LAJOS TAMÁS SZABÓ

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

(A közmunkaprogramok hatása a versenyszféra béreire Magyarországon)

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”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

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Abstract

The public work (PW) programmes have been the major active labour market policy tools since 2011 in Hungary. Majority of the public workers were inactive before the programme. Due to this the labour supply considerably increased in those district, which got significantly more subsidy from the central government for PW programmes. Large portion of the public work funds was distributed to those districts, which were below the country average development level. As the programme budget was not evenly distributed among districts, I can use this as variation to identify the indirect effect of the programme on the private sector. I estimate the effect of public work programmes on the private sector wage using regression discontinuity design. According to my estimations the private sector wage level is lower on average by 9% between 2013-2017 among the low-skilled workers in those districts where the number of public workers is higher. In the mean time in these district the private sector employment dynamics is 4% higher. This gives a (-0.43) elasticity of labour demand, which is in-line with the previous estimates for Hungary.

JEL: J21, J31, J38.

Keywords: local labour markets, labour supply, wage differentials.

Összefoglaló

A közmunkaprogram 2011 óta a foglalkoztatáspolitika legfontosabb eszköze Magyarországon. A közfoglalkoztatottak nagy része a program előtt inaktív volt. Emiatt a munkakínálat jelentősen megnőtt azokban a járásokban, amik több pénzt kaptak a közmunkára a kormányzattól. A közmunkára fordított források jelentős részét azokban a járásokban használták fel, amelyek fejlettségben az országos átlag alatt vannak. Mivel a program forrásait nem egyenlő arányban osztották szét a járások között, ezt különbséget tudom arra használni, hogy azonosítsam a program indirekt hatásait a versenyszférára. A közmunka versenyszféra béreire gyakorolt hatását szakadásos regresszióval becslem. Eredményeim szerint az alacsonyan képzettek átlagbére a versenyszférában 9%-kal alacsonyabb 2013-2017 között azokban a járásokban ahol több a közmunkás. Ezzel együtt ezekben a járásokban a versenyszféra foglalkoztatási dinamikája 4%-kal magasabb. Ez -0,43-as munkakeresleti rugalmasságot eredményez, ami a korábbi magyar becsléseknek megfelelő.

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 have indirect effect on crime (Chioda et al. (2016)), tuition policy has 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) find a positive wage and a negative employment effect of an Indian public work programme. Other types of indirect effects have also been documented (e.g., 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 good opportunity to study the effects of a 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 had an effect on non-participants, specifically on 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. It has had large budgets in the past few years; 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 effect 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 programme budget was not evenly distributed among districts, I can use this as 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 of several standardised objective socio-economic factors (e.g. local unemployment rate, high-speed internet penetration). If the value of complex indicator is below than 46.68 then the district is eligible for extra funds. Close to the cutoff in the treated districts the number of public workers is more than two times higher than in the control ones. The cutoff rule enables me to use a quasi-experimental research design, specifically a sharp regression discontinuity design (RDD) around the threshold to estimate the effect of the programme.

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 neighborhood 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 treatment. Secondly, the running variable cannot be manipulated by the districts to receive (or avoid) treatment. Since the complex indicator is calculated from 24 objective socio-economic factors the districts cannot easily achieve this. These two assumptions make it plausible to regard variation in treatment near the cutoff as if it were from a randomised experiment (Lee and Lemieux (2010)).

The main results of the paper are the following. I find that in those districts where the number of public workers is higher, the average private sector wage among the low-skilled workers is lower, and the private sector employment is larger than in the

non-treated districts. More specifically, the wages of low skilled workers are 9% lower on average between 2013-2017 in the treated districts around the cutoff, i.e. where the value of development indicator is just slightly lower than the country average. The private sector employment rate is 3.9% higher in the treated districts. This means that the elasticity of labour demand with respect to wages is -0.43, which is inline with the results of previous studies (Kőrösi (2005)). This result is consistent with Layard et al. (1991)'s job competition channel. As the majority of public workers are from the inactive population, they increase labour supply as they start searching for a new job in the private sector. This leads to lower wages 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 placebo and robustness checks suggest that the wage and employment effect is due to the programme and not other factors. Firstly, before the treatment there is no systematic difference between the treated and non-treated districts. Secondly, the programme has no effect on wages, above the median wage. Thirdly, there is no effect for arbitrarily chosen placebo cutoff values.

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 the 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. Therefore 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 indirect effects of PW the countries examined are quite different form 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 case of the above mentioned programmes it is equal.

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 (e.g., Koltai et al. (2018)). None of the studies examine the spillover effect of the PW programmes on private sector.

Thirdly, 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 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 3. In Section 4 I discuss the institutional background of PW programmes and present some descriptive statistics. In Section 5 I carry out the estimation and discuss the results. In Section 6 I conclude.

2 Possible mechanisms

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

2.1 JOB COMPETITION CHANNEL

In the first channel the labour supply grows, which decrease the private sector wage. The majority of the public workers comes from inactivity (see Section 4.3). The goal of the PW programmes is to help the inactive and long-term unemployed to find job in the private labour market by offering them practise. 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 job competition channel.

To elaborate on this channel I use the working history of the individuals. Here I do not take into consideration those, who work in the public sector because their earning is not formed by market forces. I also drop those who are on maternity leave since their employer should employ them after the maternity leave. I concentrate on those flows, where participating in the PW-programme increases the labour supply in the long-run.

Table 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). In the first channel before the PW the individual was inactive. This channel increases the labour supply on the long run since a new participant appeared in the labour market (for more details see Section 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 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.

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 case of on-the job programmes the wage was equal to the original wage). This setup is a favourable alternative than unemployment, which induce wage increase.

Although the PW wage is lower than the minimum wage (see Table 14 in Appendix), we know from anecdotal evidence that for the PW 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 strengthness of this channel is unknown.

Calmfors and Lang (1995) argues that both channels can be present. If the programme is not effectively targeted than wage pressure can be present. On the other hand, if the programme is sufficiently targeted to the long term unemployed than the

wage-declining effect would dominate. Therefore there are at least one channel, which implies a negative and an other, which implies a positive wage effect.

2.3 PW PROGRAMME IN A NEOCLASSICAL MODEL

To illustrate the effect of changes in social transfers and the introduction of PW programmes I modify the neoclassical labour supply concepts (for the original model see e.g. Cahuc et al. (2014)).

In this simple model the household can allocate time (T) to leisure (l) and working hours (h):

$$T = l + h \tag{1}$$

Without PW programme and with social transfers the budget constraint is the following:

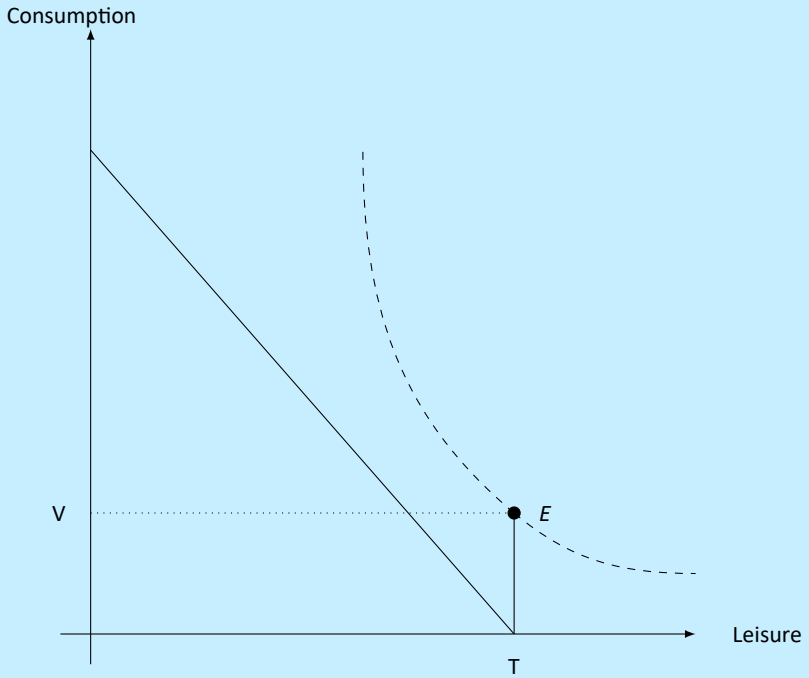
$$C = w_p h + V \tag{2}$$

where

- w_p private sector wage (at least the minimum wage),
- h hours of worked,
- V social transfers (the households get V if if they do not have any other income).

In this case, there are households, where the optimal choice is the endowment point (E), where they get the transfer but do not work (see Figure 1). This happens when the household attaches high value to leisure time (the indifference curve is steep). It can be also possible that only the endowment point is available because there are no job opportunities in the neighbourhood.

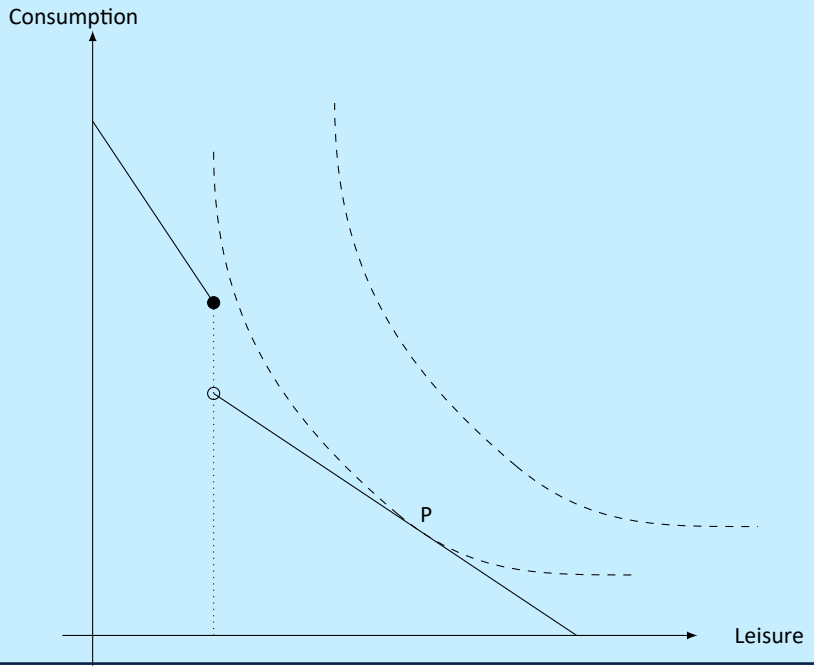
Figure 1
Original budget set with transfer and without PW



Introducing the PW programme means that there is a new job opportunity for lower wage than the private sector employment. Since the vast majority of the public workers are low-skilled (see Section 4.3) they have limited possibilities in the primary labour

market and their job is not so flexible. Furthermore, the participating time in the PW programme is limited. To illustrate these two factors, I set the private sector work available from a certain working-time threshold (it can be e.g. 6 hours a day).

Figure 2
The budget set with PW



Parallel with the introduction of the PW programme the government significantly cut back the social transfers. To illustrate this I set $V = 0$. In this case the budget constraint is the following:

$$C = w_p h\mathbf{1}(h > 6) + w_{pw} h\mathbf{1}(h < 6) \tag{3}$$

where

- w_p private sector wage (at least the minimum wage),
- w_{pw} public work wage ($w_p > w_{pw}$),
- h hours of worked.

In this setting for those, who prefer leisure much more than consumption the optimal choice is the PW programme. Their optimal choice is in *P* on Figure 2.

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 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 are often earnings, 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 lenght of an ALMP and its effectiveness. For instance, short-term subisdised jobs help participants to find a regular job, on the other hand the longer the subsidised job is, the smaller the positive effect is (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)).

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 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 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 the 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 a 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 study 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 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 job search. On the other hand, a full-time and not flexible public work can be an obstacle during job search if the public worker do 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 substitution effect if an existing job is filled with a public worker (this can be the case of enterprises run by municipalities). In this case there is no new job creation. 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 2).

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 subsidiy and training programmes. O'Leary (1997) also finds 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 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 effect on all time horizons.

There are some papers, which focus on the effect of PW programmes on private sector wages and employment. Wray et al. (2018) simulated the effect of a hypothetical PW programme in the US and get higher private sector employment on the long run. A recent set of empirical studies focus on the effect of the Indian PW programme (NREGS) on the wage of 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 for 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 rural labour market because in NREGS the wage equals to the minimum wage (Berg et al. (2018) and Imbert and Papp (2015)). In Hungary PW wage is considerably lower than the minimum wage to incentivise participants to find a job on the primary labour market and the jobs mainly available not in the 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 interesting to analyse the effect of the Hungarian PW on non-participants.

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 poverty reduction and value-added generating role as well. These goals are inline 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 in their basic competences. Based on the survey during the PW there was a large progress in the employees' skills like communication, conflict management, problem solving, adaptibility 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.

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 scheme (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)). On average this type of funding amounted 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 (see more on the allocation rule in Appendix B.1). On average this type of funding amounted 37% of the total funding between 2013-2017.
- National public works programmes: these programmes are organised by state-owned corporations (such as public utilities or forest management plants), for tasks including flood control or maintenance works in public transport infrastructure. On average this type of funding amounted 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.

PW employers can be the central government, local municipalities, churches, social cooperatives and some specified businesses (see details in Appendix B). In PW the yearly days of holiday is less than in a normal job. It is 20 days regardless of the employee's age. This stricter rule also an incentive to find a job on the primary labour market. Those who get unemployment benefit should accept the PW regardless of their educational level. Otherwhise they loose the unemployment benefit. Previously jobseekers were forced to accept the work only if it fitted to their educational level (Bördős (2015)).

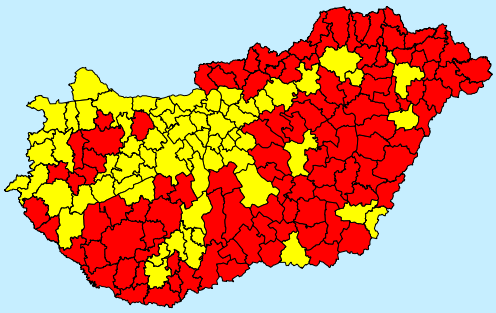
4.2 FUNDAMENTAL SUBSIDISING RULES

The Hungarian government categorised the districts according to their development. Those districts, which are below a certain threshold 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).

The complex indicator is the average of socio-demographic indicators, housing indicators, local economic indicators, infrastructural and environmental indicators (see details in Appendix A.3).

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

Figure 3
Special importance districts



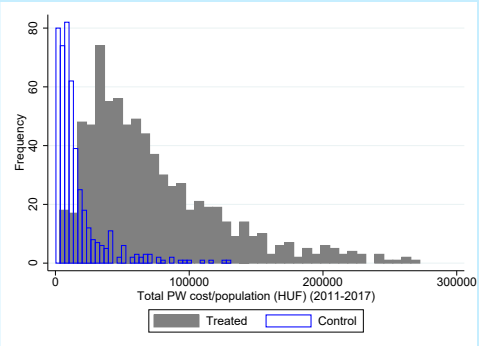
The red districts are the special importance districts. Source: 290/2014. Korm. rendelet.

This distinction can be used to define treated and non-treated districts, which are similar to each other based on observables (Figure 3). The special importance districts (treated) got more funds for PW programmes than the others (control). The less developed a district is the more PW funds it gets (see Figure 4). The identification uses the clear discontinuity in per capita PW-cost around the country average (Figure 5). The main difference is due to the micro-regional model programmes, which amounted roughly 40% of the total costs on the country level. For these programmes only the special importance districts could apply.

To be a special importance district is just a possibility to apply for more funds not a direct extra subsidy (Bördős (2015)). Based on the total funding (see Figure 4 and 5) the public worker employers use this possibility. But still this fact means that the identified effect is an intention to treat effect.

Although the *290/2014. Korm. rendelet* is the base regulation there is an other 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 the 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.

Figure 4
The total costs of PW-programmes/population (2011-2017) for districts

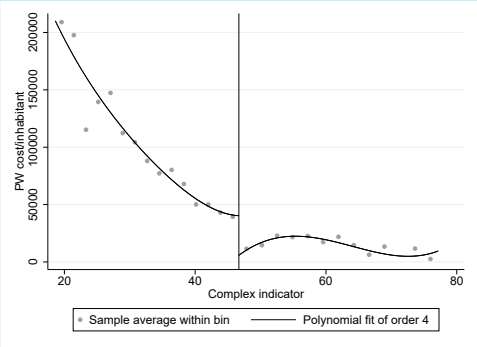


Source: Ministry of Interior and own calculations

Paralell with the introduction of the PW programmes the transfer system was reformed considerably (for details see Appendix C). 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 from the complex indicator, which helps to disentangle the effect of PW from the social transfer change.

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

Figure 5
The per capita PW-cost and the complex indicator in 2015 (without Komló and Gyula districts)



Source: Ministry of Interior and own calculations. Without Gyula nad Komló district

4.3 DATABASE AND DESCRIPTIVE STATISTICS

The databse 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 can be separated in the databse since September 2011. I transformed this database to a district and two-digit occupational level database. For this I used those who worked on the 30th April in every year (between 2009-2017). I averaged the private sector wages in every district two-digit occupational cell weighting by the employment time. It gives 45 occupational categories per district on average.

Table 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

The budget for the PW programmes increased considerably between 2011 and 2017. In the peak it was as much as the 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 was 218 thousand public workers, which was 5.5% of the total employment (Table 2). The large amount of funding and the high share of public workers makes this programme suitable to look for general equilibrium effects.

The vast majority of public workers are employed in elementary occupations, which does not require any qualification (FEOR 9). The share of these occupations are above 75% in every year. The second largest is the Office and management (customer services) occupation category (FEOR 4), in which on average 5% of public workers are employed. The other categories are less than 5% (see Figure 6). Due to this I expect the effect only in the low-income category workers.

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 case of those, who were inactive two years before the PW programme (Figure 7). This phenomenon clearly illustrates that the PW programme indeed increased considerably the labour supply.

According to these descriptive evidences the PW programme considerably increased the labour supply in the treated districts.

Figure 6
The occupational distribution of PW by year

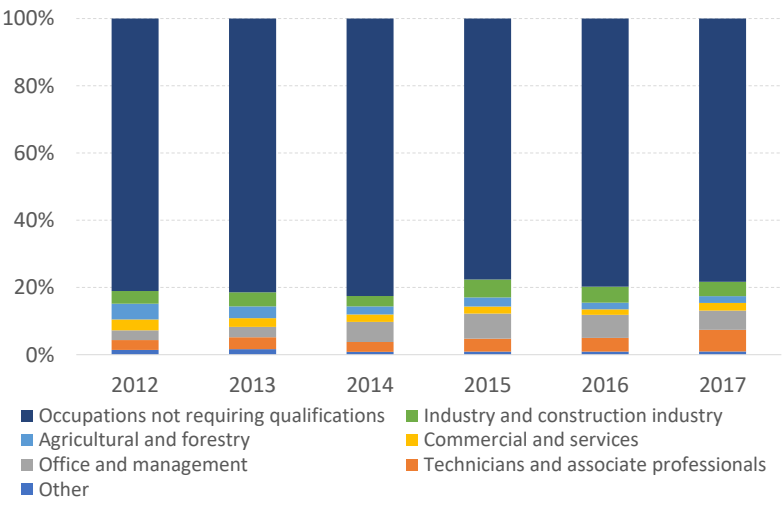
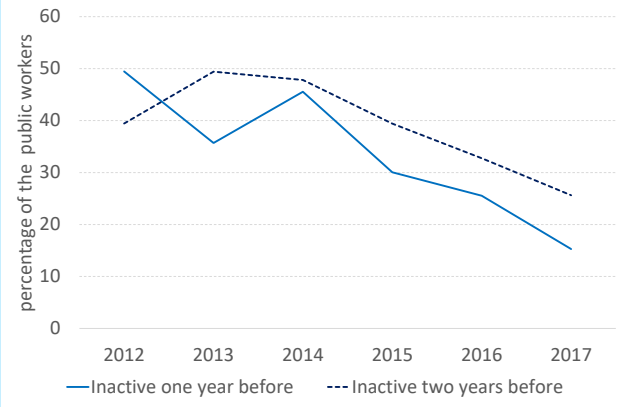


Figure 7
The share of those, who were inactive before the PW programmes (24-57 years old)

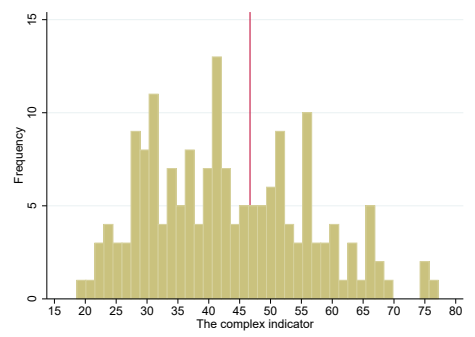


5 Empirical analysis

5.1 THE 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. The allocation mechanism was based on a development indicator. According to the government decree those districts are special importance districts, where the development level, measure 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 vica versa).

Figure 8
The distribution of the complex indicator



There are two fundamental assumption 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 socio-economic variables, which cannot be manipulated by the districts. Furthermore, based on the histogram of the complex indicator there is no sign of bunching around the cutoff (Figure 8). The variation that RDD isolates is 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)).

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

$$Y_{it} = \begin{cases} Y_{it}(1), & \text{if } x > c \\ Y_{it}(0), & \text{if } x < c \end{cases}$$

where

- i is the index for district-occupational cells (see the calculation in Appendix A.1)
- t is the year index (in the main specification it is between 2013-2017)
- $Y_{it}(1)$ is the outcome for a randomly chosen population unit if it is treated,
- $Y_{it}(0)$ 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 below the median wage. But I also check the employment changes as well. The causal parameter that can be identified as the treatment effect at the cutoff:

$$\tau = E(Y_i(1) - Y_i(0)|X_i = c) \tag{4}$$

This quantity is identified as a jump in the regression function at the cutoff value c:

$$\tau = \mu_+ - \mu_- \tag{5}$$

where

$$\mu_+ = \lim_{x \searrow c} \tag{6}$$

$$\mu_- = \lim_{x \nearrow c} \tag{7}$$

and

$$\mu(x) = E(Y_i|X_i = x) \tag{8}$$

The districts cannot manipulate their complex indicator therefore only compliers can be found.

Based on Calonico et al. (2017) the treatment effect is identified nonparametrically using kernel-based local polinomials on both sides of the cutoff. The local polinomial RD estimator of order p is

$$\hat{\tau}_p = \hat{\mu}_{p,-}(h_n) - \hat{\mu}_{p,+}(h_n) \tag{9}$$

where $\hat{\mu}_{p,-}(h_n)$ and $\hat{\mu}_{p,+}(h_n)$ are the intercepts of a weighted pth order polynomial regression for only treated and only control units. The h_n is the optimal bandwidth minimizing the mean square error.[3]

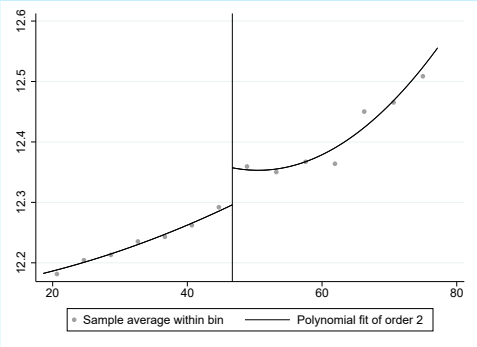
5.2 MAIN RESULTS

There is an evident difference between the private sector wages of the treated and non-treated districts (Figure 9). On the other hand, there are other factors, which can have an effect on the private sector wages other than the PW programme. For instance, the general economic conditions are better in the non-treated districts. To overcome this issue I use regression discontinuity design and compare those districts, which are close to the cutoff (46.68). In this way I compare those districts, which are similar and the main difference between them is the different public worker share.

I use the full-time equivalent private sector average wages in each occupational category (see the calculation of the private sector wage in Appendix A.1). There are 91 occupational categories between 2009-2017. On average there are 40-45 occupational categories in each district. Since the vast majority of public workers are employed in low-skilled jobs, I restrict the sample to those district-occupational cells, where the average wage was below the country level median wage in 2009. In this way I choose the sample before the treatment.

[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 9
The log(private sector fte wage) and the complex indicator



2013-17 without Komló and Gyula districts.

Based on observables the treated and control districts are similar close to the cutoff, and the distribution is smooth around the coutoff (see Figure 16 in Appendix).

My estimates show that from left of the cutoff after the treatment (2013-2017) the wages are lower by around 9-10% (Table 3). This is in-line with the first mechanism in Section 2. 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.

Table 3
RD estimates using local polynomial regression for log private fte, main specification

		(1)	(2)	(3)
Robust	Coef.	-0.0902***	-0.0996***	-0.105***
	St.error	(0.0243)	(0.0261)	(0.0298)
Observations		13,638	13,638	13,638
Time horizon		2013-2017	2013-2017	2013-2017
Left BW		2.2	6.4	12.1
Right BW		2.2	6.4	12.1
Obs. left of the cutoff		918	2651	4792
Obs. right of the cutoff		427	1580	2693
Order of polynomial		0	1	2
Restriction		Below 2009 median wage		

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

It is worth examining what is the effect of PW programmes on the private sector employment as well. The results show that the average yearly employment percentage change between 2013-2017 is around 4 percentage point higher on the left of the cutoff than on the right (Table 4). Therefore, the employment dynamics was higher in the treated districts. Comparing to the wage change there were lower wage and higher employment dynamics in the treated districts close to the cutoff. More specifically, there was a 9% decrease in wages and 3.9% increase in employment on average between 2013-2017, which means $3.9/(-9) = (-0.43)$ elasticity of labour demand with respect to wages,.This is similar to the results of Imbert and Papp (2015) for India. Kőrösi (2005) estimated the labour demand elasticity for Hungary between $(-0.2) - (-0.5)$. Kőrösi (2005) argues that these values are similar to the Western-European elasticities.

A simulation for the US economy shows that PW programme can have long lasting effects. Wray et al. (2018) calculated the effect of a theoretical PW programme with participants as much as 7-10% of the total number of employed. It has long lasting effect on the private sector employment even after 9 years. There is 2.2-2.8% higher private sector employment due to the programme. This result could imply that my estimates for employment changes can be long-lasting.

Table 4
RDD for the percentage change in private sector employment

		(1)	(2)	(3)
Robust	Coef.	3.909**	4.405**	5.012**
	St.error	(1.627)	(1.941)	(2.120)
Observations		13,641	13,641	13,641
Time horizon		2013-2017	2013-2017	2013-2017
Left BW		2.4	5.3	10.1
Right BW		2.4	5.3	10.1
Obs. left of the cutoff		920	1813	3916
Obs. right of the cutoff		428	1253	2502
Order of polynomial		0	1	2
Restriction		Below 2009 median wage		

*The outcome variable is percentage change in private sector employment, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

To assess the external validity of the results one have to take into consideration that during this period there was an economic boom in Hungary with emerging labour shortage. This economic enviroment could have a great role in that public workers could find a job in the private sector and the presence of PW programme had an effect on private sector wages. It is still a question that during a recession or a sluggish economic growth how these results would change.

In my database I cannot distinguish the inactive from those, who are employed in an undeclared work. According some estimations the number of illegal workers is between 10-17% of the total employment in Hungary (Benedek et al. (2015)). This means that the flows, which I observe from inactivity to public worker are somewhat less in reality than in the database. This means that my estimations can be considered as upper bounds for the wage effect.

My results show that the PW programme has indirect effects on those who do not participate 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 nieche in the literature, especially in the Hungarian context. To summarize of the total welfare effects of PW is beyond the scope of my paper.

5.3 PLACEBO REGRESSIONS AND ROBUSTNESS CHECKS

In 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 treatment period. The coefficients are not significant and close to zero (Table 5). This confirms the results in the main specification, because before the treatment private sector wages in the treated and control group were very similar close to the cutoff among the low-skilled workers.

Secondly, I use those sectors, where the wage was higher than the country median in 2009. In these sectors the public worker share is quite low or nil, therefore I do not expect any significant difference between the wages. As in the previous case the coefficients are close to zero and not significant (Table 6).

Thirdly, I apply two placebo thresholds one above and one below the original cutoff. In both cases the estimated effect is close to zero, not significant and instable (Table 7), which shows that there is no effect around the placebo cutoffs.

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 8) argument.

Table 5
RD estimates using local polynomial regression for log private fte wage, placebo

		(1)	(2)	(3)
Robust	Coef.	-0.00200	0.00589	-0.000667
	St.error	(0.0198)	(0.0243)	(0.0404)
Observations		12,085	12,085	12,085
Time horizon		2009-2012	2009-2012	2009-2012
Left BW		5.3	11.6	12.7
Right BW		5.3	11.6	12.7
Obs. left of the cutoff		1607	4078	4390
Obs. right of the cutoff		1102	2408	2474
Order of polynomial		0	1	2
Restriction		Below 2009 median wage		

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

Table 6
RD estimates using local polynomial regression for log private fte wage, placebo

		(1)	(2)	(3)
Robust	Coef.	-0.0158	-0.0149	-0.0112
	St.error	(0.0236)	(0.0283)	(0.0348)
Observations		20,302	20,302	20,302
Time horizon		2013-2017	2013-2017	2013-2017
Left BW		3.6	7.9	11.9
Right BW		3.6	7.9	11.9
Obs. left of the cutoff		1250	4343	6040
Obs. right of the cutoff		1597	3590	5411
Order of polynomial		0	1	2
Restriction		Above 2009 median wage		

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

Table 7
RD estimates using local polynomial regression for log private fte wage, placebo with different cutoffs

		(1)	(2)	(3)	(4)	(5)	(6)
Robust	Coef	-0.00658	-0.0240	-0.0284	0.0121	-0.0349	0.0178
	St. Error	(0.0184)	(0.0260)	(0.0314)	(0.0301)	(0.0702)	(0.0500)
Observations		13,638	13,638	13,638	13,638	13,638	13,638
Time horizon		2013-2017					
Left BW		2.3	3.2	4.7	2.2	2.3	4.7
Right BW		2.3	3.2	4.7	2.2	2.3	4.7
Obs. left of the cutoff		818	1054	2364	215	215	1058
Obs. right of the cutoff		1094	1179	1967	305	305	500
Order of polynomial		0	1	2	0	1	2
Restriction		Below 2009 median wage					
Cutoff		35	35	35	60	60	60

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. The threshold is 35 and 60 respectively. The sample contains those district-occupational cells, where the average wage was below the median wage in 2009, without Gyula and Komló districts. *** p<0.01, ** p<0.05, * p<0.1*

Table 8
RD estimates using local polynomial regression for change in per capita transfers

		(1)	(2)	(3)
Robust	Coef.	0.232	0.150	-0.310
	St. error	(0.677)	(0.828)	(1.261)
Observations		1,211	1,211	1,211
Time horizon		2011-2017		
Left BW		4.4	10.2	10.6
Right BW		4.4	10.2	10.6
Obs. left of the cutoff		112	329	350
Obs. right of the cutoff		105	266	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. The threshold is 46.68. The sample contains every district exept for Gyula and Komló districts. *** p<0.01, ** p<0.05, * p<0.1*

I make some robustness checks as well. I use a different restriction for the district-occupational cells. Instead of those, which are below the median wage, I use those, where the average PW-proportion is not 0 (see the highest 10 occupational category in Table 16 in Appendix). Out of the 90 categories there are 40, where there was at least one public worker between 2013-2017. Using this restriction the treated districts have lower wages by around 8% and there is no significant difference before the treatment (Table 9), which is also in-line with the main specification.

Table 9
RD estimates using local polynomial regression for log private fte wage, robustness check

		(1)	(2)	(3)	(4)	(5)	(6)
Robust	Coef.	-0.0182	-0.0836***	-0.0181	-0.0830***	-0.00419	-0.0847***
	St.error	(0.0223)	(0.0198)	(0.0264)	(0.0213)	(0.0307)	(0.0255)
Observations		24,998	32,825	24,998	32,825	24,998	32,825
Time horizon		2009-12	2013-17	2009-12	2013-17	2009-12	2013-17
Left BW		2.6	3.5	6.7	7.6	11.2	12.4
Right BW		2.6	3.5	6.7	7.6	11.2	12.4
Obs. left of the cutoff		1601	2094	4614	7202	7191	10596
Obs. right of the cutoff		1013	2271	3632	4950	5971	7825
Order of polynomial		0	0	1	1	2	2
Restriction		public worker share> 0					

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. The threshold is 46.68. The sample contains those district-occupational cells, where the public work share was above 0% between 2013-2017, without Gyula and Komló districts. *** p<0.01, ** p<0.05, * p<0.1*

6 Conclusion

In this paper I have evaluated the the effect of public work programmes in Hungary on private sector. I have found that the PW-programmes had a considerable effect on the labour supply and they contributed to the employment of the private sector.

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 signifianctly less financial support from the central government. I can use this rule for a sharp RD design. Since there are other differences than the PW between the districts I have compared only those, which are close to the cutoff. Due to the labour supply increase the wages in those district, where there was higher share of PW, are somewhat smaller. I made some robustness checks and the results seem to be stable.

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. Other area of the research could be a full cost-benefit analysis of the programme.

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Appendix A Database description

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

- gender, year of birth, district level place of residence,
- the exact working period of an employee at a given firm,
- the wage,
- the type of employment (e.g. self-employed, enterprenour, employee, public worker etc.),
- four digit occupational code (FEOR),
- weekly hours worked,
- the cause of absence (e.g. maternal leave, sickness etc.),
- the anonymised code of the employer.

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 are those people, who do not get any subsidy but they look for a job. I consider those as inactive, who do not work and do not get any unemployment benefit.

A.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 has several type of job, 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 districts. This means that I have around $40 \times 175 = 7000$ observations in each year.

A.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 scope of this paper.

A.3 THE VARIABLES USED FOR COMPLEX INDICATOR

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

I. Indicators of 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 / $km2^2$) (%),

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

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

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

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 (persons),

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 natural persons per thousand inhabitants (pcs),

Life expectancy at birth - men (years),

Life expectancy at birth - women (years),

III. Local economy and labor 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 jobseekers out of the permanent working age populatio (%),

Proportion of registered jobseekers 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 regular waste collection (%),

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

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

Appendix B 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.

In 2012 public employment model programmes were launched in the 94 disadvantaged micro-regions listed in Annex No. 2 of Government Decree No. 311/2007 (XI. 17) on the Classification of Beneficiary regions, in 5 priority settlements of the Gyöngyös micro-region and in 3 disadvantaged micro-regions (Devecser, Tét, Pécs micro-regions) selected based on individual decisions. 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.

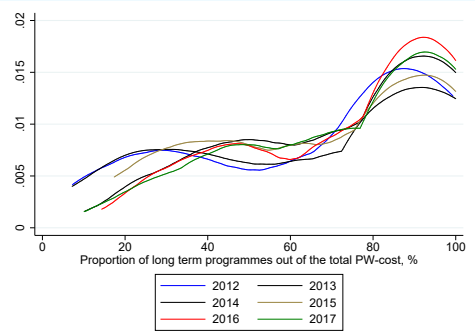
B.1 THE FINANCING RULES FOR LONG-TERM AND NATIONAL PW PROGRAMMES

The other major PW programme type is the Long-term public work programme. This was the main source for the non-special importance districts (see Figure 10). The funding of Long-term programme is based on the so-called taxpower (*adóerőképesség*). This is the possible tax income of a settlement from those enterprises, which have the official headquarters in the settlement. The municipalities can decide on the tax rate for the enterprises. The taxpower is the 1.4% of the tax base of business tax.

The funds for the Long-term public work programme is used by the County Government Agencies (*Kormányhivatal*). The Ministry of Interior gives more funds for Long-term public work programmes in those counties, where the number of micro-regional model programmes are low or they do not exist at all. According to the recommendation of the Ministry of Interior the County Councils should strongly take into consideration the taxpower of the municipalities. There are other factors, which can have an

effect on the subsidising decision (e.g. local unemployment rate). Those municipalities should be subsidised more, where the taxpower is low. The exact recommendations change from year to year but the main factor is the taxpower.

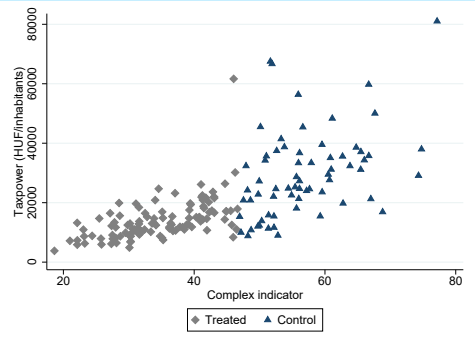
Figure 10
The proportion of Longer-term PW programmes out of the total cost for the control districts (kernel density)



Based on the financing backgrounds of the Long-term public work programmes and the Micro-regional model programmes the complex indicator is the best way to distinguish between the treated and non-treated districts. In general the taxpower is higher in the non-special importance districts (see Figure 11).

In case of the national PW programmes there are no similar factors, which determine the allocation of the funds. Those corporations can apply for for it, who are eligible (e.g. Hungarian Railways - MÁV, fire service, national parks, forest management plants etc.). In general those can apply who exercise public duties.

Figure 11
The complex indicator and taxpower in treated and non-treated districts in 2014



B.2 MAIN CHANGES IN THE PROGRAMME (2013-2017)

2013

- defined the special importance distritcs in PW: in which at least the half of the settlements are special importance (it is defined in a government decree).
- those will be cancel out from the unemployment registry who do not accept the PW job.
- From 1st September, 2013 those will 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

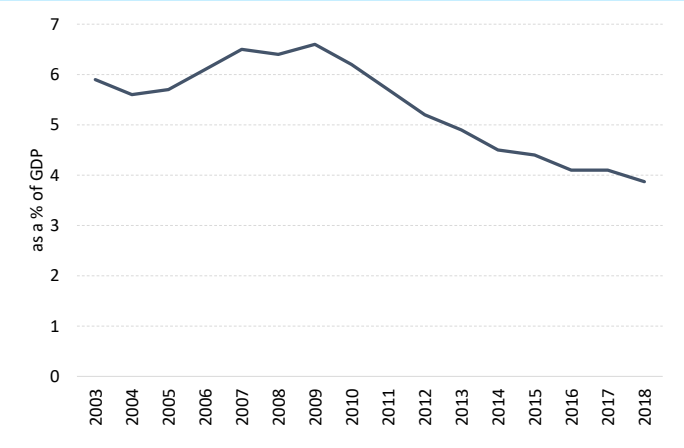
- those who manage to find a job during the PW programme will get a benefit. The amount of the allowance is the same as the amount of employment substitution support payable for the period from the termination of public works participation to the date until the public works programme was supposed to 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 has 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 time.

Appendix C Main changes in the social transfer system

Figure 12
Social protection benefits as a percentage of GDP



Including disblitiy, familiy, children, unemployment, housing, social exclusion benefits, source: CSO

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 the 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 form 180 days to 90 days (Cseres-Gergely and Molnár (2014)).

From 2012 the eligibility criteria was tighten 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 12).

Appendix D Further robustness check

D.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 treated district the average wage is smaller due to the change in the compostion of employees. To control for compostion effect I recalculated the district-occuaptional average wages for every year only for those, who were employed in 2009 in the private sector. The RDD results are very similar than in the main specification (see Table 10). This means there is not any significant compostion effect in the estimated coefficient. The reason for this could be the binding minimum-wage in case of low skilled employees

Table 10
Robustness check for compostion effect: RD estimation for those who were employed in 2009 in the private sector

		(1)	(2)	(3)
Robust	Coef.	-0.111***	-0.119***	-0.131***
	St.error	(0.0271)	(0.0278)	(0.0361)
Observations		13,410	13,410	13,410
Time horizon			2013-2017	
Left BW		2	6.3	12.2
Right BW		2	6.3	12.2
Obs. left of the cutoff		909	2564	4717
Obs. right of the cutoff		422	1561	2673
Order of polynomial		0	1	2
Restriction			Below 2009 median wage	

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

D.2 USING THOSE WHO NEVER WORKED IN THE PRIVATE SECTOR

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 relcalculated the district-occupational cell average wages. The results are quite similar to the original estimation. Therefore the significant negative coefficient is not caused by lower starting wage of previously public workers in the private sector.

D.3 CONTROLLING FOR TREATED SETTLEMENTS IN NON-TREATED DISTRICTS

There are special importance settlements in non-special importance districts[4]. The majority of these settlements are tiny (less than 1000 inhabitants) therefore the population living in special importance settlement in non-special importance districts is low (see Table 12). Close to the cutoff (not more than 10 points) there are 3 non-special importance districts (Miskolci, Tiszaújvárosi, Nagykanizsai), in which more than 10% of their population living in special importance districts. One can argue

[4] 105/2015. (IV. 23.) Korm. rendelet

Table 11
Robustness check controlling for possible composition effect

		(1)	(2)	(3)
Robust	Coef.	-0.0878***	-0.0965***	-0.102***
	St. error	0.0246)	(0.0265)	(0.0303)
Observations		13,563	13,563	13,563
Time horizon			2013-2017	
Left BW		2.2	6.4	12.1
Right BW		2.2	6.4	12.1
Obs. left of the cutoff		918	2650	4786
Obs. right of the cutoff		425	1577	2690
Order of polynomial		0	1	2

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. The district-occupational cell average wage was calculated using only those individuals, who never particiapted in the PW programme *** p<0.01, ** p<0.05, * p<0.1*

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 does not change significantly therefore this phenomenon does not alter the estimations (Table 13).

Table 12
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 13
Robustness check without those districts, where the ratio of those who live in special importance settlments is greater than 10%

		(1)	(2)	(3)
Robust	Coef.	-0.0903***	-0.0993***	-0.0951***
	St. error	(0.0233)	(0.0253)	(0.0302)
Observations		13,433	13,433	13,433
Time horizon			2013-2017	
Left BW		2.3	7.2	11.8
Right BW		2.3	7.2	11.8
Obs. left of the cutoff		918	2821	4618
Obs. right of the cutoff		427	1465	2488
Order of polynomial		0	1	2

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. 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. *** p<0.01, ** p<0.05, * p<0.1*

Appendix E Further tables and graphs

Table 14
The proportion of PW wage to minum 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 minimum wages. One for those, who don't have any qualification and for those who has at least vocational qualification.

Table 15
Population of the counties and the proportion of those, who live in special importance districts (2013)

Megye (county)	Total pupulation	Proportion of those who live in special importance districts
NO	198392	100
SO	315512	84
SZ	561379	70
BK	516892	70
JN	383489	69
BE	355199	65
HB	539507	60
BO	674999	59
CS	407389	51
BA	373984	43
HE	303503	31
TO	227996	31
VE	349007	25
ZA	279623	18
PE	1220748	17
VA	254580	15
FE	419506	12
KE	300677	7
GY	450318	3
BP	1735711	0

Table 16
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

Table 17
Robustness check for occupational categories

		(1)	(2)	(3)	(4)	(5)	(6)
Robust	Coef.	-0.0753**	-0.113***	-0.110***	-0.0796***	-0.0801***	-0.0543
	St.error	(0.0298)	(0.0317)	(0.0369)	(0.0236)	(0.0272)	(0.0351)
Observations		6,673	6,673	6,673	1,760	1,760	1,760
Time horizon		2013-2017	2013-2017	2013-2017	2013-2017	2013-2017	2013-2017
Occupational cat.		5-8	5-8	5-8	9	9	9
Left BW		1.7	5.9	11.5	2.2	6.6	8.1
Right BW		1.7	5.9	11.5	2.2	6.6	8.1
Obs. left of the cutoff		280	1240	2180	110	320	390
Obs. right of the cutoff		165	730	1315	70	240	270
Order of polynomial		0	1	2	0	1	2
Restriction		Below 2009 median wage					

*The outcome variable is the log fte private sector wage, the running variable is the complex indicator. 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. *** p<0.01, ** p<0.05, * p<0.1*

Table 18
The basic specification with yearly time restriction

		(1)	(2)	(3)	(4)	(5)
Robust	Coef.	-0.111**	-0.107*	-0.141***	-0.0969**	-0.0751
	St.error	(0.0562)	(0.0619)	(0.0512)	(0.0481)	(0.0549)
Observations		2,729	2,727	2,726	2,731	2,725
Time horizon		2013	2014	2015	2016	2017
Left BW		6.7	6.9	8.6	9.0	7.2
Right BW		6.7	6.9	8.6	9.0	7.2
Obs. left of the cutoff		531	529	687	705	547
Obs. right of the cutoff		325	324	362	410	335
Order of polynomial		1	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 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. *** p<0.01, ** p<0.05, * p<0.1*

Figure 13
Average PW proportion across districts

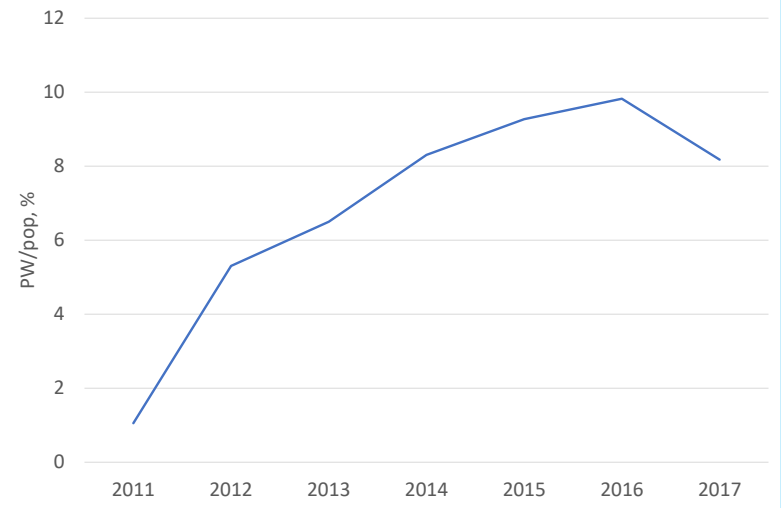
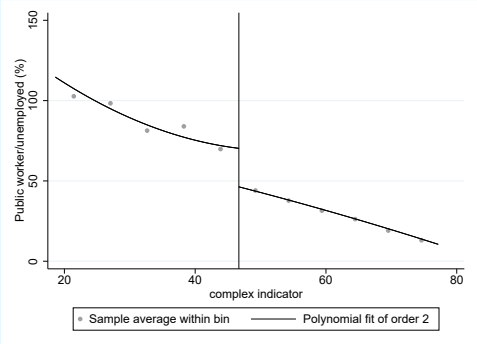
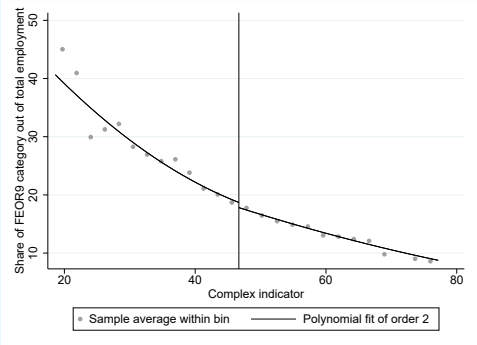


Figure 14
Public workers per unemployed (2013-2017)



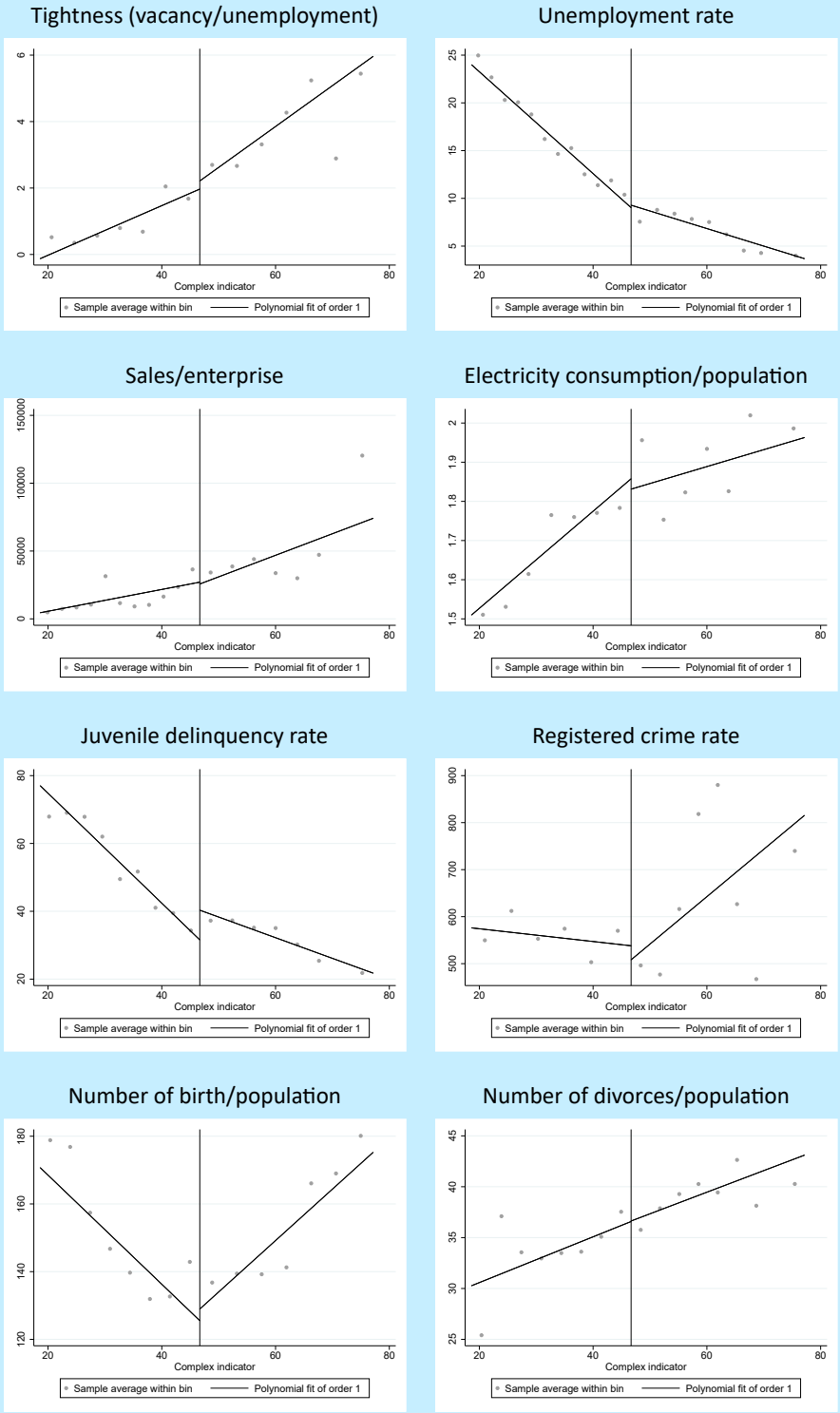
Without Gyula and Komló districts.

Figure 15
Share of FEOR9 occupational category in the total employed (2013-2017)



Without Gyula and Komló districts.

Figure 16
Other covariates (2009-2011)



Without Gyula and Komló districts.

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