

## Sector-specific gender pay gap: evidence from the European Union Countries

Hedija, Veronika

Veröffentlichungsversion / Published Version

Zeitschriftenartikel / journal article

### Empfohlene Zitierung / Suggested Citation:

Hedija, V. (2017). Sector-specific gender pay gap: evidence from the European Union Countries. *Economic Research-Ekonomska Istraživanja*, 30(1), 1804-1819. <https://doi.org/10.1080/1331677X.2017.1392886>

### Nutzungsbedingungen:

Dieser Text wird unter einer CC BY Lizenz (Namensnennung) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier:

<https://creativecommons.org/licenses/by/4.0/deed.de>

### Terms of use:

This document is made available under a CC BY Licence (Attribution). For more information see:

<https://creativecommons.org/licenses/by/4.0>

## Sector-specific gender pay gap: evidence from the European Union Countries

Veronika Hedija

Department of Economic Studies, College of Polytechnics Jihlava, Jihlava, Czech Republic

### ABSTRACT

The study aims to determine whether the unexplained gender wage gap varies in the different sectors of the economy and to identify the possible causes of these differences. Firstly, we estimate average treatment effect on the individual sectors to identify the unexplained part of gender pay gap. To identify the possible causes of observed variability in unexplained gender wage differences, we use a linear regression model. Using European Union Statistics on Income and Living Conditions (EU-SILC) data for 24 European Union (EU) members, we conclude that the unexplained gender pay gap in the individual sectors varies both within the individual EU countries and among the countries. The most important factors in explaining the differences in the gender pay gap among the individual sectors are ownership and the proportion of women in the sector. On the other hand, the proportion of female managers and the proportion of small companies are not statistically significant factors for the explanation of the variation in the sector-specific gender pay gaps. To the best of my knowledge, this study is the first to present fully comparable estimates of the unexplained sector-specific gender pay gap for the 24 EU countries and to identify the causes of the differences in the unexplained gender pay gap at the sectoral level.

### ARTICLE HISTORY

Received 21 December 2016  
Accepted 16 August 2017

### KEYWORDS

Discrimination; human capital; gender; gender pay gap; labour market; wage differences

### JEL CLASSIFICATIONS

J31; J71; M5

## Introduction

The fact that, on average, women earn less than men is well known and accepted in economic literature. Many studies are devoted to the issue of wage differences between men and women and to the classification of the causes of the existing disparities. To identify the causes of the gender wage differences, these studies mainly use Oaxaca-Blinder decomposition or its modification. These enable us to distinguish the part of the gender pay gap which could be explained by differences in known observed personal and company characteristics of men and women, from that which could not be explained by this and which is often known as the ‘remuneration effect’, ‘effect of discrimination’ or simply ‘the unexplained part of gender pay gap’. The results of these studies depend on the used data set, the number of explanatory variables and the applied method of decomposition (for more detail see Beblo,

**CONTACT** Veronika Hedija  [veronika.hedija@vspj.cz](mailto:veronika.hedija@vspj.cz)

© 2017 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Beninger, Heinze, & Laisney, 2003). However, all of these conclude that part of the gender wage differences remain unexplained.

Empirical studies also show that the raw gender pay gap and its unexplained part vary significantly by country. Christofides, Polycarpou, and Vrachimis (2013) use European Union Statistics on Income and Living Conditions (EU-SILC) data and estimate the unexplained part of the gender pay gap for 26 European countries using Oaxaca-Ransom decomposition. The unexplained gender pay gap ranges from 0.198 in the Czech Republic to 0.066 in Belgium. The gender pay gap also differs depending on the sector (public/private). Jurajda (2003) analyses the gender pay gap in the Czech and Slovak private and public sectors and concludes that the unexplained gender pay gaps differ dramatically between both sectors. Similar conclusions are presented in the paper by Chatterji, Mumford, and Smith (2011) using British data.

Applying Statistical Classification of Economic Activities in the European Community (NACE) shows that the raw gender pay gap varies, not only in the private and public sector of the economy, but also in the individual sectors of the economy. An estimate of the sector-specific unexplained gender pay gap for Italy and Spain is shown in the study conducted by Pena-Boquete, De Stefanis, and Fernandez-Grela (2010). Using Oaxaca-Blinder decomposition and the discrimination index, the authors identify the significant differences in the unexplained part of the gender pay gap among the individual sectors by use of NACE classification and also between both countries. In this context a number of questions arise: what part of the gender wage differences remain unexplained in the individual sectors in the EU member states? How do sector-specific unexplained gender pay gaps vary across European countries? What are the causes of the existing disparity?

The aim of this study is to determine whether and to what extent the unexplained gender wage gap varies in the different sectors of the economy of EU members and to identify the possible causes of these differences.

The first section of the article describes the current knowledge in the field of gender pay differences and their causes. The second section is devoted to the used methods and data sets. To estimate the unexplained part of the gender pay gap we calculate the average treatment effect on the treated (ATT) for the individual sectors of the selected European countries. We identify the significant variability in the unexplained gender pay gap calculated for the individual sectors and countries. We attempt to explain this variability using the linear regression model with the ATT as a dependent variable. For explanatory variables we use ownership, the proportion of women and the proportion of female managers in the sector and the proportion of small companies. The final section of the article summarises the obtained results. We conclude that the unexplained gender pay gap is lower: (1) in the public sector when compared to the private sector; (2) in industries employing a similar proportion of men and women; (3) in industries having a higher proportion of female managers; and (4) in industries containing a lower share of small companies. These factors provide an explanation of at least part of the differences in the sector-specific gender pay gaps.

The main contribution of this study is its aim to identify the causes of the differences in the unexplained gender pay gap among the individual sectors of the economy. Existing studies are largely devoted to differences in the raw gender pay gap among sectors or to the differences in the unexplained part of the gender wage gap among countries. This study also brings a valuable contribution in presenting fully comparable estimates of the unexplained portion of the sector-specific gender pay gap for the selected 24 EU member states.

## Unexplained wage differences between men and women

The literature dealing with the issue of wage differences between men and women is very broad. There are a large amount of studies that are devoted to the identification of the causes of the existing gender wage differences. Despite many differences among the individual studies, they all conclude that a certain part of the wage differences between men and women remains unexplained (for example Oaxaca, 1973; Blinder, 1973; Pena-Boquete et al., 2010; Mysíková, 2012; Hedija, 2014). The existence of the unexplained portion is then attributed to unobservable differences in the characteristics of men and women, household-specific factors or to discrimination against women.

The results of the empirical studies show that the unexplained gender pay gap varies among the individual regions. Therefore, several empirical studies are devoted to the identification of the differences in the unexplained gender pay gap across countries and to the explanation of the causes of the existing disparity. These studies confirm the importance of the role of institutions in explaining the variation in country specific gender pay gaps. Blau and Kahn (2003) use micro-data from the International Social Survey Programme for 22 countries over the period 1985–1994 and conclude that the extent of collective-bargaining has a significant negative effect on the gender pay gap. From this point of view, wage-setting institutions have an important effect on the gender pay gap. Arulampalam, Booth, and Bryan (2007) analyse gender pay gaps across wage distribution in 11 countries using micro-data from the European Community Household Panel over the period 1995–2001. They extend the range of involved institutional factors and use the work–family reconciliation index, wage dispersion and union coverage as factors explaining the variation in the country specific gender pay gaps. They conclude that differences in childcare provision and wage setting institutions across EU countries may to a certain degree account for the variation in the unexplained gender pay gap. Similar conclusions are also shown by Christofides et al. (2013). They use data for 26 European countries from EU-SILC 2007 and confirm the quantitatively important relationship between the unexplained gender pay gap and country specific policies and institutions.

The unexplained gender pay gap differs not only across countries and regions but also within the individual industries and between the public and private sectors. Chatterji et al. (2011) examine the public–private sector gender pay gap using data for Britain in 2004 and Oaxaca-Ransom decomposition. They conclude that the unexplained gender pay gap in the private sector is more than two times higher when compared to the public sector. Studies by Antón and Muñoz de Bustillo (2013) and by Rahona-López, Murillo-Huertas, and Salinas-Jiménez (2016) using Spanish Wage Structure Survey data also identify higher unexplained gender wage differences in the private sector. Rahona-López et al. (2016) examine the wage differences by sector (public/private) and by gender. They use a modification of the Oaxaca-Blinder decomposition to isolate wage differences occurring due to differences in personal, occupational and company characteristics and the unexplained part of the gender wage gap. Regarding the public–private sector gender wage differences, they conclude that both the raw gender pay gap and its unexplained part are higher in the private sector. Separately, both sectors show that an increase in wage distribution leads to an increase in the unexplained wage differences. The conclusions of Antón and Muñoz de Bustillo (2013) are similar.

Pena-Boquete et al. (2010), using NACE classification, estimate the unexplained part of the gender pay gap not only for the private and public sectors but also for the individual sectors of the economy. They use data for Italy and Spain and identify the significant variations in the unexplained wage differences across the individual sectors as well as between countries. This study is primarily focused on the distribution of wage discrimination and therefore does not analyse the causes of variability in the sector-specific gender pay gap. The contribution of our study is firstly, to estimate the sector-specific unexplained gender pay gap for 24 European countries and secondly, to identify the possible causes of the existing variability.

## Data

The data used are provided by EU-SILC (Eurostat, 2012). EU-SILC covers multidimensional micro-data on income, poverty, social exclusion and living conditions. We use cross-sectional data for 2011, which comes from EU-SILC 2012 and covers data from 30 European countries. Our study is based on EU-SILC data for 24 member states of the EU (Austria, Bulgaria, Cyprus, the Czech Republic, Germany, Denmark, Estonia, Greece, Spain, Finland, France, Hungary, Italy, Lithuania, Luxembourg, Latvia, the Netherlands, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia and the United Kingdom), which contains all the required information.

EU-SILC data do not contain information on hourly wages. It is therefore necessary to narrow the sample to be able calculate the hourly wages using available data. We narrow the reference population sample to persons who were employees in the reference period, worked all 12 months in a full-time job, had no other jobs and earned an income. We exclude the self-employed, as we are interested in wages and the potential different evaluation of male and female employees by the employer.

We use the following variables on selected personal and company characteristics of the employee: age, level of education (highest attained level of education according to the International Standard Classification of Education (ISCED-97), sickness (temporary inability to work due to sickness in the income reference year), partnership (having a partner in a common household), occupation (according to the International Standard Classification of Occupations (ISCO-08)), sector (economic activity using classification NACE Rev.2), company size (less than 11 employees and 11+ employees), contract (having a work contract of limited duration), managerial position (having formal responsibility for supervising a group of other employees) and hourly gross wage. The hourly gross wage is calculated as the employee's cash and non-cash incomes per year divided by the number of hours usually worked per year (including overtime).

The raw wage differences between men and women in the individual sectors of the economy using NACE classification are shown in Table 1. The reported raw gender pay gap is calculated as the difference between the log average gross hourly wage of women and the log average gross hourly wage of men. We can see that the wage differences vary in the individual countries. Overall, the gender pay gap ranges from  $-0.037$  to  $-0.325$ . The smallest differences in earnings are identified in Poland, Lithuania and Slovenia; on the other hand, the largest raw gender pay gap is in Estonia, Cyprus and the Czech Republic. From this perspective, it is worth mentioning the fact that the transformation economies occur both at the top and at the bottom of the list, though it was expected that a common

**Table 1.** Raw gender pay gap in the individual sectors of EU countries.

	AT		BG		CY		CZ		DE		DK	
	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N
a	0.234	28	-0.246	188	-0.558	32	-0.159	243	-0.341	91	-0.125	24
b-e	-0.303	720	-0.320	1191	-0.416	432	-0.292	2325	-0.313	2327	-0.062	341
f	0.019	348	0.098	299	-0.175	412	-0.006	474	0.029	405	0.095	96
g	-0.267	484	-0.240	660	-0.374	803	-0.411	737	-0.286	568	-0.139	279
h	-0.101	208	-0.152	279	-0.264	175	-0.208	480	0.028	393	-0.067	88
i	-0.088	145	-0.192	238	-0.279	318	-0.282	236	-0.300	130	0.052	23
J	-0.304	108	-0.340	98	-0.074	125	-0.365	158	-0.244	419	-0.188	91
k	-0.367	132	0.071	76	-0.364	266	-0.343	178	-0.255	382	-0.226	106
l-n	-0.310	248	0.113	223	-0.191	349	-0.239	357	-0.241	508	-0.188	242
o	-0.138	334	-0.178	378	-0.212	539	-0.226	508	-0.166	1138	-0.063	169
p	-0.275	313	-0.338	359	-0.205	326	-0.247	531	-0.227	578	-0.014	250
q	-0.228	304	-0.079	298	-0.414	196	-0.247	471	-0.298	768	-0.171	444
r-u	-0.286	113	-0.353	96	-1.237	413	-0.213	143	-0.174	248	-0.039	103
All	-0.178	3485	-0.198	4383	-0.260	4386	-0.239	6841	-0.235	7955	-0.096	2256
	EE		EL		ES		FI		FR		HU	
	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N
a	-0.228	264	-0.684	15	-0.221	196	-0.098	64	-0.287	119	-0.046	349
b-e	-0.363	1216	-0.298	274	-0.140	1418	-0.125	654	-0.211	1447	-0.254	2300
f	-0.263	407	-0.053	68	0.058	423	0.163	246	0.004	764	0.304	535
g	-0.415	535	-0.142	290	-0.227	835	-0.292	381	-0.175	663	-0.223	1017
h	-0.387	350	-0.317	84	-0.105	372	-0.055	241	0.049	454	-0.125	607
i	-0.517	120	-0.146	121	-0.127	371	-0.071	93	0.053	171	-0.303	251
j	-0.268	112	-0.455	45	-0.153	217	-0.147	183	-0.288	286	-0.197	171
k	-0.408	52	-0.382	85	-0.271	254	-0.301	82	-0.254	243	-0.335	173
l-n	-0.206	223	-0.018	89	-0.114	541	-0.224	317	-0.084	644	-0.008	384
o	-0.052	375	0.002	378	-0.069	914	-0.139	221	-0.100	653	-0.022	977
p	-0.356	496	-0.158	258	-0.155	655	-0.269	321	-0.177	830	-0.206	959
q	-0.293	269	-0.142	162	-0.275	724	-0.373	636	-0.181	779	-0.139	645
r-u	-0.413	154	-0.032	56	-0.227	371	-0.263	128	-0.204	203	0.081	199
All	-0.325	4573	-0.068	1925	-0.072	7291	-0.198	3567	-0.137	7256	-0.111	8567
	IT		LT		LU		LV		NL		PL	
	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N
a	-0.236	217	0.175	183	-0.748	35	-0.186	199	-0.417	24	-0.138	197
b-e	-0.192	2597	-0.284	818	-0.209	521	-0.255	800	-0.119	376	-0.254	2786
f	0.055	566	0.084	321	0.241	544	0.132	280	-0.287	130	0.216	869
g	-0.077	1156	-0.177	590	-0.209	429	-0.324	639	-0.102	273	-0.212	1298
h	0.120	549	0.048	368	-0.205	379	-0.022	443	-0.265	130	-0.002	585
i	-0.165	343	-0.122	87	-0.177	204	-0.250	123	-0.402	27	-0.230	206
j	-0.108	276	-0.139	66	-0.386	127	-0.232	101	-0.099	110	-0.190	146
k	-0.154	424	-0.427	72	-0.208	415	-0.267	110	-0.353	112	-0.259	216
l-n	-0.147	710	-0.021	242	-0.447	425	0.067	305	-0.080	231	0.045	538
o	-0.105	1029	-0.055	316	-0.084	491	0.005	447	-0.030	298	-0.106	777
p	-0.069	1020	-0.078	554	-0.203	363	-0.204	574	-0.221	182	-0.129	971
q	-0.213	889	-0.290	399	-0.079	396	-0.157	295	-0.092	311	-0.215	648
r-u	-0.332	406	-0.153	116	-0.453	288	-0.061	178	-0.008	51	-0.144	211
All	-0.076	10,182	-0.038	4132	-0.142	4617	-0.129	4494	-0.073	2255	-0.037	9448
	PT		RO		SE		SI		SK		UK	
	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N	GPG	N
a	-0.231	87	0.113	154	-0.043	74	0.020	22	-0.232	151	-0.337	29
b-e	-0.315	836	-0.180	1355	-0.057	420	-0.181	968	-0.223	1521	-0.208	910
f	0.206	291	0.078	474	-0.040	149	-0.018	177	0.010	380	-0.177	305
g	-0.205	581	-0.238	768	-0.213	242	-0.169	473	-0.263	723	-0.182	642
h	0.168	180	-0.053	312	-0.235	137	0.095	182	-0.156	390	-0.120	242
i	-0.166	293	-0.168	110	0.038	38	-0.109	109	-0.144	225	-0.148	194
j	-0.232	80	-0.126	95	-0.276	95	-0.138	102	-0.225	159	-0.127	195
k	-0.109	91	-0.156	82	-0.165	50	-0.193	108	-0.196	144	-0.449	258
l-n	-0.182	252	0.180	186	-0.132	301	-0.069	293	-0.135	273	-0.192	619

Continued

**Table 1.** (Continued)

	PT		RO		SE		SI		SK		UK	
	GPG	N										
o	0.086	441	-0.180	309	-0.102	150	-0.051	270	-0.194	801	-0.219	494
p	-0.187	494	-0.055	267	-0.097	264	-0.224	387	-0.152	510	-0.203	553
q	-0.461	435	-0.232	240	-0.217	454	-0.312	251	-0.204	380	-0.140	830
r-u	-0.398	151	-0.185	86	-0.134	106	-0.244	70	-0.183	115	-0.116	188
All	-0.064	4212	-0.124	4438	-0.156	2480	-0.059	3412	-0.173	5772	-0.174	5459

Note: The raw gender pay gap is calculated as the difference between the log average gross hourly wage of women and the log average gross hourly wage of men, a - agriculture, forestry and fishing; b-e - mining and quarrying, manufacturing, electricity, gas, steam and air-conditioning supply, water supply, sewerage, waste management and remediation activities; f - construction; g - wholesale and retail trade, repair of motor vehicles and motorcycles; h - transportation and storage; i - accommodation and food service activities; j - information and communication; k - financial and insurance activities; l-n - real estate activities, professional, scientific and technical activities, administrative and support service activities; o - public administration and defence, compulsory social security; p - education; q - human health and social work activities; r-u - arts, entertainment and recreation, other service activities, activities of households as employers, undifferentiated goods- and services-producing activities of households for own use and activities of extraterritorial organisations and bodies.

Source: Eurostat (2012), author's computations.

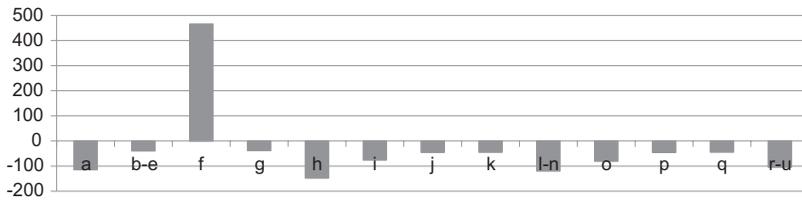
trend in these countries would be found. With regards to the raw gender pay gap in the individual sectors, we can generally state that the lowest wage differences can be observed in the construction, transportation and storage and public administration and defence sectors. On the contrary, the largest raw gender pay gap can be found in financial and insurance activities. However, the sector-specific wage differences vary in the individual countries.

The variability in wage differences between the individual EU countries is demonstrated in Figure 1, which shows the coefficient of variance in the sector-specific raw gender pay gap within the individual EU countries. It is calculated as the proportion of the average raw gender pay gap in the individual EU countries and the standard deviation and is reported in per cent. The smallest variation in wage differences among EU countries is in wholesale and retail trade, where the coefficient of variation reaches 37.7%. On the other hand, the differences are largest in construction, where the coefficient of variation totals 465%.

The variation in the sector-specific raw gender pay gap differs when focusing on the individual countries. Figure 2 shows the variation in the sector-specific raw gender pay gap within the individual EU countries. The smallest number of differences in the sector-specific raw gender pay gap is reported in Estonia, Slovakia and the Czech Republic, the largest in Hungary, Lithuania and Romania.

The variation in the sector-specific raw gender pay gap differs when focusing on the individual countries. Figure 2 shows the variation in the sector-specific raw gender pay gap within the individual EU countries. The smallest number of differences in the sector-specific raw gender pay gap is reported in Estonia, Slovakia and the Czech Republic, the largest can be found in Hungary, Lithuania and Romania.

The data show that the wage differences between men and women vary in the individual sectors and significant differences are identified also among the individual countries. However, these results are only indicative. The observed gender wage differences may predominantly be the result of the different characteristics of men and women working in the various sectors and do not express the extent of wage discrimination against women in the labour market.



**Figure 1.** Variation in the sector-specific raw gender pay gap within the individual EU countries. Source: Eurostat (2012), author's computations.



**Figure 2.** Variation in the sector-specific raw gender pay gap between individual EU countries. Source: Eurostat (2012), author's computations.

## Methods

To identify the differences in the unexplained part of the gender pay gap in the individual sectors and to find the potential causes of its variability, we firstly estimate the unexplained part of the gender pay gap in the individual sectors of the economy for the selected EU countries. In the second step, we use the regression model with the sector-specific unexplained part of the gender pay gap as a dependent variable.

To establish the unexplained part of the gender pay gap, we estimate the ATT, as did Jurajda and Paligorova (2009) or Hedija (2014, 2015), for example. ATT reflects the part of the raw gender pay gap which could not be explained by differences in the known observed characteristics of men and women in the sample and which could be the result of wage discrimination against women. The ATT is the average benefit resulting from being treated. In our case the ATT is the mean effect for women in the form of a lower wage resulting from being a woman. For more detail about the used method see Wooldridge (2002).

We counted the ATT for the individual sectors of the economy according to NACE Rev. 2 for 24 EU member states (we received the sector-specific ATT for 24 countries). For the calculation of the ATT we use the following formula

$$ATT = E(y_i(1) - y_i(0) | T_i = 1). \quad (1)$$

Where T is the binary treatment indicator, T=1 denotes treatment and T=0 otherwise, y(1) is the potential outcome with treatment and y(0) is the potential outcome without treatment. In our case, to be treated means to be a woman. We can rewrite the ATT as

$$ATT = E(y_i(1) | T_i = 1) - E(y_i(0) | T_i = 1). \quad (2)$$

Where the ATT represents the gender pay gap, which cannot be explained by the different characteristics of men and women. The term  $E(y_i(1)|T_i=1)$  is the sample average of the logarithm of the gross wage of women and the term  $E(y_i(0)|T_i=1)$  is the sample average of the logarithm of the gross wage of women, if they were men. From our sample, we know the first term on the right side of equation 2 – the sample average of the logarithm of the hourly gross wage of women. The second term – the average of the logarithm of the women hourly gross wage if they were men, we must in some manner estimate. There are more ways to carry out this estimation. We chose to use the regression model.

Firstly, we estimate the coefficients of the wage function of men

$$(y_i|T_i = 0) = \beta_0 \cdot X_i + u_i. \quad (3)$$

Where  $y_i$  is the logarithm of the male gross hourly wage,  $\beta_0$  is the vector of the coefficients of the wage function,  $X$  is the vector of the chosen observed characteristics of men and  $u$  is a disturbance term. As explanatory variables we use age, age squared, education level, sickness, partnership, occupation, company size, contract and managerial position. This set of explanatory variables is available in EU-SILC microdata and is frequently used in studies estimating the wage function (for example Christofides et al., 2013; Balcar & Gottvald, 2016). For more detail regarding individual explanatory variables see ‘Data’ section.

We then go on to use the estimated coefficients of the male wage function to compute the average of the logarithm of the gross hourly wage of women, if they were men.

$$E(y_i(0)|T_i = 1) = E(\beta_0 \cdot X_i). \quad (4)$$

Where  $E(\beta_0 \cdot X_i)$  is the mean of the predicted wages (the logarithm of the gross hourly wage) of every woman in the sample. Finally, we estimate the ATT as the difference between the average of the logarithm of the gross hourly wage of women and the average of the predicted values of wages computed from the male wage function.

$$ATT = E(y_i(1)|T_i = 1) - E(\beta_0 \cdot X_i|T_i = 1). \quad (5)$$

The estimated ATT represents the unexplained gender pay gap. The negative sign indicates that women receive relatively lower wages compared to men. The results obtained are the same as those found when using the Oaxaca-Blinder decomposition with men’s wages as the equilibrium wage.

We then construct the linear regression model using the sector-specific ATT as a dependent variable.

$$ATT_{ij} = \alpha + \beta_1 \cdot public_{ij} + \beta_2 \cdot women_{ij} + \beta_3 \cdot femalemanagers_{ij} + \beta_4 \cdot smallfirms_{ij} + \beta_5 \cdot country_j + u_{ij} \quad (6)$$

Where  $i$  denotes the sector,  $j$  is the country,  $public_{ij}$  is the dummy for the public sector,  $women_{ij}$  is the share of women in sector  $i$  and country  $j$ ,  $femalemanagers_{ij}$  denotes the share of female managers in sector  $i$  and country  $j$ ,  $smallcompanies_i$  is the proportion of small companies in sector  $i$  and country  $j$ ,  $country_j$  is the country dummy and  $u_{ij}$  is a disturbance term.

As explanatory variables we use the public sector, the proportion of women, the proportion of female managers, the proportion of small companies and country. A description of the variables and the arguments for their inclusion follows. There are many empirical studies concluding that the unexplained gender pay gap is lower in the public sector when compared to the private sector (see for example, Jurajda, 2003; Chatterji et al., 2011). The reason may be attributed to the different wage setting mechanisms in both sectors and a simple implementation of the anti-discrimination policy in the public sector, which is regulated. We use a dummy variable for the public sector; this denotes the sectors with a dominant share of public ownership (NACE o, p and q).

Another explanation for the differences in the sector-specific gender pay gap could be variation in the representation of women in leadership. Several empirical studies confirm the fact that the presence of female managers lead to a decrease in the gender pay gap (Hultin & Szulkin, 1999, 2003; Cardoso & Winter-Ebmer, 2010; Hedija, 2015). These conclusions are in accordance with the social identity theory. This theory states that individuals tend to favour members of their own group over other group members (Tajfel, 1982; Tajfel & Turner, 1979). Hence, women in managerial positions, that can affect the wage of their subordinates, are likely to evaluate female employees better than male employees. Taking this into consideration, we use the proportion of female managers as the other control variable. This is calculated as the share of female managers on all managers using classification of occupation ISCO-08, where managerial employees have ISCO code 1.

The unexplained gender pay gap may also be affected by the proportion of women in the sector. If the proportion of women is low, the women may in some sense be different to the standard woman, i.e., having more male characteristics. There is also a certain likelihood that they could be part of the male teams and may be perceived as men. This can also be applied to their salaries. To capture the effect of the proportion of women on the unexplained gender pay gap, we use this as the other control variable in the model. The proportion of women is calculated as the share of women on all the employees in the sector.

The proportion of small companies is another factor that could possibly determine the size of the gender pay gap. Wage discrimination of women should be more difficult to implement in small companies in comparison to their larger counterparts. The employees of small businesses know each other better and may also disclose the size of their wages. To maintain a good working environment and good relationships at work, imposing wage discrimination against women is more difficult for employers in these companies. The proportion of small companies is calculated as the share of companies with a maximum of 10 employees.

To estimate the coefficients of the model we use ordinary least squares (OLS) with robust standard errors.

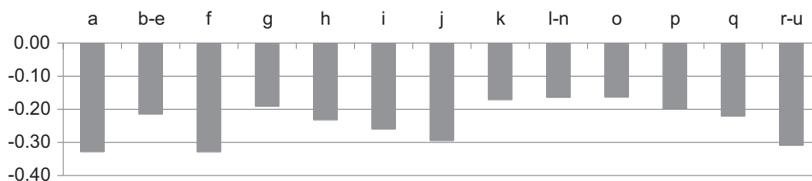
## **Empirical results and discussion**

We calculated the sector-specific unexplained gender pay gap using equation 5. Firstly, we estimated the wage function of men using equation 3. As explanatory variables we used age, age squared, partnership, education, occupation, company size, contract, managerial position and sickness. We then estimated the ATT from equation 5 as the difference between the average female wage and the female wage if the women were men. The results are shown in Table 2.

**Table 2.** ATT in the individual sectors of the EU countries.

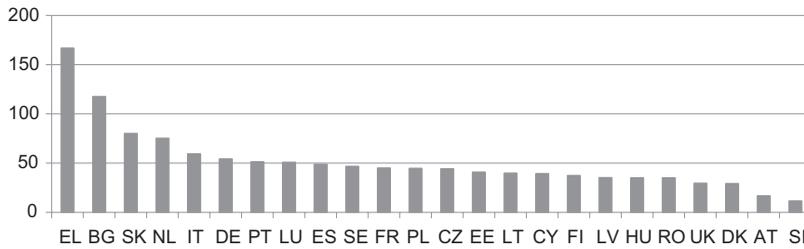
	AT	BG	CY	CZ	DE	DK	EE	EL
a	–	–0.459***	–	–0.199***	–0.164	–	–0.153*	–
b–e	–0.150**	–0.314***	–0.396***	–0.268***	–0.217***	–0.107***	–0.333***	–0.201***
f	0.007	–0.243**	–0.392**	0.073	–0.086	0.182	–0.511***	0.228
g	–0.159***	–0.186***	–0.241***	–0.283***	–0.216***	–0.128**	–0.321***	–0.113***
h	–0.128	–0.282***	0.060	–0.107*	–0.082	–0.017	–0.443***	–0.281
i	–0.062	–0.402***	–0.115	–0.299***	–0.374***	–	–0.630**	–0.316***
j	–0.192	–0.405**	–0.285***	–0.507***	–0.106*	–0.219***	–0.389**	–0.108
k	–0.223***	0.617**	–0.057	–0.269***	–0.120**	–0.227***	–2.115	–0.161*
l–n	–0.188*	–0.296***	0.015	–0.159***	–0.115**	–0.149***	–0.273***	0.170
o	–0.082	–0.301***	–0.153**	–0.249***	–0.081**	–0.060	–0.191***	–0.034
p	–0.178**	–0.302***	–0.087	–0.099***	–0.144***	0.004	–0.405***	0.020
q	–0.135***	–0.174**	–0.232	–0.187**	–0.093**	–0.016	–0.615***	0.235***
r–u	–0.154	–0.096	–0.570***	–0.190**	–0.103	0.060	–0.715***	–
	ES	FI	FR	HU	IT	LT	LU	LV
a	–0.381***	–0.192	–0.227	–0.408***	–0.115	–0.079	–	–0.018
b–e	–0.182***	–0.104**	–0.180***	–0.178***	–0.189***	–0.302***	–0.303***	–0.172**
f	–0.156	–0.213*	0.001	–0.094	–0.244**	–0.008	–0.059	–0.454**
g	–0.144***	–0.287***	–0.095**	–0.207***	–0.060*	–0.121**	–0.178***	–0.301***
h	–0.122**	–0.146**	0.002	–0.168**	0.057	–0.038	–0.202***	–0.426**
i	–0.128**	0.626	–0.017	–0.170**	–0.109*	–	–0.102**	0.076
j	–0.156**	–0.137**	–0.184**	0.060	–0.027	0.086	–0.451***	0.043
k	–0.184***	0.071	–0.069	–0.266***	–0.068*	–0.457**	–0.105**	–0.175
l–n	–0.133***	–0.121**	–0.026	–0.077	–0.010	–0.001	–0.120*	–0.076
o	–0.053*	–0.067	–0.117***	–0.129**	–0.061**	–0.307***	–0.144***	–0.235***
p	–0.055	–0.267***	–0.118***	–0.225***	–0.034	–0.160**	–0.034	–0.124
q	–0.166**	–0.119	–0.322***	–0.223***	–0.070**	–0.214***	–0.173***	–0.513***
r–u	–0.020	–0.110	–0.102	–0.056	–0.069	–0.360***	–0.274***	–0.010
	NL	PL	PT	RO	SE	SI	SK	UK
a	–	–0.046	–0.171	–0.041	–0.533***	–	–0.159**	–
b–e	–0.094*	–0.211***	–0.244***	–0.197***	0.019	–0.194***	–0.197***	–0.182***
f	–0.475**	–0.400***	–0.031	–0.203**	–0.185	–0.289**	–0.045	–0.181**
g	–0.113	–0.133***	–0.172***	–0.199***	–0.118	–0.247***	–0.258***	–0.132***
h	–0.139	–0.173**	0.119	–0.086	–0.304***	–0.265*	–0.137**	0.039
i	–	–0.302***	–0.122**	–0.070	–	–0.128	–0.110*	–0.304***
j	0.082	–0.317**	–0.410***	–0.045	–0.411***	–0.071	–0.290***	–0.144*
k	–0.215***	–0.062	–0.008	–0.427***	0.446	–0.284**	0.176	–0.166**
l–n	–0.043	–0.190***	0.030	0.055	–0.149**	0.006	–0.113*	–0.118***
o	–0.071**	–0.075*	–0.143***	–0.238***	–0.203***	0.008	–0.206***	–0.150***
p	–0.067	–0.039	–0.074**	–0.100	–0.156***	–0.265***	–0.191***	–0.203***
q	0.011	–0.173	–0.224***	–0.045	–0.214***	–0.275**	–0.453***	–0.138***
r–u	–	–0.201	–	–0.118	–0.209**	–0.129	0.162*	–0.080

Source: Eurostat (2012), author's computations.

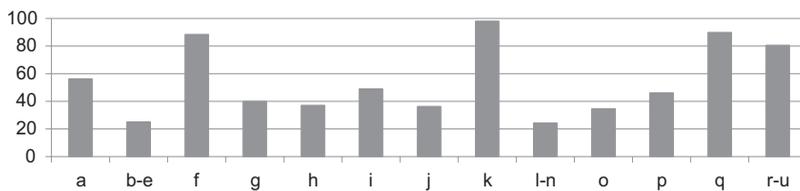


**Figure 3.** Average unexplained gender pay gap in the individual sectors. Note: Only ATT significant at a minimum level of 10 percent. Source: Eurostat (2012), author's computations.

On average, the lowest ATT is in public administration and defence (o), real estate, professional, scientific and technical activities, administrative and support service activities (l–n) and financial and insurance activities (k). Here the average unexplained gender pay gap



**Figure 4.** Variation in the sector-specific unexplained gender pay gap within the individual EU countries. Note: Only the ATT significant at a minimum level of 10%. The coefficient of variation for the individual country is calculated as a proportion of the standard deviation and the average value of the sector-specific ATT expressed in percent of the country ATT. Source: Eurostat (2012), author's computations.



**Figure 5.** Variation in the sector-specific unexplained gender pay gap between the individual EU countries. Note: Only the ATT statistically significant at a minimum level of 10%. The coefficient of variation for the individual sectors is calculated as a proportion of the standard deviation and the average value of the sector-specific ATT in the individual EU countries expressed in percent of the country ATT. Source: Eurostat (2012), author's computations.

reaches approximately 16%, to the disadvantage of women. On the other hand, the largest average unexplained gender pay gap is identified in construction (f), agriculture, forestry and fishing (a) and arts, entertainment and recreation (r–u). The average unexplained gender wage differences are more than 30% to the disadvantage of women. The average ATT for the individual sectors is shown in Figure 3.

We conclude that the estimated sector-specific unexplained gender pay gap varies both within and among the individual EU countries. To assess the variability, we present the coefficient of variation in the sector-specific ATT among the countries and within the individual countries. To enable a comparison of the results among the individual countries, we use for the purpose of this calculation the ATT for the individual sectors as a percentage of the countries' ATT. Figure 4 shows the coefficient of variation in the sector-specific ATT within the individual EU countries. It ranges from 166.8 in Greece to 11.5% in Slovenia, exceeding 60% in only four countries. The variability of the sector-specific ATT among the individual EU countries is shown in Figure 5. The proportion of the sector-specific ATT on the country ATT varies among the individual EU countries. The largest variability is observed in financial and insurance activities (k), human health and social work activities (q), construction (f) and arts, entertainment and recreation, etc. (r–u) where the coefficient of variation reaches more than 80%. The coefficient of variation is less than 50% in the other sectors, with the exception of agriculture, forestry and fishing (a).

To explain the existing differences in the unexplained gender pay gap among the individual sectors of the economy, we regress the statistically significant sector-specific ATT.

For explanatory variables we use a dummy for the public sector, the proportion of women, the proportion of female managers and the proportion of small companies in the individual sectors. The results are shown in Table 3.

The most important factor explaining the differences in the existing wage differences between men and women among the individual sectors is ownership and the proportion of women in the sector.

The unexplained gender pay gap in the public sector is at a minimum 4 percentage points lower in comparison to the private sector. These results are not surprising and are in accordance with the conclusions of the previous studies (for example Jurajda, 2003; Chatterji et al., 2011). The lower unexplained wage gap in the public sector can be attributed to the difference in the wage setting power in the private and public sectors, where the public sector faces state regulation in the area of earnings. Therefore, managers have less space for the application of wage discrimination against women. Another factor that may play a role could be the stricter application of anti-discrimination legislation in the public sector.

The results also show that the unexplained gender pay gap is lower in sectors, where the proportion of women is 30–70%. On the other hand, the markedly high and low representation of women in the sector increases the gender differences in earnings. The gender pay gap in sectors with 30–70% of women is lower by approximately 5 percentage points when compared to sectors containing 0–30% of women and by 10 percentage points in comparison to sectors containing 70%, and higher, of women. This can be explained by the fact that wages in industries with a high proportion of women are lower and men working in the sector must be offered higher wages comparable with salaries in other sectors. Consequently, the wage gap is higher in comparison to the sectors with a lower proportion of women. We also have to conclude that the hypothesis, stating a lower gender wage gap is in sectors with a low proportion of women, has not been confirmed. Women working in these sectors earn relatively more than men, which is the case in sectors with a very high proportion of women, but less in comparison with industries employing 30–70% women. To some extent this may be due to the relatively small sample and diversity of work by women and men in these sectors. Verification regarding the validity of this hypothesis would deserve further research.

The proportion of female managers and the proportion of small companies are not statistically significant factors explaining the variation in the unexplained gender pay gap between the individual sectors of the economy.

Nevertheless, the analysis shows that the gender pay gap was lower in the sectors with a higher proportion of female managers. The gender pay gap in sectors with less than 30% female managers was higher approximately by 2 percentage points in comparison with the sectors having 30–70% female managers and by 4 percentage points compared to sectors having more than 70% female managers. These conclusions support the thesis that women in leadership tend to implement lower wage discrimination against women and are in accordance to the results of previous studies, which confirm the negative relationship between the size of the gender pay gap and the proportion of women in leadership (for example Cardoso & Winter-Ebmer, 2010; Hedija, 2015).

When analysing the proportion of small companies in the industry, the results reveal that the unexplained gender pay gap is higher in sectors with a higher proportion of small companies. The wage differences between men and women in sectors containing less than 30% of small companies is smaller by 5 percentage points in comparison with industries

**Table 3.** Model of the ATT differences by sector: evidence from OLS.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Public	0.045** (0.020)	0.040 (0.029)	0.084*** (0.025)	0.070** (0.029)	0.076*** (0.026)	0.045 (0.037)	0.044 (0.035)
Women	-	0.019 (0.072)	-	-	-	-	-
30-70%	-	-	0.058*** (0.020)	0.046** (0.021)	0.054*** (0.020)	0.059*** (0.020)	0.062*** (0.020)
70% plus	-	-	-0.053 (0.033)	-0.082* (0.046)	-0.070* (0.039)	-0.057 (0.039)	-0.053 (0.039)
Female managers	-	-	-	0.088 (0.099)	-	-	-
30-70%	-	-	-	-	0.011 (0.024)	0.019 (0.027)	0.021 (0.027)
70% plus	-	-	-	-	0.042 (0.054)	0.050 (0.055)	0.044 (0.055)
Small companies	-	-	-	-	-	-0.114 (0.079)	-
30-70%	-	-	-	-	-	-	-0.045* (0.027)
70% plus	-	-	-	-	-	-	-0.091 (0.114)
Country	yes						
Constant	-0.187*** (0.014)	-0.196*** (0.036)	-0.230*** (0.031)	-0.240*** (0.034)	-0.226*** (0.032)	-0.188*** (0.040)	-0.204*** (0.037)
R <sup>2</sup>	0.278	0.278	0.348	0.354	0.351	0.361	0.368
F-test	3.60***	3.59***	6.60***	5.99***	6.03***	5.74***	5.78***
N	189	189	189	189	189	189	189

\*\*\* significant at the 1% level.

\*\* significant at the 5% level.

\* significant at the 10% level, robust standard errors in brackets.

Source: Eurostat (2012), author's computations.

containing 30–70% of small companies and smaller by 9% when compared to industries containing more than 70% of small companies. The explanation could be that the larger companies may have internal wage regulations. The fact that larger companies are most often owned by foreigners could also play a role, as these put much more emphasis on compliance with anti-discrimination legislation.

The findings of the analysis show that even though the condition of non-discrimination is anchored in legislation, wage differences between men and women still persist in the EU countries and they vary in individual sectors of the economy. The analysis shows that women's work is undervalued in comparison with the work of men which may provide the competitive advantage to countries having higher level of wage discrimination of women resulting in lower labour costs. On the other hand, equality of women on the labour market brings benefits in the better use of women skills and talent that could improve a businesses' performance and effectiveness. Smith and Bettio (2008) report that greater equality of women brings advantages in the form of higher economic growth, higher tax revenues and sustainable fertility rates. There is a space for the governments of the individual EU countries to motivate and force the firm to respect the anti-discriminatory legislation.

Some limitations of this study could be the data used. We employ the micro-data from EU-SILC 2012. The data do not cover the direct employee–employer relationship and also information about real abilities and skills of the individual employees. To some extent the estimated unexplained part of gender pay gap could be biased due to these facts. Other limitations could be the age of the data used. EU-SILC micro-data are provided with some lag. Nevertheless, the situation on the field of wage differences and gender wage inequality does not change dramatically from year to year. Therefore, we are not afraid to say that the conclusions of this study are still valid in general.

## Conclusion

The aim of this study was to determine whether and to what extent the unexplained gender wage gap varies in the different sectors of the economy of the member states of the EU and to identify the possible causes of these differences.

We use EU-SILC data for 24 EU member states for the year 2011 and estimate the unexplained part of the gender pay gap applying the ATT. We conclude that not only the raw gender pay gap, but also its unexplained part, vary both in the individual sectors of the surveyed countries and among the individual countries.

Considering only statistically significant estimates of the ATT, the average unexplained gender pay gap for the individual sectors ranges from -0.16 in public administration and defence (o) to -0.33 in construction (f) and agriculture, forestry and fishing (a). However, there are significant differences among the individual countries. The largest variability in the sector-specific ATT is observed in financial and insurance activities (k), where the coefficient of variation is approximately 98%. On the other hand, smaller differences in the sector-specific ATT are in real estate, professional, scientific and technical, administrative and support service activities (l–n), where the coefficient of variation reaches 24%. The unexplained gender pay gap in the individual sectors also differs within the individual countries. The coefficient of variation in the sector-specific ATT within the individual EU countries ranges from 166.8 in Greece to 11.5% in Slovenia and it nears 40% in most other countries.

The possible causes of the existing differences in the unexplained gender pay gap among the individual sectors could be attributed to ownership in the sense of domination of the private or public sector, the proportion of female managers in the sector, the predominant company size and the proportion of women in the sector. We examine the impact of these factors on the differences in the sector-specific ATT and conclude that the ownership and the proportion of women in the sector have a significant effect on explaining the differences in the unexplained gender pay gap among the individual sectors of the economy. In sectors with a dominant public sector, the unexplained gender pay gap is lower by approximately by 4 percentage points when compared to the private sector. It is also higher in the sectors employing a higher proportion of women, where the lowest gender wage differences are in sectors with a similar proportion of men and women.

Finally, the results show that the unexplained gender pay gap is lower in sectors with a higher proportion of female managers and in sectors with a lower proportion of small companies. However, the predominant company size and the proportion of female managers are not statistically significant factors in explaining the variability of the ATT between sectors.

## Funding

This work was supported by the College of Polytechnics Jihlava [grant number 1200/4/61353, The Relationship Among Firm Size, Firm Growth and Gender Characteristics].

## Disclosure statement

No potential conflict of interest was reported by the author.

## References

- Antón, J., & Muñoz de Bustillo, R. (2013). Public-private sector wage differentials in Spain. An updated picture in the midst of the Great Recession (MPRA Paper No. 48986). Retrieved from <http://mpra.ub.uni-muenchen.de/id/eprint/48986>
- Arulampalam, W., Booth, A., & Bryan, M. (2007). Is there a glass ceiling over Europe? Exploring the gender pay gap across the wage distribution. *Industrial & Labor Relations Review*, 60(2), 163–186.
- Balcar, J., & Gottvald, J. (2016). Wage determinants and economic crisis 2008-2014: Evidence from the Czech Republic. *Journal of Economics*, 64(1), 3–21.
- Beblo, M., Beninger, D., Heinze, A., & Laisney, F. (2003). *Methodological issues related to the analysis of gender gaps in employment, earnings and career progression* (Final Report, October 29, 2003). Retrieved from <http://ec.europa.eu/social/BlobServlet?docId=2142&langId=en>
- Blau, F. D., & Kahn, L. M. (2003). Understanding international differences in the gender pay gap. *Journal of Labor Economics*, 21(1), 106–144.
- Blinder, A. (1973). Wage discrimination: Reduced form and structural estimates. *The Journal of Human Resources*, 8(4), 436–455.
- Cardoso, A. R., & Winter-Ebmer, R. (2010). Female-led firms and gender wage policies. *Industrial and Labour Relations Review*, 64(1), 143–163.
- Chatterji, M., Mumford, K., & Smith, P. N. (2011). The public–private sector gender wage differential in Britain: Evidence from matched employee–workplace data. *Applied Economics*, 43(26), 3819–3833.
- Christofides, L., Polycarpou, A., & Vrachimis, K. (2013). Gender wage gaps, ‘sticky floors’ and ‘glass ceilings’ in Europe. *Labour Economics*, 21, 86–102.
- Eurostat. (2012). European union statistics on income and living condition 2012 [Micro-data].

- Hedija, V. (2014). Do women really face wage discrimination on the labor market? An analysis using intra-household specialization. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 62(6), 1279–1286.
- Hedija, V. (2015). The effect of female managers on gender wage differences. *Prague Economic Papers*, 24(1), 38–59.
- Hultin, M., & Szulkin, R. (1999). Wages and unequal access to organizational power: An empirical test of gender discrimination. *Administrative Science Quarterly*, 44(3), 453–472.
- Hultin, M., & Szulkin, R. (2003). Mechanisms of inequality unequal access to organizational power and the gender wage gap. *European Sociological Review*, 19(2), 143–159.
- Jurajda, Š. (2003). Gender wage gap and segregation in enterprises and the public sector in late transition countries. *Journal of Comparative Economics*, 31(2), 199–222.
- Jurajda, Š., & Paligorova, T. (2009). Czech female managers and their wages. *Labour Economics*, 16(3), 342–351.
- Mysiková, M. (2012). Gender wage gap in the Czech Republic and central European countries. *Prague Economic Papers*, 21(3), 328–346.
- Oaxaca, R. (1973). Male-female wage differentials in urban labour markets. *International Economic Review*, 14(3), 693–709.
- Pena-Boquete, Y., De Stefanis, S., & Fernandez-Grela, M. (2010). The distribution of gender wage discrimination in Italy and Spain: A comparison using the ECHP. *International Journal of Manpower*, 31(2), 109–137.
- Rahona-López, M., Murillo-Huertas, I., & Salinas-Jiménez, M. (2016). Wage differentials by sector and gender: A quantile analysis for the Spanish case. *Journal of Economic Policy Reform*, 19(1), 1–19. doi:10.1080/17487870.2015.1028936
- Smith, M., & Bettio, F. (2008). *Analysis note: The economic case for gender equality* (EGGE – European Commission's Network of Experts on Employment and Gender Equality issues – Fondazione Giacomo Brodolini). Retrieved from <http://eurogender.eige.europa.eu/documents/analysis-note-economic-case-gender-equality>
- Tajfel, H. (1982). Social psychology of intergroup relations. *Annual Review of Psychology*, 33, 1–39.
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33–47). Monterey: CA Brooks-Cole.
- Wooldridge, J. (2002). *Econometric analysis of cross section and panel data*. Cambridge: MIT Press.