian roma during the 2010's). In *Társadalmi riport (Social Report)*, pp. 144–165. TÁRKI Társadalomkutatási Intézet.

Bertrand, Marianne and Sendhil Mullainathan (2004, September). Are emily and greg more employable than lakisha and jamal? a field experiment on labor market discrimination. *American Economic Review 94*(4), 991–1013.

Betcherman, Gordon, N. Meltem Daysal, and Carmen Pagés (2010). Do employment subsidies work? evidence from regionally targeted subsidies in turkey. *Labour Economics 17*(4), 710–722.

Bíró, Anikó, Dániel Prinz, and László Sándor (2020). Tax evasion and the minimum wage. *HAS CERS IE Working Paper 2020/43*.

Blanchflower, David G. and Andrew J. Oswald (1995, December). *The Wage Curve*, Volume 1 of *MIT Press Books*. The MIT Press.

Blanchflower, David G. and Andrew J. Oswald (2005, May). The Wage Curve Reloaded. NBER Working Papers 11338, National Bureau of Economic Research, Inc.

Blundell, Richard, Monica Costa Dias, Costas Meghir, and John van Reenen (2004). Evaluating the employment impact of a mandatory job search assistance program. *Journal of the European Economic Association 2*(4), 569–606.

Bodnár, Katalin and Lajos Tamás Szabó (2014, August). The Effect of Emigration on the Hungarian Labour Market. MNB Occasional Papers 2014/114, Magyar Nemzeti Bank (Central Bank of Hungary).

Boheim, Rene and Mark P. Taylor (2002, December). The search for success: do the unemployed find stable employment? *Labour Economics 9*(6), 717–735.

Booth, Alison L. and Pamela Katic (2011). Estimating the wage elasticity of labour supply to a firm: What evidence is there for monopsony?*. *Economic Record 87*(278), 359–369.

Borjas, George J. (2003). The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market. *The Quarterly Journal of Economics 118*(4), 1335–1374.

Borjas, George J. (2005). *Labor Economics*. McGraw-Hill/Irwin.

Botello-Peñaloza, Héctor Alberto (2021, March). Wage Inequality of Venezuelan Migrants in Ecuador. *The Indian Journal of Labour Economics 64*(1), 115–132.

Boustan, Leah Platt, Price V. Fishback, and Shawn Kantor (2010). The effect of internal migration on local labor markets: American cities during the great depression. *Journal of Labor Economics 28*(4), 719–746.

Bördős, Katalin (2015). The institutional and legislative context of public works schemes: a historical overview. In *The Hungarian Labour Market 2015*, pp. 67–77. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Brollo, Fernanda, Katja Maria Kaufmann, and Eliana La Ferrara (2020, 05). Learning Spillovers in Conditional Welfare Programmes: Evidence from Brazil. *The Economic Journal 130*(628), 853–879.

Burks, Stephen, Bo Cowgill, Mitchell Hoffman, and Michael Housman (2015). The value of hiring through employee referrals. *The Quarterly Journal of Economics 130*(2), 805–839.

Cahuc, Pierre, Stéphane Carcillo, and André Zylberberg (2014, December). *Labor Economics, second edition*, Volume 1 of *MIT Press Books*. The MIT Press.

Caliendo, Marco, Reinhard Hujer, and Stephan L. Thomsen (2005, March). The Employment Effects of Job Creation Schemes in Germany: A Microeconometric Evaluation. IZA Discussion Papers 1512, Institute of Labor Economics (IZA).

Calmfors, Lars and Anders Forslund (1991). Real-wage determination and labour market policies: The swedish experience. *The Economic Journal 101*(408), 1130–1148.

Calmfors, Lars and Harald Lang (1995, 05). Macroeconomic Effects of Active Labour Market Programmes in a Union Wage-Setting Model. *The Economic Journal 105*(430), 601–619.

Calonico, Sebastian, Matias D. Cattaneo, Max H. Farrell, and Rocío Titiunik (2017). Rdrobust: Software for regression-discontinuity designs. *The Stata Journal 17*(2), 372–404.

Calonico, Sebastian, Matias D. Cattaneo, and Rocío Titiunik (2014). Robust data-driven inference in the regression-discontinuity design. *The Stata Journal 14*(4), 909–946.

Card, David (2001). Immigrant inflows, native outflows, and the local labor market impacts of higher immigration. *Journal of Labor Economics 19*(1), 22–64.

Card, David, Jochen Kluve, and Andrea Weber (2017, 10). What works? a meta analysis of recent active labor market program evaluations. *Journal of the European Economic Association 16*.

Card, David and Alan B. Krueger (1994, October). A Living Wage? The Effects of the Minimum Wage on the Distribution of Wages, the Distribution of Family Earnings, and Poverty. Working Papers 712, Princeton University, Department of Economics, Industrial Relations Section.

Card, David and Ethan G. Lewis (2007, January). The Diffusion of Mexican Immigrants During the 1990s: Explanations and Impacts. In *Mexican Immigration to the United States*, NBER Chapters, pp. 193–228. National Bureau of Economic Research, Inc.

Carlsson, Magnus and Dan-Olof Rooth (2007). Evidence of ethnic discrimination in the swedish labor market using experimental data. *Labour Economics 14*(4), 716–729.

Charles, Kerwin Kofi and Jonathan Guryan (2008). Prejudice and wages: An empirical assessment of becker's the economics of discrimination. *Journal of Political Economy 116*(5), 773–809.

Chioda, Laura, João M.P. De Mello, and Rodrigo R. Soares (2016). Spillovers from conditional cash transfer programs: Bolsa família and crime in urban brazil. *Economics of Education Review 54*, 306 – 320.

Christian, Sikandra, Alain de Janvry, Daniel Egel, and Elisabeth Sadoulet (2015, January). Quantitative Evaluation of the Social Fund for Development Labor Intensive Works Program (LIWP). Department of Agricultural & Resource Economics, UC Berkeley, Working Paper Series qt2s5230h2, Department of Agricultural & Resource Economics, UC Berkeley.

Connolly, Helen and Peter Gottschalk (2009, November). Do earnings subsidies affect job choice? The impact of SSP subsidies on job turnover and wage growth. *Canadian Journal of Economics 42*(4), 1276–1304.

Cseres-Gergely, Zsombor and György Molnár (2014). Közmunka, segélyezés, elsődleges és másodlagos munkaerőpiac (Public work, transfers, primary and secondary labour market). In Tamás Kolosi and István György Tóth (Eds.), *Társadalmi Riport (Social Report)*, pp. 204–225. TÁRKI Társadalomkutatási Intézet Zrt.,.

Csáfordi, Zsolt (2014). The wage curve in Hungary from the viewpoint of inactivity. Master's thesis, Central European University, Budapest.

Csoba, Judit and Zita Éva Nagy (2012). The evaluation of training, wage subsidy and public works programs in Hungary. In Károly Fazekas and Gábor Kézdi (Eds.), *The Hungarian Labour Market 2012*, pp. 96–123. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Daly, Mary C., Bart Hobijn, Aysegül Sahin, and Robert G. Valletta (2012, Summer). A Search and Matching Approach to Labor Markets: Did the Natural Rate of Unemployment Rise? *Journal of Economic Perspectives 26*(3), 3–26.

Dasgupta, Utteeyo, Subha Mani, Joe Vecci, and Tomáš Želinský (2020, March). Game of Prejudice – Experiments at the Extensive and Intensive Margin. GLO Discussion Paper Series 499, Global Labor Organization (GLO).

Delteil, Violaine, Ariane Pailhe, and Dominique Redor (2004, September). Comparing individual wage determinants in Western and Central Europe: on the way to convergence? The cases of France and Hungary. *Journal of Comparative Economics 32*(3), 482–499.

Demekas, Dimitri G. and Zenon G. Kontolemis (2000, July). Government Employment and Wages and Labour Market Performance. *Oxford Bulletin of Economics and Statistics 62*(3), 391–415.

Diamond, Peter (2011, June). Unemployment, vacancies, wages. *American Economic Review 101*(4), 1045–72.

Dustmann, Christian, Francesca Fabbri, and Ian Preston (2005). The impact of immigration on the british labour market. *The Economic Journal 115*(507), F324–F341.

Dustmann, Christian, Tommaso Frattini, and Ian P. Preston (2012, 04). The Effect of Immigration along the Distribution of Wages. *The Review of Economic Studies 80*(1), 145–173.

Dustmann, Christian, Tommaso Frattini, and Anna Rosso (2015, April). The Effect of Emigration from Poland on Polish Wages. *Scandinavian Journal of Economics 117*(2), 522–564.

Dustmann, Christian, Uta Schönberg, and Jan Stuhler (2016, November). The impact of immigration: Why do studies reach such different results? *Journal of Economic Perspectives 30*(4), 31–56.

Dustmann, Christian, Uta Schönberg, and Jan Stuhler (2017). Labor supply shocks, native wages, and the adjustment of local employment. *The Quarterly Journal of Economics 132*(1), 435–483.

Edo, Anthony and Hillel Rapoport (2019). Minimum wages and the labor market effects of immigration. *Labour Economics 61*, 101753.

Eichler, Martin and Michael Lechner (2002, April). An evaluation of public employment programmes in the East German State of Sachsen-Anhalt. *Labour Economics 9*(2), 143–186.

Elliott, Robert J. R. and Joanne K. Lindley (2008, June). Immigrant wage differentials, ethnicity and occupational segregation. *Journal of the Royal Statistical Society Series A 171*(3), 645–671.

Escudero, Verónica (2016). Workfare programmes and their impact on the labour market effectiveness of Construyendo Perú. Technical report.

Escudero, Verónica, Jochen Kluve, Elva López Mourelo, and Clemente Pignatti (2019, December). Active Labour Market Programmes in Latin America and the Caribbean: Evidence from a Meta-Analysis. *Journal of Development Studies 55*(12), 2644–2661.

Faberman, R. Jason and Guido Menzio (2018). Evidence on the relationship between recruiting and the starting wage. *Labour Economics 50*(C), 67–79.

Fazekas, Károly, Péter Benczúr, and Álmos Telegdy (Eds.) (2013). *The Hungarian Labour Market 2013*. Number 2013 in The Hungarian Labour Market Yearbooks. Institute of Economics, Centre for Economic and Regional Studies.

Fazekas, Károly and Gábor Kézdi (2012, July-Dece). *The Hungarian Labour Market 2012*. Number 2012 in The Hungarian Labour Market Yearbooks. Institute of Economics, Centre for Economic and Regional Studies.

Fletcher, Jason and Ryne Marksteiner (2017, November). Causal spousal health spillover effects and implications for program evaluation. *American Economic Journal: Economic Policy 9*(4), 144–66.

Galasso, Emanuela and Martin Ravallion (2004). Social Protection in a Crisis: Argentina's Plan Jefes y Jefas. *The World Bank Economic Review 18*(3), 367–399.

Gehrke, Esther and Renate Hartwig (2018). Productive effects of public works programs: What do we know? what should we know? *World Development 107*, 111 – 124.

Girma, Sourafel, Yundan Gong, Holger Görg, and Sandra Lancheros (2015). Estimating direct and indirect effects of foreign direct investment on firm productivity in the presence of interactions between firms. *Journal of International Economics 95*(1), 157 – 169.

Gramlich, Edward M. (1976). Impact of Minimum Wages on Other Wages, Employment, and Family Incomes. *Brookings Papers on Economic Activity 7*(2), 409–462.

Granovetter, Mark S. (1973). The strength of weak ties. *American Journal of Sociology 78*(6), 1360–1380.

Green, Gary, Leann Tigges, and Daniel Diaz (1999, 06). Racial and ethnic differences in job-search strategies in atlanta, boston, and los angeles. *Social Science Quarterly 80*, 263–278.

Gyöngyösi, Győző and Emil Verner (2018, February). Financial Crisis, Creditor-Debtor Conflict, and Political Extremism. VfS Annual Conference 2018 (Freiburg, Breisgau): Digital Economy 181587, Verein für Socialpolitik / German Economic Association.

Hall, Robert E. and Paul R. Milgrom (2008, September). The limited influence of unemployment on the wage bargain. *American Economic Review 98*(4), 1653–74.

Harmon, Nikolaj Arpe (2013, 2). Are workers better matched in large labor markets? Working paper.

Heckman, James J., V. Joseph Hotz, and Marcelo Dabos (1987, August). Do We Need Experimental Data To Evaluate the Impact of Manpower Training On Earnings? *Evaluation Review 11*(4), 395–427.

Heckman, James J, Lance Lochner, and Christopher Taber (1998, May). General-Equilibrium Treatment Effects: A Study of Tuition Policy. *American Economic Review 88*(2), 381–386.

Hedegaard, Morten Størling and Jean-Robert Tyran (2018, January). The price of prejudice. *American Economic Journal: Applied Economics 10*(1), 40–63.

Heinrich, Carolyn, Peter Mueser, Kenneth Troske, Kyung-Seong Jeon, and Daver Kahvecioglu (2013, December). Do Public Employment and Training Programs Work? *IZA Journal of Labor Economics 2*(1), 1–23.

Hjort, Jonas (2014). Ethnic divisions and production in firms. *The Quarterly Journal of Economics 129*(4), 1899–1946.

Hofer, Helmut, Gerlinde Titelbach, Rudolf Winter-Ebmer, and Alexander Ahammer (2017, June). Wage Discrimination Against Immigrants in Austria? *LABOUR 31*(2), 105–126.

Holzer, Harry J. (1987a, March). Hiring Procedures in the Firm: Their Economic Determinants and Outcomes. NBER Working Papers 2185, National Bureau of Economic Research, Inc.

Holzer, Harry J. (1987b, June). Informal Job Search and Black Youth Unemployment. *American Economic Review 77*(3), 446–452.

Holzer, Harry J. (1998, 09). Why do small establishments hire fewer blacks than larger ones? *Journal of Human Resources 33*, 896–914.

Hujer, Reinhard, Uwe Blien, Marco Caliendo, and Christopher Zeiss (2006, October). Macroeconometric Evaluation of Active Labour Market Policies in Germany. A Dynamic Panel Approach Using Regional Data. In Floro Ernesto Caroleo and Sergio Destefanis (Eds.), *The European Labour Market. Regional Dimensions*, AIEL Series in Labour Economics, Chapter 14, pp. 287–309. AIEL - Associazione Italiana Economisti del Lavoro.

Imbert, Clément and John Papp (2015, April). Labor market effects of social programs: Evidence from india's employment guarantee. *American Economic Journal: Applied Economics 7*(2), 233–63.

Ioannides, Yannis M. and Linda Datcher Loury (2004, December). Job information networks, neighborhood effects, and inequality. *Journal of Economic Literature 42*(4), 1056–1093.

Jacobsen, Joyce P. (1992). Spillover effects from government employment. *Economics Letters 39*(1), 101–104.

Jacobson, Louis S, Robert J LaLonde, and Daniel G Sullivan (1993, September). Earnings Losses of Displaced Workers. *American Economic Review 83*(4), 685–709.

Jaenichen, Ursula and Gesine Stephan (2007, 07). The effectiveness of targeted wage subsidies for hard-to-place workers. *Applied Economics 43*.

Kaas, Leo and Christian Manger (2012). Ethnic discrimination in germany's labour market: A field experiment. *German Economic Review 13*(1), 1–20.

Kende, Anna, Márton Hadarics, Bigazzi Sara, Mihaela Boza, Jonas Kunst, Nora Anna Lantos, Barbara Lasticova, Anca Minescu, Monica Pivetti, and Ana Urbiola (2020, 05). The last acceptable prejudice in europe? anti-gypsyism as the obstacle to roma inclusion. *Group Processes Intergroup Relations 24*, 388–410.

Kertesi, Gábor and János Köllő (1997, October). The Birth of the Wage Curve in Hungary, 1989-1995. William Davidson Institute Working Papers Series 104, William Davidson Institute at the University of Michigan.

Kertesi, Gábor and János Köllő (1999, June). Unemployment, Wage Push and the Labour Cost Competitiveness of Regions - The Case of Hungary, 1986-1996. Budapest Working Papers on the Labour Market 9905, Institute of Economics, Centre for Economic and Regional Studies.

Kertesi, Gábor and Gábor Kézdi (2011). Roma employment in hungary after the post-communist transition. *Economics of Transition and Institutional Change 19*(3), 563–610.

Kertesi, Gábor and Gábor Kézdi (2013). Ethnic segregation between hungarian schools: Long-run trends and geographic distribution. *Hungarian Statistical Review Special number 16*, 18–45.

Kőrösi, Gábor (2005). *A versenyszféra munkapiacának működése (The Operation of the Labour Market in the Private Sector)*. MTA Közgazdaságtudományi Intézet.

Köllő, János (2009). *A pálya szélén Iskolázatlan munkanélküliek a posztszocialsita gazdaságban (On the Edge of the Labour Market Uneducated Unemployed in the Post-socialist Economy)*. Osiris Kiadó.

Köllő, János (2015). Public workers in the legal labour market. In *The Hungarian Labour Market 2015*, pp. 112–119. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Kálmán, Judit (2015). The background and international experiences of public works programmes. In *The Hungarian Labour Market 2015*, pp. 42–59. Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Kluve, Jochen (2016). A review of the effectiveness of active labour market programmes with a focus on latin america and the caribbean. Research Department Working Paper 9, International Labour Office.

Kluve, Jochen, David Card, Michael Fertig, Marek Góra, Lena Jacobi, Peter Jensen, Reelika Leetmaa, Leonhard Nima, Eleonora Patacchini, Sandra Schaffner, Christoph Schmidt, Bas Klaauw, and Andrea Weber (2007, 01). *Active labor market policies in Europe: Performance and perspectives*. Springer-Verlag Berlin Heidelberg.

Koltai, Luca, Katalin Bördős, Judit Csoba, Bálint Herczeg, Eszter Hamza, Boldizsár Megyesi, Nándor Németh, Katalin Rácz, Dorottya Szabó, Mónika Váradi, Eszter Varga, and Tünde Virág (2018). A közfoglalkoztatás hatása a helyi gazdaságra, helyi társadalomra (The Effect of Public Work on the Local Economy and Local Society). Technical report.

Kopasz, Marianna and András Gábos (2018). A segélyezési rendszer 2015. március 1-jei átalakításának hatásai (the effect of the 1 march 2015 social subsidy reform). Technical report, TÁRKI.

KSH (2010). *Magyarország 1989 - 2009 A változások tükrében (Hungary 1989-2009 In the Scope of Changes)*. Központi Statisztikai Hivatal (Central Statistical Office).

KSH (2011). *Hungarian Standard Classification of Occupations (HCSO-08/FEOR-08)*. Hungarian Central Statistical Office.

KSH (2014, December). Statistical Reflections. *Labour Market Trends, 2014Q1-Q3, Hungarian Central Statistical Office*.

Kulinyi, Márton (2013). *Közfoglalkoztatási ismeretek. Módszertani kézikönyv gyakorlati és elméleti alkalmazóknak (Public Employment Fundamentals. Methodology Guidebook for Theoretical and Practical Users)*. Esély Labor Egyesület, Budapest.

Lacroix, Robert and François Dussault (1984). The spillover effect of public-sector wage contracts in canada. *The Review of Economics and Statistics 66*(3), 509–512.

LaLonde, Robert J. (1986). Evaluating the econometric evaluations of training programs with experimental data. *The American Economic Review 76*(4), 604–620.

Lamo, Ana, Javier J. Pérez, and Ludger Schuknecht (2012). Public or private sector wage leadership? an international perspective*. *The Scandinavian Journal of Economics 114*(1), 228–244.

Lang, Kevin and Ariella Kahn-Lang Spitzer (2020, May). Race discrimination: An economic perspective. *Journal of Economic Perspectives 34*(2), 68–89.

Langa, Malose, Juliana Tappe Ortiz, Palesa Mataboge, Vicky Talbot, and Buyisile Mncina (2019). Global Comparative Analysis of Public Employment Programmes: Strengths and limitations. Technical report.

Layard, Richard, Stephen Nickell, and Richard Jackman (1991). *Unemployment: Macroeconomic Performance and the Labour Market*. Number 9780198284345 in OUP Catalogue. Oxford University Press.

Leduc, Elisabeth and Ilan Tojerow (2020). Subsidizing domestic services as a tool to fight unemployment: Effectiveness and hidden costs. IZA Discussion Papers 13544, Institute of Labor Economics (IZA).

Lee, David S. and Thomas Lemieux (2010, June). Regression discontinuity designs in economics. *Journal of Economic Literature 48*(2), 281–355.

Lee, Myoung-jae and Sang-jun Lee (2005). Analysis of job-training effects on korean women. *Journal of Applied Econometrics 20*(4), 549–562.

Levine, Phillip B. (1993). Spillover effects between the insured and uninsured unemployed. *Industrial and Labor Relations Review 47*(1), 73–86.

Levinsohn, James and Margaret McMillan (2011, 10). Globalization and poverty: Does food aid harm the poor? household evidence from ethiopia. *NBER Book Chapters*.

Longhi, Simonetta (2020, June). Does geographical location matter for ethnic wage gaps? *Journal of Regional Science 60*(3), 538–557.

Marinescu, Ioana and Ronald Wolthoff (2020). Opening the Black Box of the Matching Function: The Power of Words. *Journal of Labor Economics 38*(2), 535–568.

McKenzie, David, Caroline Theoharides, and Dean Yang (2014, April). Distortions in the international migrant labor market: Evidence from filipino migration and wage responses to destination country economic shocks. *American Economic Journal: Applied Economics 6*(2), 49–75.

Mód, Péter (2013). Az aktív foglalkoztatáspolitikai eszközök fontosabb létszámadatai 2013-ban (The Relevant Employment Figures of Active Labour Market Policies in 2013). Technical report, Nemzeti Munkaügyi Hivatal, Kutatási és Elemzési Főosztály, Budapest.

Mishra, Prachi (2007). Emigration and wages in source countries: Evidence from mexico. *Journal of Development Economics 82*(1), 180–199.

MNB (2012, April). Report on Fiscal Stability. Technical report, Central Bank of Hungary.

MNB (2020). Financial accounts (financial assets and liabilities of institutional sectors).

Modestino, Alicia, Daniel Shoag, and Joshua Ballance (2016). Downskilling: changes in employer skill requirements over the business cycle. *Labour Economics 41*(C), 333–347.

Molnár, György, Tamás Bakó, Zsombor Cseres-Gergely, Judit Kálmán, and Tibor Szabó (2014). A munkaerőpiac peremén lévők és a költségvetés (On the Edge of the Labour Market and the State Budget). Technical report, MTA KRTK KTI.

Monras, Joan (2020). Immigration and wage dynamics: Evidence from the mexican peso crisis. *Journal of Political Economy 128*(8), 3017–3089.

Montgomery, James D. (1991). Social networks and labor-market outcomes: Toward an economic analysis. *American Economic Review 81*(5), 1407–18.

Montgomery, James D. (1992). Job search and network composition: Implications of the strength-of-weak-ties hypothesis. *American Sociological Review 57*(5), 586–596.

Mortensen, Dale T. (1982, December). Property Rights and Efficiency in Mating, Racing, and Related Games. *American Economic Review 72*(5), 968–979.

Mouw, Ted (2003, 12). Social capital and finding a job: Do contacts matter? *American Sociological Review 68*, 868.

Muehlemann, Samuel and Mirjam Strupler Leiser (2018). Hiring costs and labor market tightness. *Labour Economics 52*(C), 122–131.

Mueller, Andreas I., Damian Osterwalder, Josef Zweimüller, and Andreas Kettemann (2018, October). Vacancy Durations and Entry Wages: Evidence from Linked Vacancy-Employer-Employee Data. NBER Working Papers 25118, National Bureau of Economic Research, Inc.

Muralidharan, Karthik, Paul Niehaus, and Sandip Sukhtankar (2020, Apr). General equilibrium effects of (improving) public employment programs: Experimental evidence from india. *Econometrica (forthcoming)*.

Nobilis, Benedek (2011, 01). Labor market tightness and individual wage dynamics in Hungary. Technical report.

O'Leary, Christopher J. (1997). A net impact analysis of active labour programmes in hungary. *Economics of Transition and Institutional Change 5*(2), 453–484.

Orosz, Gábor, Emile Bruneau, Linda Tropp, Nora Sebestyen, István Tóth-Király, and Beáta Bőthe (2018, 03). What predicts anti-roma prejudice? qualitative and quantitative analysis of everyday sentiments about the roma. *Journal of Applied Social Psychology 48*.

Ortego-Marti, Victor (2017, September). The Cyclical Behavior Of Unemployment And Vacancies With Loss Of Skills During Unemployment. *Macroeconomic Dynamics 21*(6), 1277–1304.

Pedulla, David and Devah Pager (2019, 11). Race and networks in the job search process. *American Sociological Review 84*.

Pissarides, Christopher (2000). *Equilibrium Unemployment Theory* (2 ed.). The MIT Press.

Price, Joseph, Lars Lefgren, and Henry Tappen (2013). Interracial workplace cooperation: Evidence from the nba. *Economic Inquiry 51*(1), 1026–1034.

Roshchina, Ekaterina (2016). *Essays on Job Search and Labor Market Dynamics*. Ph. D. thesis, Department of Economics Duke University.

Schmieder, Julia (2019, May). *Essays in labor and demographic economics*. Ph. D. thesis, Freien Universität, Berlin, Germany.

Shimer, Robert (2005, March). The cyclical behavior of equilibrium unemployment and vacancies. *American Economic Review 95*(1), 25–49.

Sianesi, Barbara (2008). Differential effects of active labour market programs for the unemployed. *Labour Economics 15*(3), 370 – 399.

Silva, Fabiana (2018, 12). The strength of whites' ties: How employers reward the referrals of black and white jobseekers. *Social Forces 97*, 741–768.

Simonovits, Gábor, Sean Kates, and Blanka Szeitl (2019, 06). Local economic shocks and national election outcomes: Evidence from hungarian administrative data. *Political Behavior 41*.

Sík, Endre, Bori Simonovits, and Blanka Szeitl (2016, 08). Az idegenellenesség alakulása és a bevándorlással kapcsolatos félelmek magyarországon és a visegrádi országokban (the xenophobia and fear from immigration in hungary and the visegrád countries). *REGIO 24*, 81.

Smirnykh, L. and E. Polaykova (2020). Income and the integration of migrants in the Russian labour market. *Journal of the New Economic Association 47*(3), 84–104.

Smith, Sandra S. (2000). Mobilizing social resources: Race, ethnic, and gender differences in social capital and persisting wage inequalities. *The Sociological Quarterly 41*(4), 509–537.

Smith, Sandra S. (2005, 07). "Don't put my name on it": Social Capital Activation and Job-Finding Assistance among the Black Urban Poor. *American Journal of Sociology 111*, 1–57.

Stewart, Mark B. (2007). The interrelated dynamics of unemployment and low-wage employment. *Journal of Applied Econometrics 22*(3), 511–531.

Székelyi, Mária, Antal Örkény, and György Csepeli (2001). Romakép a mai magyar társadalomban (roma image in nowadays' hungarian society). *Szociológiai Szemle 11*(3), 19–46.

Tanova, Cem (2003, 04). Firm size and recruitment: Staffing practices in small and large organisations in north cyprus. *Career Development International 8*, 107–114.

Tcherneva, Pavlina R. (2013). Beyond full employment: What argentina's plan jefes can teach us about the employer of last resort. In M.J. Murray and M. Forstater (Eds.), *Employment Guarantee Schemes*, pp. 79–102. Palgrave Macmillan, New York.

Telegdy, Álmos (2018). Public wage spillovers: The role of individual characteristics and employer wage policies. *Labour Economics 55*, 116–129.

TÁRKI (2019). The TÁRKI Omnibus Survey. Technical report, TARKI Social Research Institute.

van Ours, Jan C. (2004). The locking-in effect of subsidized jobs. *Journal of Comparative Economics 32*(1), 37 – 55.

Verme, Paolo and Kirsten Schuettler (2021). The impact of forced displacement on host communities: A review of the empirical literature in economics. *Journal of Development Economics 150*(C).

Vodopivec, Milan (1999). Does the slovenian public work program increase participants' chances to find a job? *Journal of Comparative Economics 27*(1), 113 – 130.

Váradi, Luca (2014, 01). *Youths Trapped in Prejudice: Hungarian Adolescents' Attitudes Towards the Roma*. Springer VS.

Welch, Finis (1979, October). Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust. *Journal of Political Economy 87*(5), 65–97.

Wilson, William Julius (1987). *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy*. Chicago: University of Chicago Press.

Wodon, Quentin (2012). *Poverty and the Policy Response to the Economic Crisis in Liberia*. The World Bank.

Wood, Martin, Jon Hales, Susan Purdon, Tanja Sejersen, and Oliver Hayllar (2009). A test for racial discrimination in recruitment practice in British cities . Technical report.

Wray, L. Randall, Stephanie A. Kelton, Pavlina R. Tcherneva, Scott Fullwiler, and Flavia Dantas (2018). Public Service Employment: A Path to Full Employment Program. Technical report.

Zimmermann, Laura V. (2012, September). Labor Market Impacts of a Large-Scale Public Works Program: Evidence from the Indian Employment Guarantee Scheme. IZA Discussion Papers 6858, Institute of Labor Economics (IZA).

Zimmermann, Laura V. (2020, 04). Why guarantee employment? evidence from a large indian public-works program. Technical report.

Zweimüller, Josef and Rudolf Winter-Ebmer (2003, December). On-the-job-training, job search and job mobility. *Swiss Journal of Economics and Statistics 139*(IV), 563–576.

10.14754/CEU.2021.05

Appendix A

Appendix for Chapter 1

A.1 Database description

The database of the Hungarian State Treasury (MÁK) contains the full population, who had at least one-day of legal work between 1997-2017. The following variables are used in the study:

- district level place of residence,
- the wage,
- the type of employment (e.g. self-employed, entrepreneur, employee, public worker etc.),
- four-digit occupational code (FEOR),
- weekly hours worked,

The database also contains if someone gets some kind of subsidy from the government. Based on this I can identify the unemployed. The name and conditions of the unemployment benefit changed from year to year. I considered those as unemployed, who get some kind of unemployment benefit from the government. On the other hand, this is not exactly the same group of people, who are unemployed according to the ILO definition. The difference is those people, who do not get any subsidy but look for a job. I consider those as inactive, who do not work and do not get any unemployment benefit.

A.1.1 Variable generation: private sector full-time equivalent average wage

To calculate the average wages I selected those individuals, who had any kind of employment on 30th April in every year (between 2009-2017). In this way, I can overcome the seasonality issues. The Hungarian administrative database contains everyone, after whom the employer pays the pension contributions. This means that every type of employment is included (e.g. part-time job, self-employment etc.). Since there are many individuals, who have several types of jobs, I choose the highest wage for everyone. I calculated the district-two digit occupational cell full-time-equivalent wage for every year using the highest wage for each individual. There are 175 districts in Hungary (the capital is counted as one district). There are on average 40 two-digit occupational categories per district.

A.1.2 Time period selection

The public workers can be separated in the database from September 2011. Since I choose April 30th in every year to check the individuals' employment status and wage, the first year, when a used-to-be public worker can work in the private sector is in 2013. That is why the pre-treatment period is between 2009-2012 and the after-treatment period is 2013-2017. I do not want to include years before the great recession because it created big turbulences in the labour market and it is out of the scope of this paper.

A.1.3 The variables used for complex indicator

The ingredients of the complex indicator (based on *290/2014. Korm. rendelet*):

I. Indicators of the social and demographic situation:

Urbanity/rurality index (what proportion of the population of the given district lives in settlements with a population density of more than 120 people / km^2) (%),

Mortality rate (number of deaths per thousand inhabitants, average of the last five years)

Migration difference per thousand inhabitants (average of the last five years, persons)

Number of beds providing nursery care and daycare services per ten thousand permanent residents aged 0-2 (pcs),

The proportion of recipients of regular child protection benefits from the permanent population aged 0-24 (%),

Number of people receiving active care (regular social assistance and employment replacement support) per thousand permanent residents,

II. Indicators of housing and living conditions:

Average price of used flats (HUF),

Proportion of dwellings built during the last five years out of the housing stock at the end of the period (%),

Proportion of dwellings without comfort (inhabited) out of inhabited dwellings (%),

The income forming the PIT base per permanent resident (thousand HUF),

Number of age-weighted passenger cars operated by persons per thousand inhabitants (pcs),

Life expectancy at birth - men (years),

Life expectancy at birth - women (years),

III. Local economy and labour market indicators:

Proportion of those aged 18 and over with at least a high school (%),

Proportion of registered jobseekers in the working age permanent population (annual average %),

Proportion of permanently - at least 12 months - registered job seekers out of the permanent working age population (%),

Proportion of registered job seekers with no more than primary school (%),

Number of operating enterprises per thousand inhabitants (pcs),

Number of retail stores per thousand inhabitants (pcs),

Proportion of local tax revenues of local governments from current year revenues (%),

IV. Infrastructure and environmental indicators:

Proportion of dwellings connected to the public sewerage network (%),

Proportion of dwellings involved in the regular waste collection (%),

Number of broadband internet subscribers per thousand inhabitants (pcs),

Proportion of roads built out of all municipal roads (%).

A.2 Regulations on the PW

Based on Act CVI of 2011 on the Modification of the Acts on Public Employment and Related to Public Employment and Other Acts public employers can be:

- local and national municipalities and their legal entity associations,

- budgetary organisations (such as water directorates, forest management organisations, national parks),
- churches,
- organisations with non-profit legal status,
- civil organisations,
- business associations entrusted with the management and maintenance of state and municipality property or business associations established by the state or municipality for this purpose,
- water management companies,
- forest managers (private forest managers),
- social co-operatives and
- organisations operating railway track network.

Activities planned in the model programmes are performed based on the following seven pillars:

- agricultural project,
- inland water drainage,
- repairing agricultural roads,
- utilisation of bio and renewable sources of energy,
- renovation of the public road network in the inner areas of the settlements,
- elimination of illegal waste disposal sites and
- winter and other value creating public employment.

A.2.1 Main changes in the programme (2013-2017)

2013

- Those will cancel out from the unemployment registry who do not accept the PW job.
- From 1st September 2013 those will be excluded from the PW job, whose child is permanently absent from school without reason (e.g. illness) or whose living environment is not as tidy as it was specified by local government decrees.
- From 1st January a minimum wage for the clerk of works in PW was introduced (it is smaller than the usual minimum wage by roughly 20%).
- From 1st of April the regular weekly wage payments became monthly.

2015

- If someone does not accept a regular job, which was offered to him, he should be excluded from the PW job.

2016

- Those who manage to find a job during the PW programme will get a benefit. The amount of the allowance is the same as the amount of employment substitution support payable for the period from the termination of public works participation to the date until the public works programme was supposed to last if the individual did not find employment.
- From 1st July 2016 the PW employment spell will count to the long-term unemployment period. In this way the employers in the primary labour market get 2 years benefit to employ a previously public worker (do not need for paying social security contribution for 2 years, and in the 3rd year 50% is payable).

2017

- Those who have secondary education can enter the PW programme if they cannot accept a job 3 times (due to the employer) or the Labour market centre cannot provide a suitable job in 3 months.

10.14754/CEU.2021.05

A.3 Main changes in the social transfer system

The gradual increase of retirement age started in 2009 from 60 years and it reaches 65 years in 2021 for men and women. Those women who worked at least 40 years can be pensioners as well (Fazekas and Kézdi (2012)).

The reform of the social transfer system started in 2011. In general, the eligibility criteria for the social benefits were tighten.

From 1st September 2011 the maximum amount of unemployment benefit decreased from 120% to 100% of the actual minimum wage. The minimum allowance was 60% of the minimum wage after the reform this limit was eliminated. The benefit period declined from 180 days to 90 days (Cseres-Gergely and Molnár (2014)).

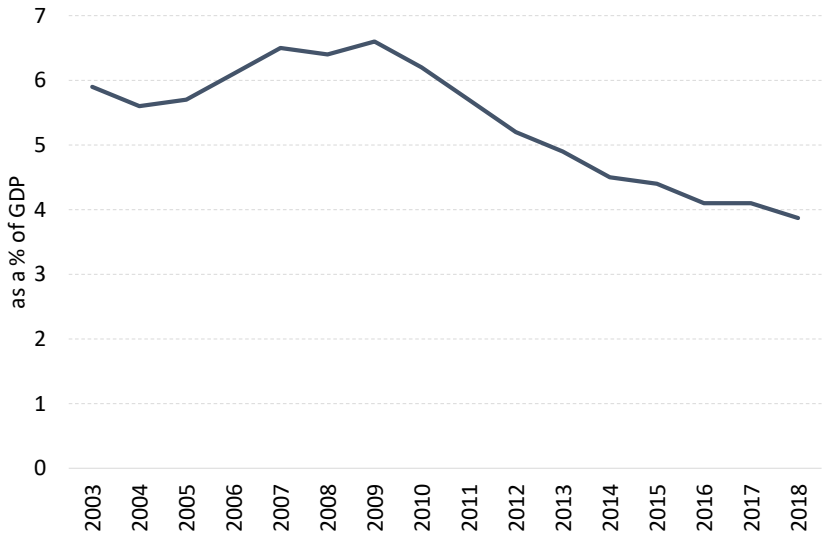
From 2012 the eligibility criteria was tightened for disabled pension. This affected not only the new pensioners but also the current ones. In this way, the number of disabled pensioners decreased.

From the 1st March 2015 the regular social subsidy (*rendszeres szociális segély*) was terminated. Instead of housing allowances (*lakásfenntartási támogatás*), debt management assistance (*adósságkezelési szolgáltatás*) and fairness nursing fee (*méltányossági ápolási díj*) the settlement aid (*települési támogatás*) was introduced (Kopasz and Gábos (2018)). The cost of these subsidies decreased by 30% in real terms between 2014-2016, although the number of eligible people for these subsidies did not change much.

The consequence of these reforms was a steady decline in the social benefits (see Figure A.1).

10.14754/CEU.2021.05

Figure A.1: Social protection benefits as a percentage of GDP



Note: Including disblitiy, familiy, children, unemployment, housing, social exclusion benefits. Source: KSH.

A.4 Other robustness check

A.4.1 Using those who worked in private sector in 2009

It can be argued that those who were public workers have lower productivity than those who were employed in the private sector. If the public workers manage to find a job in the private sector, their wage is smaller than those who were employed in the private sector before. If only the newcomers' wage is smaller than the insider workers' wage (and nothing else changes in the private sector) means that in the special importance district the average wage is smaller due to the change in the composition of employees. To control for composition effect I recalculated the district-occupational average wages for every year only for those, who were employed in 2009 in the private sector. The RDD results are very similar to the main specification (see Table A.1). This means there is not any significant composition effect in the estimated coefficient.

Table A.1: Robustness check for composition effect: fuzzy RD estimation for those who were employed in 2009 in the private sector, occupational category 9

		(1)	(2)	(3)
Robust	Coef.	-0.00550***	-0.00533*	-0.00480*
	St.error	(0.00204)	(0.00281)	(0.00283)
Observations		2,595	2,595	2,595
Time horizon			2013-2017	
Left BW		2.7	5.0	9.0
Right BW		2.7	5.0	9.0
Obs. left of the cutoff		165	315	630
Obs. right of the cutoff		105	270	465
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. The district-occupational cell average wage was calculated using only those individuals, who worked in the private sector in 2009. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.2 Using those who never worked as public workers

This robustness check is similar to the previous one, on the other hand here I only use those individuals who have never participated in the PW programme. In this way, I can

totally filter out the composition effect. I recalculated the district-occupational cell average wages. The results are quite similar to the original estimation (Table A.2). Therefore the significant negative coefficient is not caused by the lower starting wage of previously public workers in the private sector.

Table A.2: Robustness check controlling for possible composition effect for occupational category 9, fuzzy RDD

		(1)	(2)	(3)
Robust	Coef.	-0.00486***	-0.00467*	-0.00514**
	St. error	(0.00158)	(0.00253)	(0.00256)
Observations		2,580	2,580	2,580
Time horizon			2013-2017	
Left BW		4.2	5.2	9.7
Right BW		4.2	5.2	9.7
Obs. left of the cutoff		240	330	660
Obs. right of the cutoff		210	270	555
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. The district-occupational cell average wage was calculated using only those individuals, who never participated in the PW programme. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.3 Controlling for treated settlements in non-treated districts

There are special importance settlements in non-special importance districts[1]. The majority of these settlements are tiny (less than 1000 inhabitants) therefore the population living in special importance settlements in non-special importance districts is low (see Table A.3). Close to the cutoff (not more than 10 points), there are 3 non-special importance districts (Miskolc, Tiszaújváros, Nagykanizsa), in which more than 10% of their population living in special importance districts. One can argue that in these districts there is some treatment effect, which contaminates the estimations (creating treatment in non-treated districts). To overcome this issue I dropped these three districts and checked the results. The coefficients do not change significantly therefore this phenomenon does not alter the estimations (Table A.4).

[1] 105/2015. (IV. 23.) Korm. rendelet

Table A.3: The proportion of those who live in special importance settlements in non-special importance districts

Affected population is	Number of districts	mean	p50	min	max
greater than 10%	3	18.1	15.7	12.1	26.4
smaller than 10%	13	3.3	3.2	0.3	7.1

Districts, which are maximum ±10 point from the cutoff.

Table A.4: Robustness check without those districts, where the ratio of those who live in special importance settlements is greater than 10%, occupational category 9

		(1)	(2)	(3)
Robust	Coef.	-0.00558***	-0.00494**	-0.00577**
	St. error	(0.00195)	(0.00241)	(0.00264)
Observations		2,550	2,550	2,550
Time horizon			2013-2017	
Left BW		3.1	5.8	10.6
Right BW		3.1	5.8	10.6
Obs. left of the cutoff		165	435	750
Obs. right of the cutoff		135	285	540
Order of polynomial		0	1	2

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample does not contain Gyula and Komló districts. It also does not contain Miskolc, Tiszaújváros, Nagykanizsa districts where the proportion of those who live in special importance settlements is 12, 26 and 16% respectively. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.4 Effect on the flows to private sector employment

It is an interesting question whether there was a significantly larger flow from public workers to the private sector. Municipalities can fire some employees and employ others in the public work programme for the same job. In this case, the positive labour supply shock is not due to the PW rather the previously fired employees. On the other hand, if the labour supply increase is due to public work then there are significantly more new entrants to the private sector from PW in the special importance districts.

To examine this question I calculated what was the status of the new entrants to the private sector one year before. In general, they could work in the public sector or in the public work programmes but they could be inactive or unemployed as well. To overcome the difference between the age structure of the districts I just use only the 24-57 years old. I calculate the number in each status and divide it by the total number of new entrants to the private sector.

There are significantly more public workers on the left than on the right of the cutoff (Table A.6). This means that compare to other sources only from the public work arrived more workers in special importance districts than in the non-special importance ones. The arrivals from the public sector to the private sector does not differ around the cutoff. This means that not the fired municipality workers appeared in the private sector, at least not around the cutoff.

Table A.5: RDD for the proportion of new entrants from different sources to the total new entrants in the private sector

		(1)	(2)	(3)	(4)
		PW	public sector	Unemp.	Inactivity
Robust	Coef.	2.801***	-0.477	-1.195	0.685
	St.error	(0.965)	(0.893)	(1.248)	(2.870)
Observations		865	865	865	865
Time horizon			2013-2017		
Left BW		6.7	6.2	6.6	7.8
Right BW		6.7	6.2	6.6	7.8
Obs. left of the cutoff		160	155	160	190
Obs. right of the cutoff		125	120	125	135
Order of polynomial		1	1	1	1
Mean of dept. var.		8.56	7.46	9.1	63.9

The outcome variable is the ratio between the newcomers from the source sector and the number of newcomers to the private sector (in percentage points) for the 24-57 years old, i.e. (number of those who were public workers in $t-1$ and private sector workers in t)/(total number of new workers in private sector workers in t), (number of those who were public sector workers in $t-1$ and private sector workers in t)/(total number of new workers in private sector workers in t), etc. The running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample contains districts without Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.5 Is there a difference in public workers' previous labour market status around the cutoff?

I calculated RDD's for the previous status of public workers (Table A.6). I do not find any evidence for a difference in the share of public workers previous status around the cutoff. The share of inactive people, who started working in PW is quite high on both sides of the cutoff.

Table A.6: RDD for the proportion of new entrants from different sources to the total new entrants in the PW

		(1)	(2)	(3)	(4)
		Private sector	Public sector	Unemp.	Inactivity
Robust	Coef.	1.783	-0.237	-0.585	2.379
	St.error	(4.219)	(0.458)	(1.102)	(4.527)
Observations		865	865	865	865
Time horizon			2013-2017		
Left BW		7.8	5.1	6.3	7.1
Right BW		7.8	5.1	6.3	7.1
Obs. left of the cutoff		195	155	155	170
Obs. right of the cutoff		135	115	120	130
Order of polynomial		1	1	1	1
Mean of dept. var.		21.0	1.3	6.0	71.7

The outcome variable is the ratio between the newcomers from the source sector and the total number of newcomers to the PW (in percentage points) for the 24-57 years old, i.e. (number of those who were private sector workers in $t-1$ and public workers in t)/(total number of new workers in PW in t), etc. The running variable is the complex indicator. Additional covariates are year FE's. The threshold is 46.68. The sample contains districts without Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.6 Estimation for other occupational categories

In the other blue-collar occupational categories (category 5-8) there is also a negative effect but it is not significant (Table A.7). The reason for this could be the one magnitude smaller first stage coefficient compared to occupational category 9 (Table A.8). In these occupations, I use only those categories, where the average wage was below the median in 2009. In this way, I filter out the high-skilled workers.

Table A.7: Robustness check for occupational categories

Occupational cat.		5	6	7	8
Robust	Coef.	-0.0682	-0.00462	-0.0626	-0.0868
	St.error	(0.116)	(0.0107)	(0.0689)	(0.157)
Observations		905	1,710	2,608	1,428
Time horizon		2013-2017			
Left BW		6.3	5.0	4.2	2.3
Right BW		6.3	5.0	4.2	2.3
Obs. on the left		165	210	260	100
Obs. on the right		125	175	175	31
Order of polyn.		1	1	1	1
Restriction		Below 2009 median wage			

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample contains those district-occupational cells, where the average wage was below the median wage in 2009, without Gyula and Komló districts. Occupational categories: 5 Commercial and services occupations, 6 Agricultural and forestry occupations, 7 Industry and construction industry occupations, 8 Machine operators, assembly workers, drivers of vehicles. In the case of category 8 without outliers. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

Table A.8: Robustness check for occupational categories, first stage

Occupational cat.		5	6	7	8
Robust	Coef.	0.231*	1.252	1.657***	0.993***
	St.error	(0.124)	(5.74)	(0.437)	(0.347)
Observations		905	1,710	2,608	1,428
Time horizon		2013-2017			
Left BW		6.3	5.0	4.2	2.3
Right BW		6.3	5.0	4.2	2.3
Obs. on the left		165	210	260	100
Obs. on the right		125	175	175	31
Order of polyn.		1	1	1	1
Restriction		Below 2009 median wage			

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 46.68. The sample contains those district-occupational cells, where the average wage was below the median wage in 2009, without Gyula and Komló districts. Occupational categories: 5 Commercial and services occupations, 6 Agricultural and forestry occupations, 7 Industry and construction industry occupations, 8 Machine operators, assembly workers, drivers of vehicles. In the case of category 8 without outliers. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.4.7 Estimation for placebo cutoffs

I use two placebo thresholds one above and one below the original cutoff. In both cases, the estimated effect is close to zero and not significant (Table A.9), which shows that there is no effect around the placebo cutoffs.

Table A.9: Fuzzy RD estimates using local polynomial regression for log private fte wage for occupational category 9, placebo with different cutoffs

		(1)	(2)
Robust	Coef.	0.00363	-0.00737
	St.error	(0.0129)	(0.0126)
Observations		2,595	2,595
Time horizon		2013-2017	
Left BW		2.6	8.8
Right BW		2.6	8.8
Obs. on the left		165	435
Obs. on the right		180	240
Order of polyn.		1	1
Cutoff		35	60

The outcome variable is the log fte private sector wage, the running variable is the complex indicator, the treatment variable is the proportion of public workers in a district-occupational cell. Additional covariates are year FE's. The threshold is 35 and 60 respectively. The sample is without Gyula and Komló districts. Standard errors are clustered at district level. *** p<0.01, ** p<0.05, * p<0.1

A.5 Supplementary tables and graphs

Table A.10: Descriptive statistics of district two-digit occupational cells in the private sector

variable	mean	p50	p25	p75
FTE employment	323.47	90.65	20.52	309.45
log(FTE wage)	12.29	12.21	11.97	12.56
PW share	4.49	0	0	2.27

The table contains the number of full-time equivalent workers, the log average wage and the public worker share between 2013-2017 in the private sector.

Table A.11: Descriptive statistics of district two-digit occupational cells in the private sector occupational category 9

variable	mean	p50	p25	p75
FTE employment	660.89	448.75	231.38	729.55
log(FTE wage)	11.8	11.78	11.71	11.88
PW share	25.37	18.9	9.03	37.99

The table contains the number of full-time equivalent workers the log average wage and the public worker share between 2013-2017 in the Elementary occupations, which does not require qualification in the private sector.

Figure A.2: Log wages around the cutoff (2009-2012)

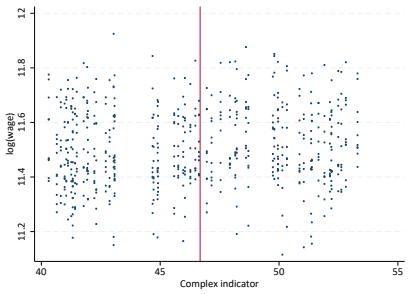


Table A.12: The proportion of PW wage to minimum wage

	Public worker net wage/minimum wage	
	Without qualification	With qualification
2011	78%	86%
2012	77%	85%
2013	77%	85%
2014	76%	84%
2015	75%	83%
2016	71%	79%
2017	64%	66%

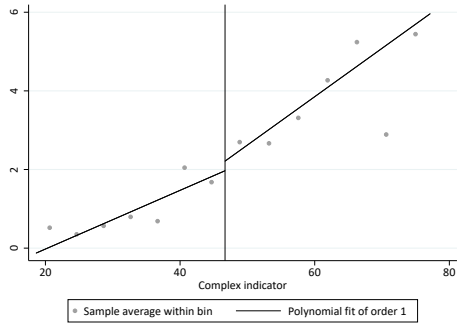
In Hungary, there are two minimum wages. One for those, who don't have any qualifications and for those who have at least vocational qualifications.

Table A.13: Those occupation categories, where the PW-proportion is the highest, average (2012-2017)

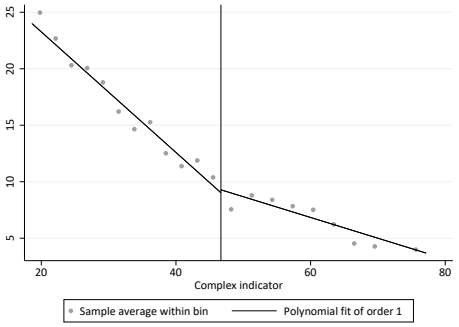
Occupational category	FEOR-code	PW-proportion
Forestry, game-farming and fisheries occupations	62	36.6
Simple service, transport and similar occupations	92	32.2
Simple industry, construction industry, agricultural occupations	93	21.8
Cleaners and related simple occupations	91	15.4
Other industry and construction industry occupations	79	12.0
Agricultural occupations	61	10.2
Office clerks	41	5.4
Educational assistants	34	5.0
Building industry occupations	75	3.6
Technicians and other related technical professionals	31	3.2

Figure A.3: Other covariates (2009-2011)

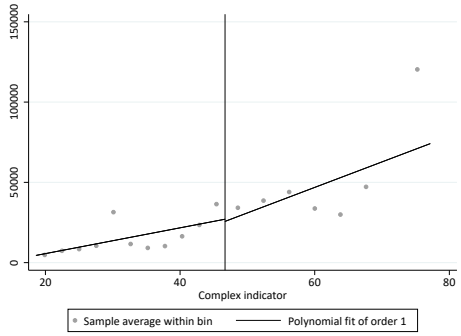
Tightness (vacancy/unemployment)



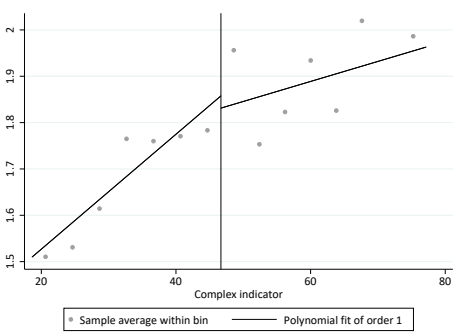
Unemployment rate



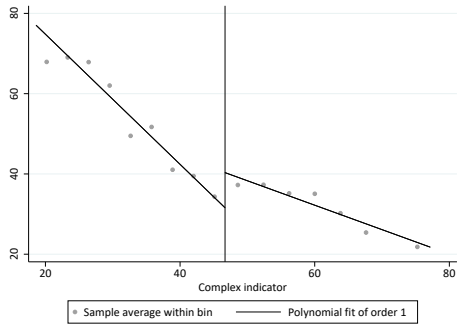
Sales/enterprise (HUF)



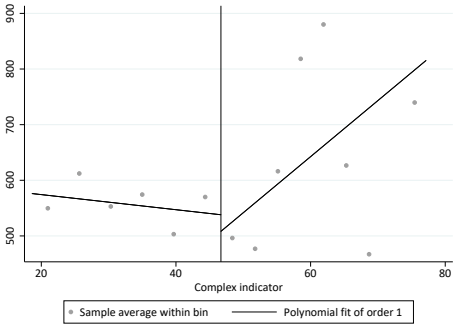
Electricity consumption/population (kWh/pop)



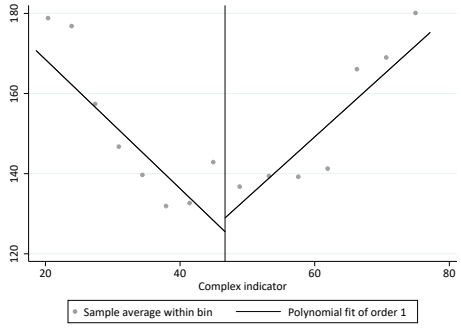
Juvenile delinquency rate



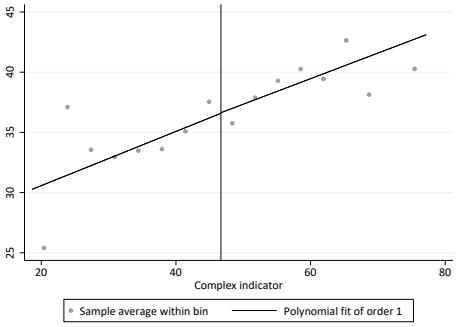
Registered crime rate



Number of birth/10 thousand inhabitants



Number of divorces/10 thousand inhabitants



10.14754/CEU.2021.05

Appendix B

Appendix for Chapter 2

B.1 Database description

B.1.1 Average wage calculation

The database of the Hungarian State Treasury (MÁK) contains the full population, who had at least one day of legal work between 1997-2017. The following variables are used in the study:

- district level place of residence,
- the wage,
- the type of employment (e.g. self-employed, entrepreneur, employee, public worker etc.),
- four-digit occupational code (FEOR),
- weekly hours worked,

To calculate the average wages I selected those individuals, who had any kind of employment in the private sector on 30th April in every year (between 2009-2017). In this way, I can overcome the seasonality issues. The Hungarian administrative database contains everyone, after whom the employer pays the pension contributions. This means that every type of employment is included (e.g. part-time job, self-employment etc.). Since there are many individuals, who have several types of jobs, I choose the highest wage for everyone.

I calculated the district-two digit occupational cell full-time equivalent wage for every year using the highest wage for each individual. There are 175 districts in Hungary (the capital is counted as one district). There are on average 40 two-digit occupational categories per district.

B.1.2 Calculation of occupational level tightness

There are nine main categories[1] in the Hungarian Standard Classification of Occupations (FEOR):

1. Managers,
2. Professionals,
3. Technicians and associate professionals,
4. Office and management (customer services) occupations,
5. Commercial and services occupations,
6. Agricultural and forestry occupations,
7. Industry and construction industry occupations,
8. Machine operators, assembly workers, drivers of vehicles,
9. Elementary occupations not requiring qualification.

Based on the skill requirements for each occupational category (see KSH (2011)) I constructed the one-digit occupational level tightness in the following way. In each category, the numerator is the number of one-digit occupational level vacancies. The denominators are the following:

- for categories 1-2: the number of unemployed with bachelor or masters degree,
- for category 3: the number of unemployed with bachelor or masters degree plus the number of unemployed with high school,

[1]Apart from armed forces occupations.

- for categories 4-8: the number of unemployed with high school or post-secondary vocational education, secondary education (at grammar schools, vocational schools, trade schools) or primary level of education,
- for category 9: the number of unemployed with a primary level of education or without any education.

B.2 Different measure of the instrument

To have more variation in the instrument I downloaded the distances from 6 border-crossings (Hegyeshalom, Sopron, Kópháza, Kőszeg, Bucsu, Rábafüzes) and the district capitals. I calculated the minimum of these distances both in driving time and distance in kilometres. I used these two measures as alternative IV's. The estimated coefficients are significant and quite similar to the original estimation (Table B.1). The first stages are also similar to the original estimation (Table B.2). This means that my results are robust to a different type of distance measure.

Table B.1: Main IV specification

	(1)	(2)
VARIABLES	lnw	lnw
lntight	0.0667**	0.0602*
	(0.0280)	(0.0240)
Observations	22,639	22,639
No. of dist.-occ. cells	2,830	2,830
Time horizon	2009-2017	2009-2017
County FE	Yes	Yes
Year FE	Yes	Yes
R-overall	0.139	0.143
Instrument	disctance in km	distance in time

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, the county and year FE. The instrumental variable is the distance from the Austrian border-crossings and its interaction with the after2011 dummy. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes (same sample as in Table 2.2). Standard errors are clustered on district level. *** p<0.01, ** p<0.05, * p<0.1

Table B.2: Main IV specification, first stage

	(1)	(2)
VARIABLES	lntight	lntight
distance × after2011	-0.00412***	-0.00857***
	(0.000824)	(0.00124)
distance	-0.00370	-0.00485
	(0.00253)	(0.00339)
Observations	22,639	22,639
No. of dist.-occ. cells	2,830	2,830
Time horizon	2009-2017	2009-2017
County FE	Yes	Yes
Year FE	Yes	Yes
R-overall	0.561	0.565
Disctance	km	minutes
H_0 : distance × after2011=0		
χ^2	24.98	47.92
p-value	0.0000	0.0000

The dependent variable is the log tightness in a district-one digit occupational cell. The independent variable is the distance from the Austrian border-crossings (in km and in minutes as well) and its interaction with the after2011 dummy. Other covariates are the share of high skilled workers, the county and year FE. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Standard errors are clustered on district level. *** p<0.01, ** p<0.05, * p<0.1

B.3 OLS and reduced form

If the tightness increases the wages also increase. But in the meantime (due to reverse causality) the higher wages imply lower tightness because more unemployed willing to fill a job. This means that in the OLS estimation the parameter of tightness in the wage equation is lower than in the IV case.

Table B.3: The OLS specification

	(1)
VARIABLES	lnw
lntight × after2011	0.00258
	(0.00185)
Observations	22,399
No. of dist.-occ. cells	2,830
Time horizon	2009-2017
County FE	Yes
Year FE	Yes
R-overall	0.165

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the log tightness in a district-one digit occupational cell. Other covariates are the share of high skilled workers, the county and year FE. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Standard errors are clustered on district level. *** p<0.01, ** p<0.05, * p<0.1

The reduced form is the following equation:

$$\ln(wage_{ijt}) = \delta_0 + \delta_1 post2011_t \times dist_i + \delta_2 dist_i + \gamma X + u_{ijt} \tag{B.1}$$

where

- i is the index for district-occupational cells ,
- j is the index for districts,
- t is the year index,
- $post2011 = 1$ if year > 2010, 0 otherwise,

- $dist_i$ is the distance form the Western border (in minutes by car),
- X other covarites (FE's share of high skilled in a district),

In the reduced form the $distance \times after2011$ negatively affects wages (see Table B.4). The parameter of interest means that after the opening of the Austrian labour market wages decline by 0.06 percentage for every additional 1 minute travelling time to Austria. Thus if a district is 20 minutes farther from the Austrian border than another the wages there are 1.2% lower.

Table B.4: Reduced form

	(1)
distance × after2011	-0.000617***
	(0.000204)
distance	-0.000276
	(0.000350)
Observations	22,639
No. of dist.-occ. cells	2,830
Time horizon	2009-2017
County FE	Yes
Year FE	Yes
R-overall	0.16

The dependent variable is the log private sector fte wage in a district-two digit occupational cell. The independent variable is the distance from the Austrian border and its interaction with the after2011 dummy. Other covariates are the share of high skilled workers, the county and year FE. The sample contains those districts, for which minimum of the distance to Vienna and Graz is less than 180 minutes. Standard errors are clustered on district level. *** p<0.01, ** p<0.05, * p<0.1

B.4 Detailed model setup

I briefly summarize the modified version of Mortensen–Pissarides model Pissarides (2000) based on Roshchina (2016).

The definitions of the labour demand and supply:

$$\begin{aligned} Labour\ demand &= filled\ jobs + vacancies \\ Labour\ supply\ (L) &= unemployed + employed \end{aligned} \tag{B.2}$$

The unemployment rate is $u = \frac{U}{L}$, the vacancy rate is $v = \frac{V}{L}$ and the total number of matches between jobseekers and vacancies is mL. The matching function defines the newly created jobs:

$$m = m(U, V) \tag{B.3}$$

where

- m number of matches,
- U number of unemployed,
- V number of vacancies.

The $m(u, v)$ function is increasing in both arguments, which can be written in another form:

$$mL = m(uL, vL) \xrightarrow{:\,\mathrm{L}} m = m(u, v). \tag{B.4}$$

Dividing the matching function with the unemployment rate:

$$\frac{m(u,v)}{u} = m\Big(1, \frac{v}{u}\Big) = p(\theta), \tag{B.5}$$

gives the job finding probability of the unemployed. This probability is the increasing function of θ. Similarly, dividing by the number of vacancies:

$$\frac{m(u,v)}{v} = m\Big(\frac{u}{v}, 1\Big) = m\Big(1, \frac{v}{u}\Big)\frac{u}{v} = \frac{p(\theta)}{\theta} = q(\theta) \tag{B.6}$$

gives the rate at which a vacant job is matched to a worker. The $q(\theta)$ function is decreasing in θ, which is intuitive since, if the number of vacancies rise compare to the unemployed, the vacancy filling probability ($q(\theta)$) diminishes.

From now on, I use a modified version of Roshchina (2016) model. In this setup, there are L isolated locations. In every location l there is a continuum of firms that can post as many vacancies as they wish. The price p of the final good which they produce is exogenously given. Let the vacancy filling rate be in location l:

$$q(\theta_l) = \left(\frac{V_l}{U_l}\right)^{-(1-\sigma)} \tag{B.7}$$

And the job finding probability is:

$$p(\theta_l) = q(\theta_l)\theta_l = \left(\frac{V_l}{U_l}\right)^{\sigma} \tag{B.8}$$

where σ is the parameter of the matching function.

B.4.1 Labour supply

For the jobseeker, the return on being unemployed is the unemployment benefit plus the expected value of finding a job with probability $p(\theta_l)$. Consequently, the expected value of unemployment in location l:

$$rJ_l^U = z + p(\theta_l)(J_l^E - J_l^U) \tag{B.9}$$

where

- z is the unemployment benefit, i.e. the outside option of the worker,
- J_l^U the value of unemployment,
- J_l^F the value of employment,
- r discount rate.

For the employee, the flow return on employment is equal to his wage and the expected value of losing the job with probability s. So the expected value of employment in location l can be expressed as an asset equation:

$$rJ_l^E = w_l + s(J_l^U - J_l^E) \tag{B.10}$$

where

- s is the separation rate, the probability that a worker loses his job,
- J_l^U the value of unemployment,
- w_l is the wage.

B.4.2 Labour demand

Each firm in location l has a flow revenue from the production of $y_l = p + \eta_l$, where p is the price of the good and η_l is location specific revenue advantage. For the firms y_l is given and they can only decide on the number of posted vacancies. As in the labour demand case, the flow value of a vacancy and a filled job can be determined as well. For the firm the flow return on a vacancy is the expected gain of finding a suitable worker with probability $q(\theta)$ and the cost of posting the vacancy:

$$rJ_l^V = -\gamma_0 + q(\theta_l)(J_l^F - J_l^V) \tag{B.11}$$

where

- J_l^V is the value of a vacant job,
- γ_0 is the cost of an open vacancy, i.e. the cost of the time and resources (e.g. advertising costs) used to find a suitable employee.

Similarly, the value of a filled job is the profit (the difference between revenue and wage) plus the expected value of the job becoming vacant with probability s:

$$rJ_l^F = y_l - w_l + s(J_l^V - J_l^F) \tag{B.12}$$

where

- J_l^F is the value of a filled job.

B.4.3 Wage determination process

After a match, a surplus is generated because the job seeker is better off working, and then to be unemployed. The firm is also better off with a filled vacancy than with a vacant one. Using the above equations, we can express the sum of the employer's and employee's surplus. This surplus can be considered as a monopolistic rent and it is divided between the worker and the firm. The split is made during the negotiations. The total surplus, which they can split, is:

$$(J_l^F + J_l^E) - (J_l^V + J_l^U) = \underbrace{J_l^F - J_l^V}_{firm's\ surplus} + \underbrace{J_l^E - J_l^U}_{worker's\ surplus} \tag{B.13}$$

In this model, the bargaining power of the worker, β is exogenously given and the Nash-bargain method is used to determine the distribution of the surplus. In this framework, bargained wage maximizes the geometric average of the two actors' surplus, weighted by their relative bargain power:

$$\max_{w} (J_l^F - J_l^V)^{1-\beta}(J_l^E - J_l^U)^{\beta} \tag{B.14}$$

Since the objective function is a Cobb-Douglas type, the first order condition can be expressed as follows:

$$(J_l^E - J_l^U) = \frac{\beta}{1-\beta}(J_l^F - J_l^V) \tag{B.15}$$

which is

$$(J_l^E - J_l^U) = \beta((J_l^F - J_l^V) - (J_l^E - J_l^U)). \tag{B.16}$$

Therefore, the worker's surplus is equal to β fraction of the total surplus. Subtracting rJ^U (B.9) from rJ^E (B.10) the worker's surplus can be calculated in two steps:

$$rJ_l^E - rJ_l^U = w_l + s(J_l^U - J_l^E) - z - p(\theta_l)(J_l^E - J_l^U) \tag{B.17}$$

After some transformation, the workers surplus is as follows:

$$J_l^E - J_l^U = \frac{w_l - z}{r + s + p(\theta_l)} \tag{B.18}$$

This means that the worker's surplus depends positively on the difference between wage and unemployment benefit. If the separation rate s increases, the worker's surplus diminishes. This is intuitive since, if the probability of losing the job grows, the surplus (or the expected value of the surplus) shrinks.

In the search and matching models entry is free for the firms to the labour market ($J_l^V = 0$). Plugging this assumption into equation (B.11): $J_l^F = \frac{\gamma_0}{q(\theta_l)}$. Setting equal equation (B.15) and (B.18) gives

$$\frac{\beta}{1-\beta}\frac{\gamma_0}{q(\theta)} = \frac{w_l - z}{r + s + p(\theta_l)} \tag{B.19}$$

Substituting J_l^F and J_l^V in equation (B.12) gives an expression:

$$r + s = (y_l - w_l)\frac{q(\theta_l)}{\gamma_0} \tag{B.20}$$

Substituting (B.20) into equation (B.19), using that $\frac{p(\theta)}{q(\theta)} = \theta$ (see equation (B.8)) and after some transformation the equilibrium wage is:

$$w_l = \beta(y_l + \gamma_0\theta_l) + (1 - \beta)z \tag{B.21}$$

10.14754/CEU.2021.05

Appendix C

Appendix for Chapter 3

C.1 Robustness checks and placebos

C.1.1 Does Jobbik vote share affect labour supply?

To check whether Jobbik vote share affects labour supply we calculate the labour search intensity (the ratio of unemployed to inactive) of Roma people in every district. Then we use the same bins based on Jobbik vote share and small firm proportion as in the case of the simulation. If there would be a strong connection between Jobbik vote and small firm share there would be a clear increasing pattern in the search intensity by increasing the small firm and Jobbik vote share. This pattern is missing from the data (Table C.1 and C.2), which implies that the labour supply is not affected by local prejudices and district level small firm share.

Table C.1: Search intensity of Roma men (age 15-59)

		Small firm share					
		10	20	30	40	50	60
Vote share of Jobbik	15		113	74	84	100	90
	20	79	55	72	88	59	153
	25	50		77	83	110	
	30		61	72	77	105	
	35		51	111	80		
	40			48			

Table C.2: Search intensity of Roma women (age 15-59)

		Small firm share					
		10	20	30	40	50	60
Vote share of Jobbik	15		49	37	34	36	58
	20	38	30	29	34	25	58
	25	24		31	33	40	
	30		21	27	30	35	
	35		24	34	27		
	40			15			

C.1.2 District level observation

In this robustness check, we calculate the Roma and non-Roma employment rates for districts. We estimate a similar equation as in the main specification but without individual level controls. In this setting, there are two observations (Roma and non-Roma) for every district.

$$\begin{aligned} e_{ij} = \beta_1 r_{ij} + \beta_2 r_{ij} \cdot V_j + \beta_3 r_{ij} \cdot S_j + \\ + \beta_4 r_{ij} \cdot V_j \cdot S_j + \theta_j + u_{ij} \end{aligned} \tag{C.1}$$

where

- i is the ethnicity (Roma or non-Roma), j is the district (*járás*),
- e_{ij} is the employment rate for Roma ($i = 1$) and non-Roma ($i = 0$),
- r_{ij} is the Roma ethnicity dummy (1 if Roma, 0 otherwise),
- V_j is the votes for Jobbik in district j (proportion of total votes),
- S_j is the proportion of employed people in small firms (with 2-30 employees),
- θ_j district FE; and
- u_{ij} is the error term.

The first stage equations are:

$$r_{ij} \cdot V_j = \alpha_1 r_{ij} \cdot L_j + \delta_1 r_{ij} \cdot S_j \cdot L_j + \theta_j + u_{ij} \tag{C.2}$$

$$r_{ij} \cdot S_j \cdot V_j = \alpha_2 r_{ij} \cdot L_j + \delta_2 r_{ij} \cdot S_j \cdot L_j + \theta_j + u_{ij} \tag{C.3}$$

where

- L_j is the total debt to population ratio in district j.

Table C.3: The district level linear employment probability model age 15-60, without high school, estimated by IV

	Men	Women
Roma	-0.748*	-1.198**
	(0.421)	(0.558)
Roma × Vote	2.110	4.720
	(2.293)	(2.978)
Roma × Small	1.778	2.918*
	(1.421)	(1.659)
Roma × Vote × Small	-8.978	-15.64*
	(7.870)	(9.023)
Observations	350	350
R-squared	0.944	0.932
District FE	YES	YES
IV F-stat (R × V)	537.51	537.51
IV F-stat (R × V × S)	534.09	534.09

IV: foreign currency debt/population in a district.
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results are quite similar to the original estimation (see Table C.3). The sign of the parameters is the same as in the original estimation. The magnitudes are also similar. On the other hand, not as many parameters are significant as in the original case, which is not surprising since here the number of observations are considerably smaller. The qualitative conclusion of the simulation is the same as in the individual case, albeit the estimated gaps are somewhat larger (see Table C.4).

Table C.4: The predicted employment gaps of Roma men depending on small firms and Jobbik votes in the district using district level regressions

			Small firm proprtoion		
			20-30%	30-40%	40-50%
Vote share of Jobbik	20-25%	Estimate	-0.336	-0.360	-0.382
		Sd. error	(0.02)	(0.04)	(0.06)
	25-30%	Estimate	-0.341	-0.393	–*
		Sd. error	(0.05)	(0.06)	

*Less than 5 districts in the cell.
The predicted national average employment gap is -.32 at the average district value of Jobbik (18.8%) and the average district small firm employment share (31.2%).
Age 15-60, without a high school or college/university attainment, comparing to non-Roma men with similar individual attributes, IV method.
Clustered standard errors in parentheses.

C.1.3 Alternative estimation of the first stage

In the first stage estiamtion, the R^2 can be considered too high (above 0.9), which can be due to the Roma dummy. To check whether the first stage is strong enough we restricted the sample to the Roma and estimated the first stages to this restricted sample without the dummies. In these specifications district FE' cannot be used due to multicollinearity with the other district level variables. We estimated the following equations:

$$V_j = \alpha_1 L_j + \delta_1 S_j \cdot L_j + X_{ij}\gamma_1 + u_{ij} \tag{C.4}$$

$$S_j \cdot V_j = \alpha_2 L_j + \delta_2 S_j \cdot L_j + X_{ij}\gamma_2 + u_{ij} \tag{C.5}$$

where

- X_{ij} is individual level controls.

Table C.5: First stage estimate using only the Roma

	Men		Women	
	V_j	$V_j \times S_j$	V_j	$V_j \times S_j$
L_j	-0.305*	-0.00114	-0.230	0.0140
	(0.178)	(0.0342)	(0.180)	(0.0342)
$L_j \times S_j$	0.187	-0.259**	-0.115	-0.324***
	(0.533)	(0.106)	(0.545)	(0.107)
Controls	Yes	Yes	Yes	Yes
District FE	No	No	No	No
IV F-stat	79.4	79.5	81.75	80.07
No. of observations	51,226	51,226	59,953	59,953
R-squared	0.307	0.561	0.310	0.569

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The magnitude and sign of the estimated parameters are the same in every case (Table C.5). For men, the significance of parameters is also the same, for women one parameter

is significant. The R^2's are much smaller than in the original case but they indicate that the instruments have explanatory power. The F-statistics are still well above 10.

C.1.4 Industry composition instead of small firm share

One can argue that some industries organise production in many small teams, while in other industries firms would pool all workers into one big team. Team size may matter for the same reasons as firm size. To check whether this argument is relevant we calculate the share of workers in agriculture, manufacturing and services. We included these into the equations instead of small firm shares. The question is whether the triple interaction is significant and what is the magnitude of the parameter compared to the small firm share.

We estimate the following equation:

$$\begin{aligned} e_{ij} = \beta_1 r_{ij} + \beta_2 r_{ij} \cdot I_j + \beta_3 r_{ij} \cdot V_j + \\ + \beta_4 r_{ij} \cdot I_j \cdot V_j + \theta_j + X_{ij}\gamma + u_{ij} \end{aligned} \tag{C.6}$$

where

- i is the individual, j is the district (*járás*),
- e_{ij} is the employment status of the individual (1 if employed, 0 otherwise),
- r_{ij} is the Roma nationality dummy (1 if Roma, 0 otherwise),
- I_j is the share of workers to the total number of workers in the main industries (separate equations for agriculture, manufacturing and services),
- V_j is the votes for Jobbik in district j (proportion of total votes),
- θ_j district FE,
- X_{ij} are the individual level controls; and
- u_{ij} is the error term.

In the case of men, the triple interactions are at least two magnitudes smaller than in the case of small firm share. Two of the parameter estimates are not significant one is significant at 10% level (Table C.6). This indicates that industry composition does not play a role in the employment gap. Similar conclusions can be drawn from the estimated parameters in the case of women (Table C.7).

Table C.6: Placebo estimates using industry shares instead of small firm proportion (men 18-60 years old)

VARIABLES	Services emp	Manufacturing emp	Agriculture emp
Roma	-0.274***	-0.125***	-0.205***
	(0.0815)	(0.0294)	(0.0171)
Roma × Vote	-0.320	-0.401**	-0.0527
	(0.448)	(0.178)	(0.0947)
Roma × Service	0.00105		
	(0.00105)		
Roma × Vote × Service	0.00227		
	(0.00608)		
Roma × Manuf		-0.00335**	
		(0.00142)	
Roma × Vote × Manuf		0.0106	
		(0.00774)	
Roma × Agri			0.00371
			(0.00307)
Roma × Vote × Agri			-0.0298*
			(0.0158)
Observations	1,222,154	1,222,154	1,222,154
R-squared	0.193	0.193	0.193
District FE	Yes	Yes	Yes

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
Service, Manuf, Agri: share of those (in percentage points) who work in services, manufacturing, agriculture respectively (to the total employment in a given district).
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.7: Placebo estimates using industry shares instead of small firm proportion (women 18-60 years old)

VARIABLES	Services emp	Manufacturing emp	Agriculture emp
Roma	-0.304***	-0.133***	-0.212***
	(0.0628)	(0.0223)	(0.0142)
Roma × Vote	0.0872	-0.267**	-0.0328
	(0.332)	(0.123)	(0.0718)
Roma × Service	0.00136*		
	(0.00105)		
Roma × Vote × Service	-0.00200		
	(0.00445)		
Roma × Manuf		-0.00359***	
		(0.00108)	
Roma × Vote × Manuf		0.0104*	
		(0.00564)	
Roma × Agri			0.00350
			(0.00216)
Roma × Vote × Agri			-0.0151
			(0.0109)
Observations	945,335	945,335	945,335
R-squared	0.171	0.171	0.171
District FE	Yes	Yes	Yes

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
Service, Manuf, Agri: share of those (in percentage points) who work in services, manufacturing, agriculture respectively (to the total employment in a given district).
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

C.2 Supplementary tables and graphs

Table C.8: Control variables used in the equations

Age	Partner's income: social benefit
Age squared	No. employed in flat (besides person)
long-term ill	No. pensioners in flat (besides person)
disabled	No. living from wealth in flat (besides person)
long-term ill and disabled	No. under social care in flat (besides person)
Illness info missing	can't take care of himself (dummy)
speaks English	Flat size (m^2), natural logarithm
speaks German	Megye centre
religious	Village 5000+ pop
Married or has companion	Village 2000-4999 pop
Partner's employed	Village 1000-1999 pop
Partner's income: pens	Village 0-999 pop
Partner's income: own wealth	

category variable for reachable local labour market centers by public transport (seperate for 0, 1, 2, 3, 4 centres)

Table C.9: Descriptive statistics of the main variables on district level

Variable	Mean	Std. Dev.	Min	Max
Jobbik vote share	0.188	0.057	0.103	0.385
Small firm proportion	0.312	0.083	0.037	0.565
FX-debt/population (million HUF)	0.086	0.044	0.034	0.432

Table C.10: The linear employment probability model age 15-60, without high school, estimated by OLS

	Men	Women
Roma	-0.269***	-0.255***
	(0.0560)	(0.0358)
Roma × Vote	0.257	0.124
	(0.257)	(0.172)
Roma × Small	0.362	0.247*
	(0.241)	(0.147)
Roma × Vote × Small	-2.087*	-0.952
	(1.105)	(0.723)
Observations	1,222,154	945,335
R-squared	0.193	0.171
Controls	Yes	Yes
District FE	YES	YES

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.11: The linear employment probability model age 15-60, without high school, reduced form

	Men	Women
Roma	-0.178***	-0.156***
	(0.0335)	(0.0227)
Roma × Loan	-0.409	-0.876***
	(0.372)	(0.250)
Roma × Small	-0.271**	-0.226***
	(0.120)	(0.0788)
Roma × Loan × Small	2.343*	3.253***
	(1.280)	(0.821)
Observations	1,222,154	945,335
R-squared	0.193	0.171
Controls	YES	YES
District FE	YES	YES

We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.12: First stage estimate

	Men		Women	
	$r_{ij} \times V_j$	$r_{ij} \times V_j \times S_j$	$r_{ij} \times V_j$	$r_{ij} \times V_j \times S_j$
$r_{ij} \times L_j$	-0.392**	-0.0183	-0.386**	-0.0151
	(0.192)	(0.0376)	(0.193)	(0.0376)
$r_{ij} \times L_j \times S_j$	0.443	-0.202*	0.395	-0.221*
	(0.569)	(0.114)	(0.573)	(0.114)
Controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
IV F-stat	238.5	241.5	253.3	330.5
No. of observations	1,222,154	1,222,154	945,335	945,335
R-squared	0.914	0.918	0.918	0.922

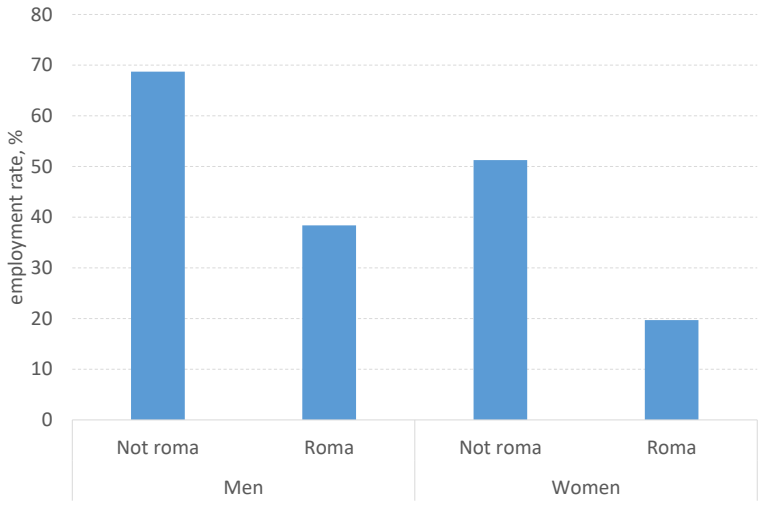
We considered employed those who worked at least one hour a week before the Census (24-30 September 2011). We do not consider as employed the following persons: the self-employed, fostered workers (participated in the public work scheme), helping family member, casual worker or those whose spouse is a self-employed who has 1 or 2 employees. These individuals are not in our sample. Budapest is considered one district.
Roma: those who choose at least once Roma from the two nationality questions (primary and secondary nationality).
Controls: see Appendix Table C.8.
IV: foreign currency debt/population in a district.
District level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.13: The predicted employment gaps of Roma women depending on small firms and Jobbik votes in the district

			Small firm proprtoion		
			20-30%	30-40%	40-50%
Vote share of Jobbik	20-25%	Estimate	-0.22	-0.23	-0.24
		Sd. error	(0.01)	(0.01)	(0.02)
	25-30%	Estimate	-0.21	-0.25	–*
		Sd. error	(0.02)	(0.02)	

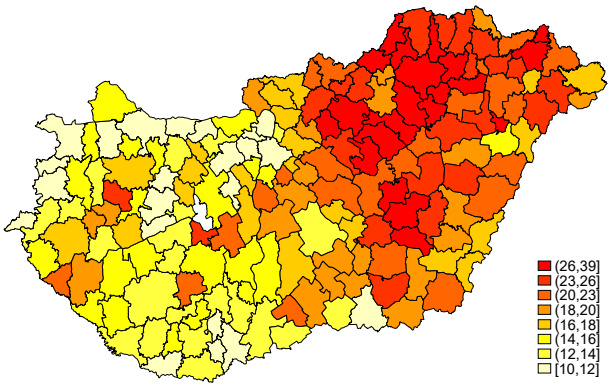
*Less than 5 districts in the cell.
Predicted national average employment gap is -.20 at the average district value of Jobbik (18.8%) and the average district small firm employment share (31.2%).
Age 15-60, without high school or college/university attainment, comparing to non-Roma men with similar individual attributes, IV method.
District level clustered standard errors in parantheses.

Figure C.1: The employment rate by nationality and gender (age 15-60 without high school)



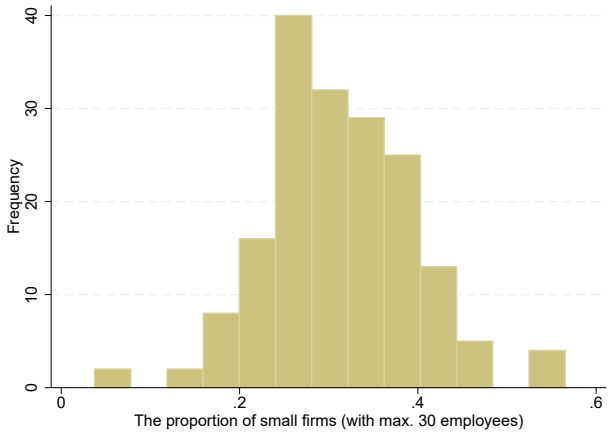
Source: Census

Figure C.2: The percentage of votes cast for the Jobbik party list in 2010



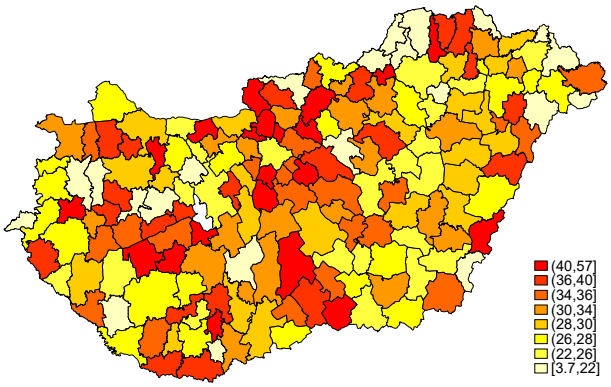
Source: valasztas.hu

Figure C.3: Histogram of proportion of small firms by district, 2011



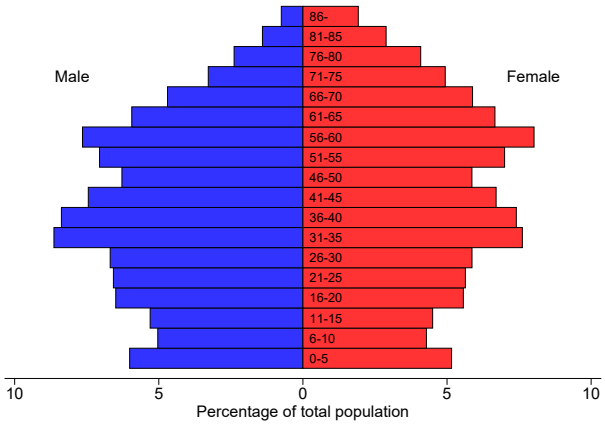
Source: GSZR, Bértarifa.

Figure C.4: The proportion of small firms by district, 2011



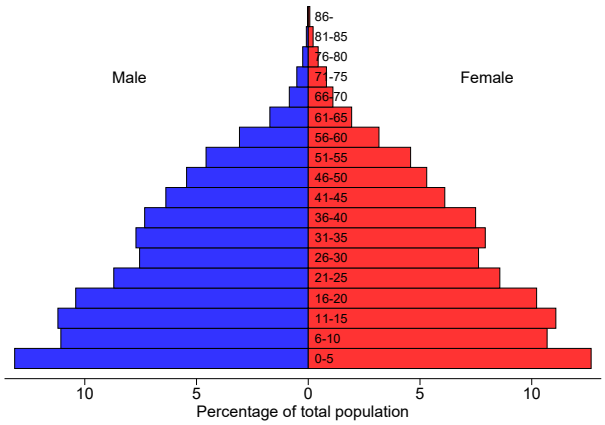
Source: GSZR, Bértarifa.

Figure C.5: The population pyramid for non-Roma, 2011



Source: Census.

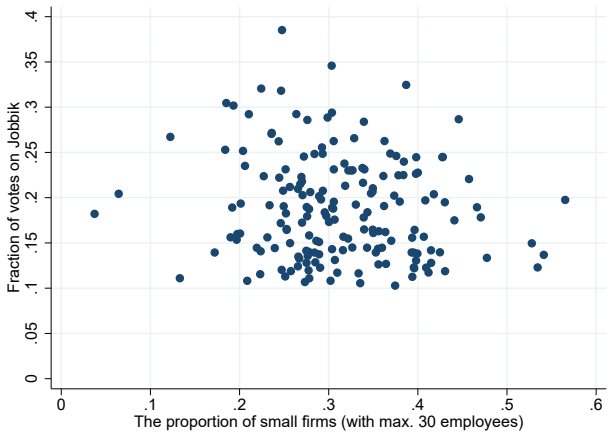
Figure C.6: The population pyramid for Roma, 2011



Source: Census.

10.14754/CEU.2021.05

Figure C.7: The proportion of votes casted for the Jobbik party list and small firms by district, 2011



Source: valasztas.hu, GSZR, Bértarifa.

10.14754/CEU.2021.05