The Effect of Gender Diversity in Firm Productivity

By

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Abstract

This thesis studies the impact of the proportion of female workers on firm productivity for Hungary. The dataset used are a linked employee-employer dataset from 2003-2011 which include data about firm balance sheets and also work characteristics. I use pooled OLS and Fixed Effects model where the dependent variable is labour productivity and main independent variable is proportion of female. I find that increasing proportion of female workers has a negative impact on firm productivity using Pooled OLS regardless of the existing gender diversity of the firm. However, the estimators of the Fixed effects model show the effect is not statistically significant.

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1.Introduction

For the past decade, especially in a globalized world, diversity of race, gender, religion, ethnicity has become more and more important to be analysed. A special interest has been given to this topic by labour economists which have researched the interaction of diversity and outcomes of labour market, especially gender differences. Even though, the participation in the labour market of women has improved, legal and institutional actions have been taken to discourage discrimination, women still fall behind men. As the labour world is one created and adjusted by men, women are the ones who must adapt. (ILO, 2019)

An important estimate in business is its productivity. Rogers (1998) defines productivity as dividing the output to input, so increasing productivity means either using less inputs to produce the same level of output or producing more output with the same level of output. It is strictly related to rising efficiency levels. As firm's objective is to maximize profit, raising productivity will mean they can either reduce costs or increase revenues which will increase profit. But productivity is also important in country level. As Paul Krugman (1992) states "productivity isn't everything, but in the long run it is almost everything", as it is related to raising overall welfare.

Given the level of significance of productivity and the social impact of diversity, their interaction can have interesting implications. The analysis of the effect of gender diversity on firm performance is supported by an understanding that men and women's outcomes in society may not be equal. A good starting point which motivates the different outcomes by gender is understanding the societal and biological aspects of two genders. Social and liberal feminism theories explain these two aspects, even though have different implications.

Social feminism believes that there is a difference in socialization of the two genders and they have a different mentality. Even though, in this theory it is not determined which of the

mentalities is superior or better, it is considered that these divergences can be reflected in their business outcomes. In the other hand, liberal feminism argues that human beings are all equal in what they believe is the human essence: rationality. All beings are rational and seek to fulfil their self-interest, but due to discrimination and systemic factors which prevent women from obtaining access to important resources such as education, women are disadvantaged in doing so. This results in women not realising true potential of their abilities which comes from a discouragement in their socialization thus concluding in different results/achievements in life. (Fischer et al, 1993)

Translating these two theories in econometrics term, will mean that for liberal feminism studying the impact of two genders will be enough to study the society while for social feminism there may be some unobserved factors which may be harder to establish and may cause endogeneity in the models. Besides stating these differences, for liberal feminism women may be more disadvantaged which can have negative impact on firm performance while for social feminism the effect is not that clear cut. That is why I look at different studies which use quantitative research, specific countries and companies to determine this effect.

Islam et al (2018) using firm-level dataset of 128 developing countries for 2009-2016 find that firms managed by woman have a lower level of productivity. An important reason is the sector, in the retail sector firms which are managed by women have a higher concentration and for manufacturing sector these firms have less intensity of capital. The differences are significant when comparing management diversity rather ownership. However, the authors state that there are reasons which drive these divergences and are not observable firm characteristics.

The negative effects are also found on studies for African countries. In Ethiopia, Aguilar et al (2014) find negative effects of women manager relative to men in agriculture productivity even when controlling for land and manager specific characteristics. This difference is significant mostly to divorced women and related to the fact that women farmers do not benefit as much

as men to programmes and land certification. For Ghana, Abegaz and Nene (2018) conclude that women are less productive than their male colleagues due to being employed in less productive firms in the manufacturing sector. In Zimbabwean manufacturing firms, Makochekanwa and Nchake (2019) stress the importance of sector and location of the firm in the sign of the effect of female manager to firm productivity.

Tsou and Yang (2019), using data from Chinese manufacturing firms find that there is a negative effect of a larger proportion of women workers on firm productivity. However, the results are influenced by type and size of firms but also education level of women workers. An increase in proportion of educated women workers have a positive effect on performance, especially in what is perceived as more "feminized" industries. Zhang (2020), using data for 35 countries and 24 industries asserts the importance of social context to determine the impact of gender diversity. He finds that the effect is influenced by institutional factors, a firm which country and industry have a positive view on gender equality benefits more by having more female workers.

Dwyert et al (2003), shows that gender diversity in management can work both ways. More diverse teams will result in discussing a larger share of ideas which can have a negative impact on performance if it delays decision making on short terms but also the effect can be positive as it allows the business to reflect on a broader share of issues and represent the needs of customers from different background. Although, the resulting effect will be based on company's culture of management. Only if the company has the appropriate settings to support diversity, the positive effects will be maximized. Nevertheless, a study from Turkey by Kiliç and Kuzey (2016) find positive effects on financial performance of firms if the board of directors have a larger proportion of female included, even that these companies are considered male-dominated. All in all, the effect is not that straightforward. It depends on how gender diversity is defined, firm characteristics and institutional context.

From a review of literature it seems that institutional factors matter. In developing countries the effect of female workers seems to have a negative impact while for developed countries firms studies including Danish, Norwegian, American seem either to find a positive or insignificant impact (Smith et al., 2006; Cordeiro and Stites-Doe, 1997; Dale-Olsen et al., 2013).

Hungary seem to be an interesting case as Hungarian women are the largest share of worker having tertiary education in total of industries but there seems to be a glass ceiling for them as they lack behind in being managers or being part of board members. This also comes from the lack of legislation regarding gender in Hungarian companies. I am interested to see the effect of having more women in this positions as they are more connected with decision-making in the companies. That is why my hypothesis is that increasing the proportion of women workers in the firm will have a negative impact on firm performance, due to the contextual factors in Hungary. Due to the presence of this glass ceiling my second hypothesis is that even for educated, skilled females the effect on productivity will be smaller relative to men.

To test these hypothesis I use data from LEED Hungary 2003-2011. The rich dataset allows to analyse and calculate proportion of women, skilled workers and proportion of skilled female worker which I use to account for gender diversity. Also the dataset allows to address firm heterogeneity across sectors, regions and years. As dependent variable labour productivity which is estimated as sales over total employment is used. My methodology includes using pooled OLS to test means of the labour productivity through different firms while to account for effects which may cause endogeneity but are constant through time I use Fixed Effect models. Nevertheless, if a violation of strict exogeneity is broken, as effects which vary through time affect both our main independent variable and dependent variable exist, the FEM estimates will be biased. I also categorize firms by type of diversity that they have and run regressions based on type and region. Results show that both female proportion and skilled

female proportion have a negative effect on diversity when using pooled OLS and are statistically significant, while in Fixed Effect models the results are not significant.

The rest of the thesis will be organized in the following way. Chapter two gives a background on situation of women in the labour market in Hungary. Chapter four describes the data and summary statistics. Chapter five explains the methodology used for the analysis. Chapter six interprets the results. Chapter seven concludes it.

2. Background

2.1. Labour market indicators by gender in Hungary

During 2003-2011, the overall position of men and women in the labour market has not made significant changes. The employment to population ratio for both men and women shows a similar trend where the maximum point is in 2006, for women 51.1% and 63.9% for men. After 2006, there is a negative trend also due to the crisis, and in 2011 the levels of employment are lower than in 2003. Another important aspect is that when compared to men, women have lower employment rates for each year. This also comes from the fact that women have lower participation rates than men for the period, where the biggest difference for these two indicators is in 2007, where men participation rate is 13.7% higher than women and employment rate is 13% higher than women. While the smallest difference is in 2010, where men participation rate is 11.5% higher than women and employment rate is 9.6% higher than women. Regarding, unemployment rates the difference between men and women varies from 0-1%, changing from one year to another. (OECD, 2011)

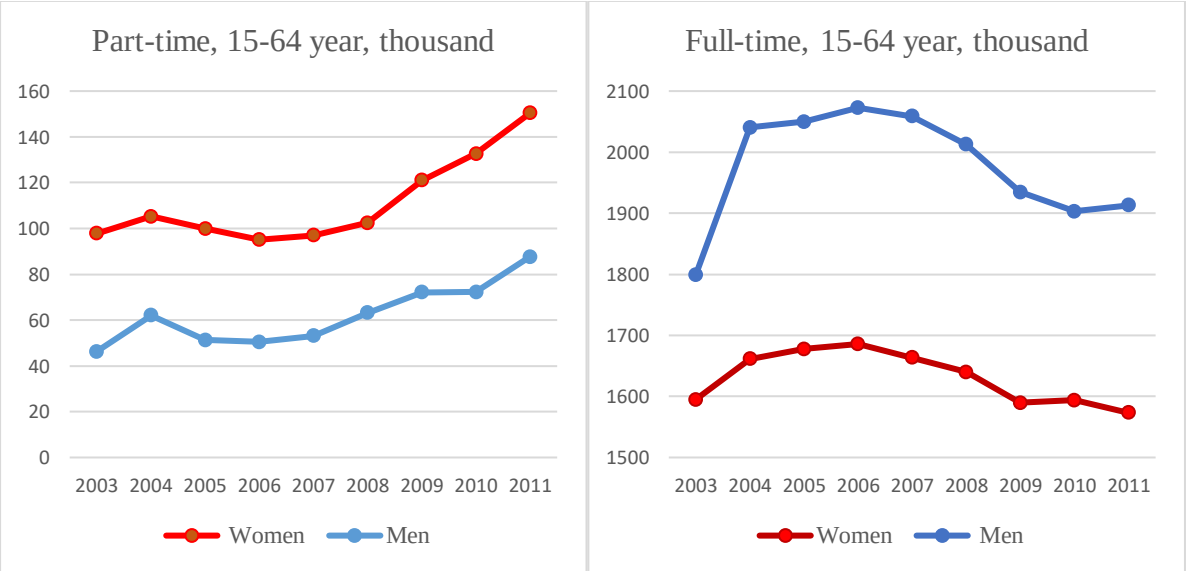
Table 1: Labour Market Indicators, population aged 15-64 years, by sex for 2003-2011

Time	2003	2004	2005	2006	2007	2008	2009	2010	2011
Women									
Employment/population ratio	50.9	50.7	51.0	51.1	50.7	50.3	49.6	50.2	50.3
Labour force participation rate	53.9	54.0	55.1	55.5	54.9	54.7	55.0	56.3	56.6
Unemployment rate	5.6	6.1	7.5	7.9	7.8	8.0	9.8	10.7	11.1
Men									
Employment/population ratio	63.4	63.1	63.1	63.9	63.7	62.7	60.7	59.9	60.7
Labour force participation rate	67.6	67.2	67.9	68.9	68.6	68.0	67.7	67.8	68.4
Unemployment rate	6.1	6.1	7.0	7.2	7.2	7.7	10.4	11.7	11.2
Difference (Women vs Men)									
Employment/population ratio	-12.6	-12.5	-12.1	-12.9	-13.0	-12.4	-11.1	-9.6	-10.4
Labour force participation rate	-13.7	-13.2	-12.8	-13.4	-13.7	-13.3	-12.7	-11.5	-11.8
Unemployment rate	-0.5	0.0	0.5	0.8	0.6	0.3	-0.6	-1.0	-0.1

Source: OECD

There is an important characteristic which differentiates men and women in Hungary by the type of work. For full time work, men are in a greater number than women while for part time work the situation is the opposite. This figures hold for all the years 2003-2011. (Eurostat, 2020). One factor which contributes to this situation is the traditional views of Hungarian society to care responsibilities. When asked if the amount of time spent looking after your children is more, less or same amount of time than your partner, men and women have different answers. Women spend more time than men taking care of the children, a statement which is approved by both genders as 64.4% of women say that they spend more time than their partner and 81.3% of men say that they spend less time than their partner. (Eurofound, 2018) This makes women face more difficulties in managing paid work and care responsibilities as 20.3% of them express it is very difficult to manage both and for 25.3% it is rather difficult. The numbers almost cut in half for male respondents which for 9.7% express that it is very difficult to manage both and for 13.8 % it is rather difficult. (Eurostat, 2016)

Figure 1: Part-time and full-time workers by gender, in thousand, 15-64 years for 2003-2011



Source: Eurostat

2.2. Gender diversity in top positions

For 2003-2011, even though men outnumber women in overall employment, the proportions depend on characteristics of education. Specifically, for tertiary education, the data shows that women compose a larger share of workers compared to men. Overall women with tertiary education account for 30% of employees, while men for 20.5%. The results vary through activities. The biggest difference where women compose larger share of workers than men is in administrative and support service activities (women 24.1% and men 13.2%). In the other hand, the sector which men outrun women is for professional, scientific and technical activities which has also the biggest share of men workers (women 48.9 % and men 74.8%). While for women the activity which women are the biggest share is education. (Eurostat,2011)

As depending on the activity, women who are qualified can be either in larger or smaller proportion than men, when it comes to being manager or part of board members there is a constant trend. Male managers are more than double of women managers and when it comes to being part of board members, being employee representatives or presidents, the differences significantly increase, showing that there may be a clear glass ceiling for women. (European Institute for Gender Equality,2011)

Table 2: Largest listed companies, members, employee representatives and president by gender, as % of total for all sectors, 2003-2011

	Board Members		**Employee representatives**		**President**	
Year	Women	Men	Women	Men	Women	Men
2003	11.1%	88.9%			4.3%	95.7%
2004	8.9%	91.1%			2.1%	97.9%
2005	9.6%	90.4%			4.7%	95.3%
2006	11.5%	88.5%			4.8%	95.2%
2007	10.8%	89.2%			0.0%	100.0%
2008	16.3%	83.7%	14.3%	85.7%	0.0%	100.0%
2009	13.3%	86.7%	30.0%	70.0%	0.0%	100.0%
2010	13.6%	86.4%	25.0%	75.0%	7.7%	92.3%
2011	5.3%	94.7%	20.0%	80.0%	0.0%	100.0%

Source: European Institute for Gender Equality

2.3. Hungary and affirmative policies regarding gender diversity on boards

As women representation in the board of companies is relatively lower than men many European countries have taken legislative measures. Most of these countries have adopted quotas where in Belgium, Iceland, Italy, France and Norway these quotas are binding and have sanctions, while for Netherlands and Spain the quotas are implemented without sanctions. Other countries such as Austria, Denmark, Greece, Finland and Slovenia have applied rules regarding companies which are state owned and UK has set targets which are voluntary. However, in Hungary there has not been any kind of measure or regulation to address this issue. The factors for this decision include socialist past, European Union membership and resisting actions which are considered 'Westernized' or part of a globalized world. (Primecz and Munkacsi, 2017)

There are advantages and disadvantages regarding women's position in labour market because of the socialist past. In that period, women in Hungary were part of low and middle positions including managerial ones, and this was mainly due to policies which motivated women to be part of labour force and facilitated reproduction. Also the rhetoric of that time incorporated a more inclusive type of thinking regarding gender and work, which involved positive discrimination for women. These policies were related to facilitating women's life as caretaker. This past made possible for the generation of today's to grow with mothers who worked and have female role models. (Fodor, 2004) However, as Hungarians want to be detached from the socialist past and relate affirmative policies such as implementing quotas and regulations of women in boards with their past, they are strictly against them. (Primecz and Munkacsi, 2017)

Hungary's membership in the European Union has led to positive steps to gender equality. As a condition to the accession process, Hungary has implemented legislation of equal opportunity which contributes positively also to social inclusion. Nevertheless, cultural factors and conservative, traditional beliefs which sustain the division of gender roles in the society and

especially in the family have a negative impact in gender equality. For example, as the role of taking care of children and doing household chores is attributed to women, the amount of time which women can dedicate to improve their skills in the workforce and have a positive impact on their career achievements decreases. Also traditional roles may cause the overall perception of women's abilities in the labour market to be seen as less capable than their male counterparts. Negative impact, has also politics which is reluctant to take gender-egalitarian measures, hence enforce perceived ideas that traditional roles are important. These policies may be harder to enforce in Hungary as they may perceived as the West politics, the ones which the public is very critical towards. (Primecz and Munkacsi, 2017)

Gender Diversity could also be supported from private companies, even if the state does not force mandatory regulations. However, the missing legislation could contribute as a justification to maintain the status quo for companies which do not have any women on board and do not have this issue to their priorities. (EWSDGE, 2016) Nevertheless, for multinational companies the situation is not the same. As they are more connected to globalised economy are actually the ones who are supporting it and especially related to management. They implement policies and practices which help gender equality. (Primecz and Munkacsi, 2017)

3. Data and descriptive statistics

The data that I use to test this question is a linked employer-employee dataset for Hungary for the period of 2003-2011. The data has information about firms, which contains their financial statements including income data but also other characteristics such as the number of employment, collected by the National Tax and Customs Authority. The data about employees is also from an administrative dataset from the National Pension Administration. The data has a 50% sample of the population of age older than 5 and contains information about employers age, sex, occupation ISIC codes and wages. The two datasets are linked by an anonymous identifier (Murakozy and Telegdy, 2020)

This dataset is a longitudinal panel which has information about 2,737,811 observations and for each year has 32,508 firms. The rich dataset allows to account for firm heterogeneity and time characteristics. To prepare data for my analysis I do some data cleaning. First, as my independent variable of interest is related to gender I drop all the firms for which employer have missing values for their gender. Second, I drop firms which have less than five employers and keep only small and medium enterprises. Third, I drop all observations, the age of whichis smaller than 15. In total, there are 104,061 firms and for each year 11,562 firm in average.

3.1. Main variables and descriptive statistics

To answer the question of the effect of gender diversity on firm productivity the first step is to decide on the main dependent variable and independent variable. The main dependent variable which is firm productivity I measure using labour productivity. I define it as the ratio of Value Added over total employment, where value added is estimated by the difference of sales minus costs of material. This measure is also used by Murakozy and Telegdy, 2020. To measure gender diversity, I use the proportion of female workers in the firm, as used by Tsou and Yang, 2019. They use this variable to measure gender structure of the firm. Based on this variable, I

divide firms in three type. If the proportion of female workers is smaller than 0.5, I categorize the firm as a male majority type. If the proportion of female workers is equal to 0.5, I categorize the firm as an equally distributed one and if the proportion is larger than 0.5 the firm is categorized as a female majority.

Due to the availability of 2-digit ISIC occupation code for each worker I can see the profession and based on classification of skills level by the Hungarian Central Statistical Office for the Hungarian standard classification of occupations (HCSO-08/FEOR-08) skill level can be estimated. If the ISIC code starts with 1,2 or 3 it means that the worker is either a manager, professional or technician and associate professional and requires a higher level of qualification and the worker is categorized as skilled. This categorization is also used by Murakozy and Telegdy, 2020. I also estimate another variable which links gender and skill level which is proportion of skilled female to the overall proportion of skilled workers. This variable is of interest as increasing the proportion of skilled female may have positive impact on productivity even when the effect of overall proportion of female workers is negative. (Tsou and Yang, 2019)

To account for firm characteristics, I include data about industry, firm age, firm size and region data. According to Smirlock et al (1984), size is important as it is related to the capability and future potential of the business. Lipczinsky and Wilson (2001), found that firm age affects the firm's experience in the industry. They relate size with income and adaptability. For example, an older firm will have higher incomes than younger ones because they tend to benefit from their previous experiences to build up a better position in the market. That's why firm size, measured by the number of employees, is included in the regression. The mean age for firm in the dataset is 39, 91% of them are small type of firms and the majority of firms, around 43.66% are located in Central Hungary. Firms which are located in a disadvantaged region account for 16.38% of the sample.

Table 3: Descriptive statistics

Variable	Observations	Mean	Standard Deviation
Labour productivity	102,771	9.304491	1.245133
Female Majority	104,061	0.280979	0.4494796
Male Majority	104,061	0.5895	0.4919268
Proportion of skilled Female	104,061	0.3664667	0.37638
Proportion of skilled workers	104,061	0.3431456	0.2625776
Equally	104,061	0.12952	0.3357764
Firm Age	104,061	39.05193	11.2388
ln exports	104,061	2.689706	4.598076
small	104,061	0.914214	0.2800495
Disadvantaged region	103,308	0.16385	0.3701411
Central Hungary	104,061	0.4366	0.4959665
Central Transdanubia	104,061	0.096799	0.2956853
Western Hungary	104,061	0.084979	0.2788518
South West Hungary	104,061	0.075754	0.2646048
North Hungary	104,061	0.079895	0.2711326
North Great Plain Hungary	104,061	0.111685	0.3149794
South Great Plain Hungary	104,061	0.114231	0.3180932

3.2. Descriptive statistics by type of gender diversity of firms

By the type of gender proportion of firms, I estimate descriptive statistics to give a general view of these firms. The majority of firms, around 58.9% of them have male workers in a greater share, then there are 28.1% of female majority and 13% have the same amount of workers for each gender. Labour productivity means show higher values for firms which have an equal proportion of men and women workers or male majority rather than female majority of workers. Nevertheless, regression analysis will be used to estimate whether these differences are significant. This result is also influenced by the way which labour productivity is denied. Male majority firms have a higher mean values for sales and sales growth and lower number of workers when compared to two other types. Female majority firms are older than the two other types and have higher values of total assets and profit in average. The majority of three types of firms are located in Central Hungary especially female majority ones. I also use histograms to plot labour productivity by type of firm and kernel density plots. From figures no large difference can be observes, thus, no conclusions can be drawn from that.

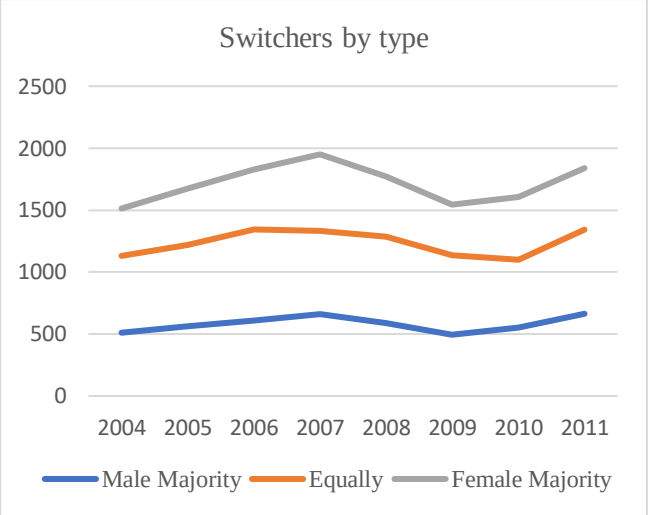
Table 4. Descriptive statistics by type of firms

	All sample			Female Majority		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Labour productivity	102,771	9.304491	1.245133	28,601	9.276666	1.351517
Firm age	104,061	11.03769	7.140558	29,239	11.63036	8.689928
Total number of workers	104,061	24.13605	25.48109	29,239	25.68716	29.12759
Total assets	104,056	335966.1	1143021	29,239	414656.2	1730344
Sales	104,061	465738.1	1087984	29,239	457332.8	1044405
Sales growth	82,413	1.253666	291.7433	22,902	0.439533	35.58377
Profit before tax	103,992	16424.47	101761.1	29,211	16991.53	103432.9
Profit after tax	103,066	14209.2	94682.66	28,951	14487.59	93577.82
ln exports	104,061	2.689706	4.598076	29,239	2.47649	4.499032
small	104,061	0.9142138	0.28005	29,239	0.893259	0.308789
Regions						
disadvantaged	103,308	0.1638498	0.370141	28,917	0.163433	0.369767
Central Hungary	104,061	0.4365997	0.495967	29,239	0.446972	0.497189
Central Transdanubia	104,061	0.096799	0.295685	29,239	0.090872	0.287432
Western Hungary	104,061	0.084979	0.278852	29,239	0.08198	0.274338
South West Hungary	104,061	0.0757536	0.264605	29,239	0.076097	0.265158
North Hungary	104,061	0.0798954	0.271133	29,239	0.086255	0.280745
North Great Plain Hungary	104,061	0.1116845	0.314979	29,239	0.103184	0.304204
South Great Plain Hungary	104,061	0.1142311	0.318093	29,239	0.114539	0.31847
	Equally			Male Majority		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Labour productivity	13,299	9.308695	1.213088	60,871	9.316647	1.198878
Firm age	13,478	11.21568	6.642248	61,344	10.71609	6.366307
Total number of workers	13,478	21.82223	21.28263	61,344	23.90511	24.39576
Total assets	13,478	275100.7	821413.7	61,340	311831.8	797882.2
Sales	13,478	381757.2	684506.5	61,344	488196.1	1176040
Sales growth	10,997	0.1230444	1.994008	48,514	1.894279	379.4588
Profit before tax	13,472	14340.3	66108.1	61,309	16612.27	107266.8
Profit after tax	13,360	12365.61	60924.13	60,755	14481.94	101086.3
ln exports	13,478	2.751232	4.589182	61,344	2.777816	4.64329
small	13,478	0.9361923	0.244419	61,344	0.919373	0.272264
Regions						
Disadvantaged region	13,358	0.1557119	0.362596	61,033	0.165828	0.37193
Central Hungary	13,478	0.4362665	0.49594	61,344	0.431729	0.495321
Central Transdanubia	13,478	0.0991245	0.29884	61,344	0.099113	0.298816
Western Hungary	13,478	0.0919276	0.288934	61,344	0.084882	0.278708
South West Hungary	13,478	0.0721175	0.258692	61,344	0.076389	0.265622
North Hungary	13,478	0.0841371	0.277604	61,344	0.075932	0.264892
North Great Plain Hungary	13,478	0.1091408	0.311827	61,344	0.116295	0.320581
South Great Plain Hungary	13,478	0.1072118	0.309394	61,344	0.115627	0.319779

3.3. Switcher firms

To be considered in the analysis given longitudinal dimension of dataset is the aspect that firm can switch from a type to another. For example, if a firm which in period t is a male majority type hires a considerate proportion of women relative of male workers, it can lead for switch into an equally or even female majority type. This behaviour will also be added to the analysis. In total, non-switchers are 3521 firms where the largest part 59.52% are male majority, 31.86% are female majority and lowest proportion is equally firms which account for 8.62% of non-switchers.

Figure 2. Switcher firms by type



In contrary by type of switchers, the largest number of firm have switched to an equal type, then to male majority and in the end to female majority. Even though, it seems that there is a variation in the number of firms who switch, a deeper analysis should be done to see if this behaviour is important.

Table 5. Switcher firms by type

Year	2004	2005	2006	2007	2008	2009	2010	2011	Sum
From Female to Male majority	169	164	203	244	202	159	156	233	1530
From Equally to Male majority	343	396	406	417	387	335	394	430	3108
From Female majority to Equally	279	255	308	286	283	289	210	279	2189
From Equally to Female majority	249	308	288	350	311	247	294	265	2312
From Male majority to Equally	342	403	427	387	411	354	339	398	3061
From Male to Female majority	131	148	196	266	177	162	213	232	1525
In total									
Switches to Male Majority	512	560	609	661	589	494	550	663	4638
Switches to Equally	621	658	735	673	694	643	549	677	5250
Switches to Female Majority	380	456	484	616	488	409	507	497	3837

4. Methodology

To analyse the effect of gender diversity on firm productivity, I use two methodological approaches. *I start with using pooled OLS where the equation is:*

$$Lnprod_{it} = \beta_0 + \beta_1\, prop\_female_{it} + \alpha_i\, F\_c_{it} + \omega Region_i + \theta_{it}\, Ind_i + \mu_{it}\, year + \gamma\, ind\_year + u_{it} + \varepsilon_i$$

$$Lnprod_{it} = \beta_0 + \beta_1\, prop\_female_{it} + \beta_2\, prop\_skilled_{it} + \alpha_i\, F\_c_{it} + \omega Region_i + \theta_{it}\, Ind_i + \mu_{it}\, year + \gamma\, ind\_year + u_{it} + \varepsilon_i$$

$$Lnprod_{it} = \beta_0 + \beta_1\, prop\_female_{it} + \beta_2\, prop\_skilled_{it} + \beta_3\, prop\_skilledfemale_{it} + \alpha_i\, F\_c_{it} + \omega Region_i + \theta_{it}\, Ind_i + \mu_{it}\, year + \gamma\, ind\_year + u_{it} + \varepsilon_i$$

where i = firm and t = year

Lnprod it is the dependent variable, natural logarithm of labour productivity

prop_female-proportion of female workers
prop_skilled - proportion of skilled workers
prop_skilledfemale - proportion of skilled female workers
F_c- includes firm characteristics such as age, size and amount of exports.
Region –region fixed effects
Ind–industry fixed effects
year–year fixed effects
ind_year- industry and year effects
β_0 – constant which is the same for all firms
u_{it} – idiosyncratic error term
ε_i – error term which accounts for individual fixed effects

I estimate three regressions with pooled OLS method to see what is the effect of gender diversity on firm productivity. The dependent variable is the labour productivity for all regressions. First, I estimate the effect of proportion of females in the dependent variables. As the effect of worker on firm productivity is linked with its skills level I include skilled workers, and to inspect if the impact of skilled worker is related to gender, I add the proportion of skilled female workers. To account for other characteristics which impact the productivity of the firm,

I add firm characteristics which include age, size of exports, size of the firm and whether the location of firm is disadvantaged. I also account for fixed effect which may have an impact such as year, industry and region. In addition, I include industry and time effects.

In order to have consistent and unbiased estimator in the pooled OLS model, the main independent variable which is the proportion of female workers must not be correlated with unobserved variables of labour productivity in u_{it} and ε_i. Even though in the regression many factors which impact labour productivity are included, this assumption is not likely to hold. For example, factors are related to the organisational culture of the company may affect both productivity and female proportions.

The equation for the fixed effects model is:

$$Lnprod_{it} = \lambda_i + \beta_1 prop\_female_{it} + \alpha_i i\,F\_c_{it} + \omega Region_i + \theta_{it} Ind_i + \mu_{it} year + \gamma\, ind\_year + u_{it}$$

$$Lnprod_{it} = \lambda_i + \beta_1 prop\_female_{it} + \beta_2 prop\_skilled_{it} + \alpha_i i\,F\_c_{it} + \omega Region_i + \theta_{it} Ind_i + \mu_{it} year + \gamma\, ind\_year + u_{it}$$

$$Lnprod_{it} = \lambda_i + \beta_1 prop\_female_{it} + \beta_2 prop\_skilled_{it} + \beta_3 prop\_skilledfemale_{it} + \alpha_i i\,F\_c_{it} + \omega Region_i + \theta_{it} Ind_i + \mu_{it} year + \gamma\, ind\_year + u_{it}$$

λ_i – unknown intercept for each firm

To account for omitted variable bias due to unobserved factors which are constant in time, I use fixed effects model. In this way these factors do not impact the consistency of our estimators. However, for the fixed effects estimator to be consistent there is a strict exogeneity assumption which is required to hold. Taking in consideration the explanatory variables of our

model for all time periods, the expected value of the idiosyncratic error and unobserved effect must be zero. (Wooldridge, 2008 p.503) If there is any factor which changes through time and has an effect in at least one of the explanatory variables and dependent variable will cause the estimators not to be consistent and biased.

5. Results

The results of the benchmark regression which is Pooled OLS, for firm level data are presented in the Table 6. It is observed that the coefficient for the female proportion is consistently negative throughout all the models, which control for industry fixed effects, year fixed effects industry and year effects, firm characteristics and region effects. After adding age and accounting for regional and industry effects the magnitude of the coefficient for the female proportion decreases while the variance of the dependent variable which is explained by the variance of the independent variables significantly increases. This can be explained by the variation in the industry productivities through year of my interest. In addition, the location of the firm shows a statistically significant effect and in the coming regressions will be more thoroughly analysed. Overall the reasons which make the impact of female proportion in labour productivity consistently negative and statistically significant may include the cultural aspects of gender in Hungary.

Table 6: Benchmark regression using pooled OLS

Pooled Ols	Benchmark regression- Dependent variable: natural logarithm of labour productivity																			
	[1]		[2]		[3]		[4]		[5]		[6]		[7]		[8]		[9]		[10]	
Female proportion	-0.234	***	-0.242	***	-0.260	***	-0.185	***	-0.164	***	-0.155	***	-0.147	***	-0.148	***	-0.077	***	-0.331	***
	0.013		0.013		0.013		0.015		0.014		0.014		0.014		0.014		0.010		0.016	
firm age			0.004	***	0.004	***	0.001		-0.001	**	-0.001	*	0.000		-0.001		-0.001	***	-0.001	
			0.001		0.001		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Log exports									0.051	***	0.053	***	0.052	***	0.052	***	0.048	***	0.048	***
									0.001		0.001		0.001		0.001		0.001		0.001	
small											0.178	***	0.175	***	0.174	***	0.069	***	0.055	***
											0.012		0.012		0.012		0.012		0.012	
disadvantaged													-0.160	***	-0.160	***	-0.123	***	-0.122	***
													0.010		0.010		0.010		0.010	
proportion of skilled																	1.107	***	1.144	***
																	0.014		0.014	
prop of skilled female																			-0.281	***
																			0.014	
constant	9.472	***	9.442	***	9.571	***	9.958	***	9.632	***	9.460	***	8.992	***	20.17	***	19.20	***	19.49	***
	0.013		0.014		0.505		0.428		0.419		0.418		0.590		1.567		1.522		1.519	
Industry and Year Effects	No		No		No		No		No		No		No		Yes		Yes		Yes	
Industry Fixed effect	No		No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Region Dummies	No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Fixed year effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R square	0.006		0.007		0.016		0.296		0.325		0.327		0.330		0.331		0.368		0.371	
observations	102771		102771		102771		102771		102771		102771		101976		102771		102037		102037	

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

As traditional roles have a significant impact, even though women have been part of labour force for a long time, their primary role is related to motherhood, their position in the firm may play a secondary role.

In addition, men are more in charge of decision making than women, as we saw the majority of firms in our sample have more men in proportion of skilled workers, their role on labour productivity may be more significant than women. When controlling for the impact of the proportion of skilled females, it is seen that the impact of female proportion becomes more negative. This shows that the strong negative impact of the presence of unskilled female in the female labour workforce.

Table 7: Main regression using Fixed Effects

Fixed effects model	Dependent variable: natural logarithm of labour productivity																			
	[1]		[2]		[3]		[4]		[5]		[6]		[7]		[8]		[9]		[10]	
Female proportion	-0.043		-0.04		-0.04		-0.04		-0.04		-0.04		-0.04		-0.04		-0.02		-0.04	
	0.04		0.04		0.04		0.04		0.04		0.04		0.04		0.04		0.024		0.042	
proportion of skilled																	0.116	***	0.116	**
																	0.035		0.035	
prop of skilled female																			-0.03	
																			0.042	
Variable																				
constant	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***
firm age			Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Log exports									Yes	***	Yes	***	Yes	***	Yes	***	Yes	***	Yes	***
small											Yes	***	Yes	***	Yes	***	Yes	***	Yes	***
disadvantaged													Yes		Yes		Yes		Yes	
Industry and Year Effects	No		No		No		No		No		No		No		Yes		Yes		Yes	
Industry Fixed effect	No		No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Region Dummies	No		No		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Fixed year effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R square overall	0.004		0.003		0.005		0.033		0.057		0.059		0.059		0.003		0.004		0.003	
observations	1E+05		1E+05		1E+05		1E+05		1E+05		1E+05		1E+05		1E+05		1E+05		1E+05	
all results are clustered by firm																				

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Even though the coefficients are statistically significant, if there are other unobserved effects which impact both proportion of female workers and labour productivity our results may be biased and not reliable. For example, if the environment of these firms prevent women to get into top positions and to advance their career this may influence their future motivation, and

developing their skills, hence it will potentially negatively influence labour productivity. As the sample has small and medium enterprises, especially small firms are more likely to pay less attention to the organisational environment, thus making small or insignificant changes in this aspect compared to large corporations throughout years.

Therefore, it can be assumed that these effects are constant through times and using fixed effects model will wipe those effects out. Table 8 shows the results of fixed effects and it can be seen that the magnitude of the effect of proportion of females workers decreases by a considerable proportion and the effect becomes statistically insignificant. In addition, even the effect of the proportion of skilled female workers decreases and becomes statistically insignificant. Nevertheless, the importance and the direction of the proportion of skilled worker has not changed, which can be explained by the presence of skilled males in the workforce.

Table 8: Pooled OLS and Fixed Effects by type of gender diversity

Female Majority									
Dependent variable: lnprod	Pooled OLS		Fixed Effects			Pooled OLS		Fixed Effects	
	[1]		[2]			[1]		[2]	
Female proportion	-0.31465	***	-0.01926		Male proportion	0.314647	***	0.019257	
	0.016856		0.027385			0.016856		0.027385	
proportion of skilled	1.142729	***	0.211495	***	proportion of skilled	1.142729	**	0.211495	***
	0.014756		0.025336			0.014756		0.025336	
prop of skilled female	-0.28973	***	-0.02529		prop of skilled Male	0.28973	***	0.025287	
	0.014662		0.02562			0.014662		0.02562	
Equally Firms									
Female proportion	-0.32881	***	-0.029219		Male proportion	0.328812	***	0.029219	
	0.01671		0.0433789			0.016711		0.043379	
proportion of skilled	1.1344	***	0.1114419	***	proportion of skilled	1.1344	***	0.111442	***
	0.014622		0.0361726			0.014622		0.036173	
prop of skilled female	-0.28128	***	-0.0251818		prop of skilled Male	0.281275	***	0.025182	
	0.014542		0.0442218			0.014542		0.044222	
Male Majority									
Female proportion	-0.3278	***	-0.03794		Male proportion	0.327804	***	0.037941	
	0.016728		0.043988			0.016728		0.043988	
proportion of skilled	1.13872	***	0.107952	***	proportion of skilled	1.13872	***	0.107952	***
	0.014647		0.036983			0.014647		0.036983	

prop of skilled female	-0.26362	***	-0.02793		prop of skilled Male	0.263622	***	0.027932	
	0.014616		0.04523			0.014616		0.04523	

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

To further account for heterogeneity of firms regarding gender diversity I will specifically run regression for each type and see how including more male or female workers affect their labour productivity. From the tables for female majority, equally and male majority types the result compared to the benchmark regression hold. Across all the types, the effect of female proportion on labour productivity is negative and statistically significant for pooled OLS. In addition, this effect is less negative and statistically insignificant for the Fixed effects model. Nevertheless, the effect of the proportion of skilled workers is positive and statistically significant in average, holding everything else constant. For pooled OLS, firms which switch from being female majority or male majority to more diverse, equally firms contribute to a positive impact in the labour productivity. However, this also holds to switching to male majority type of firms but in fixed effects the contribution is not statistically significant.

Table 9: Fixed Effects by region

FIXED EFFECTS by region	Dependent variable: lnprod													
	Region 1		Region 2		Region 3		Region 4		Region 5		Region 6		Region 7	
Female proportion	-0.00389		-0.03285		-0.16638		0.011932		0.282001		-0.14696		-.22877	*
	0.06285		0.128249		0.132181		0.154176		0.184401		0.128509		.116772	
proportion of skilled	0.147636	***	0.204975	*	-0.01805		0.103105		0.095025		0.110921		-.063157	
	0.053399		0.113105		0.119832		0.113475		0.122644		0.099189		.096061	
prop of skilled female	-0.02103		-0.0614		-0.19557		0.123334		0.187888		-0.03677		-.0909938	
	0.06197		0.127688		0.134026		0.148178		0.191617		0.13363		.1207466	
Switcher														
Switch_male	yes		yes		yes		yes		yes		yes	*	Yes	
Switch_female	yes		yes		yes		yes		yes		yes		Yes	

Switch_equall	yes		yes		yes		yes		yes		yes		Yes	
Variable														
constant	Yes	***	Yes	**	Yes	***	Yes	***	Yes	*	Yes	***	Yes	*
firm age	Yes	***	Yes		Yes		Yes		Yes		Yes		Yes	
Log exports	Yes	***	Yes		Yes		Yes		Yes		Yes	***	Yes	**
small	Yes	***	Yes		Yes		Yes		Yes		Yes		Yes	
disadvantaged	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry and Year Effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry Fixed effect	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Fixed year effects	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
R square	0.0009		0.0088		0.0548		0.025		0.0828		0.0368		0.0611	
observations	44437		9953		8745		7690		8116		11408		11685	

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Regions by number, 1- Central Hungary, 2- Central Transdanubia, 3- Western Hungary, 4- South West Hungary, 5- North Hungary, 6- North Great Plain Hungary and 7- South Great Plain Hungary.

To see if there are any disparities between regions, see if the impact of female proportion in firm productivity may be different I use fixed effects model and run regressions for each region.

The main conclusion is that the results hold, the effect of female proportion and skilled female proportion is not statistically significant. However, for some particular region specifically in North Hungary and Northern Great Plain of Hungary even though the effect of female proportion is still not significant, the direction changes. As the first region accounts for the largest proportion of firms in our sample the results hold, and the effect of skilled worker is positive and statistically significant.

6. Conclusions

This paper aims to answer the direction of the effect of gender diversity on firm performance. I use dataset from LEED, Hungary for 2003-2011 period. Considering Hungary's contextual factors of Hungary such as having no specific regulations for the diversity of the firms, a general traditional view on division of gender roles in society. A high probability of an existing glass ceiling due to the low number of women on top positions even though the biggest share of employees by tertiary education are women, I make two hypothesis.

First is that by increasing the proportion of women workers in the firm the effect on firm productivity will have a negative. Second, even increasing the proportion of skilled women workers in the firm the effect on firm productivity will be negative relative to men. I find partial support for these two hypothesis as I use pooled OLS and Fixed Effects model. In the pooled OLS the two hypothesis hold and are statistically significant while for the fixed effects model the direction of the variables hold but are not statistically significant. However, as fixed effects model removes the effect of time constant factors, it has a strict exogeneity assumption which if it does not hold may cause inconsistent estimators. That is why considering limitations of the methods I do not aim to conclude any causality.

Given the results, I will also describe limitations and discuss future research ideas. To determine causality in this case , it would need to be decided whether or not female choose to work on less productive firms or they cause the firms to be less productive. This could be done using methods of difference in difference before and after a female becomes CEO or main manger or use Instrumental variable approach by using as instrument a variable which affects labour productivity only by the impact on female proportion. In addition, more data about organisational culture of the business should be considered, whether it promotes or hinder women' s part on decision making and advancement of their careers.

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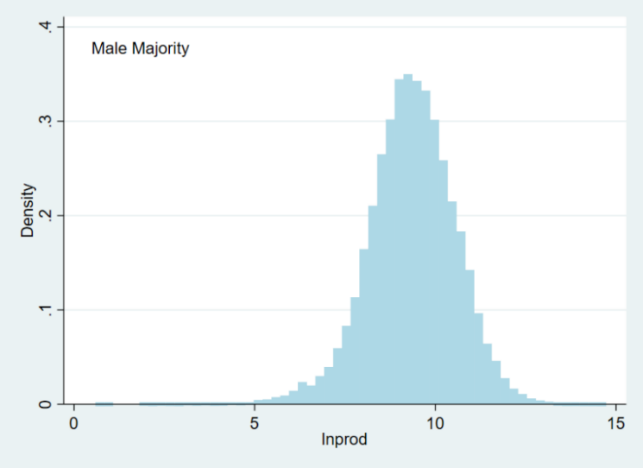
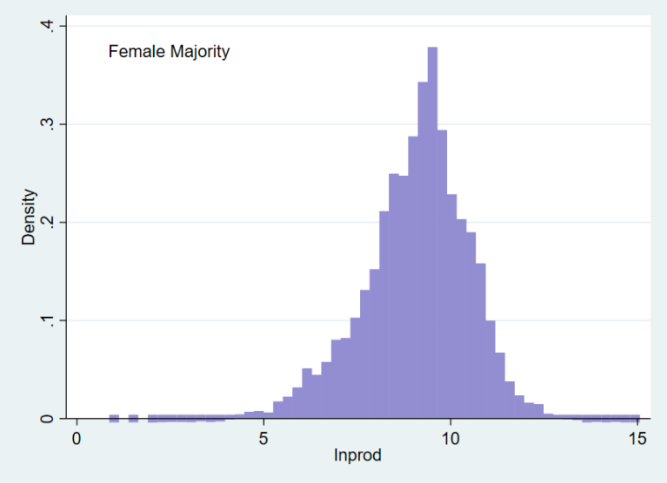
Appendix A. Results

Figure A.1: Histograms by gender diversity of firms





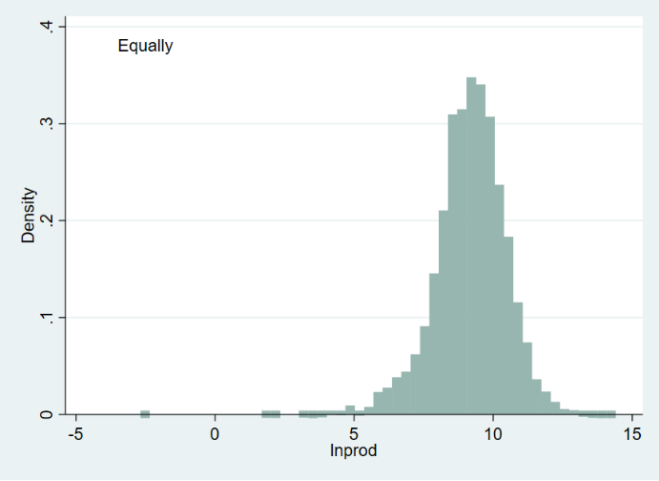


Figure A.2: Kernel density plot by gender diversity of firms

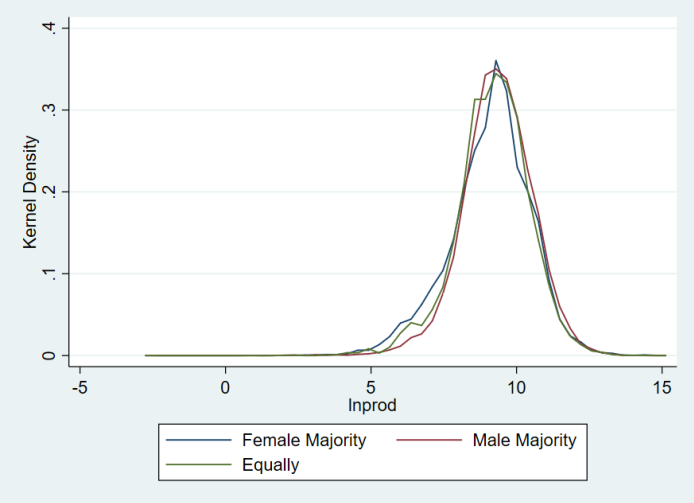


Table A.1: Pooled OLS and Fixed Effects for female majority firms

Dependent variable: lnprod	Pooled OLS		Fixed Effects			Pooled OLS		Fixed Effects	
	[1]		[2]			[1]		[2]	
Female proportion	-0.31465	***	-0.01926		Male proportion	0.314647	***	0.019257	
	0.016856		0.027385			0.016856		0.027385	
proportion of skilled	1.142729	***	0.211495	***	proportion of skilled	1.142729	**	0.211495	***
	0.014756		0.025336			0.014756		0.025336	
prop of skilled female	-0.28973	***	-0.02529		prop of skilled Male	0.28973	***	0.025287	
	0.014662		0.02562			0.014662		0.02562	
Switcher					Switcher				
Switch_male	0.067405	***	-0.01594		Switch_male	0.067405	***	-0.01594	
	0.025956		0.014908			0.025956		0.014908	
Switch_female	0.010236		0.003884		Switch_female	0.010236		0.003884	
	0.016538		0.008877			0.016538		0.008877	
Switch_eq	0.041112	*	0.012319		Switch_eq	0.041112	*	0.012319	
	0.022034		0.011065			0.022034		0.011065	
Variable					Variable				
constant	Yes	***	Yes		constant	Yes	***	Yes	
firm age	Yes	*	Yes		firm age	Yes	*	Yes	
Log exports	Yes	***	Yes		Log exports	Yes	***	Yes	
small	Yes	***	Yes		small	Yes	***	Yes	
disadvantaged	Yes	***	Yes		disadvantaged	Yes	***	Yes	
Industry and Year Effects	Yes		Yes		Industry and Year Effects	Yes		Yes	
Industry Fixed effect	Yes		Yes		Industry Fixed effect	Yes		Yes	
Region Dummies	Yes		Yes		Region Dummies	Yes		Yes	
Fixed year effects	Yes		Yes		Fixed year effects	Yes		Yes	
R square	0.3745		0.0027		R square	0.3745		0.0027	
observations	93704		93704		observations	93704		93704	

Table A.2: Pooled OLS and Fixed Effects for equally firms

Dependent variable: lnprod	Pooled OLS		Fixed Effects		Dependent variable: lnprod	Pooled OLS		Fixed Effects	
	[1]		[2]			[1]		[2]	
Female proportion	-0.32881	***	-0.029219		Male proportion	0.328812	***	0.029219	
	0.01671		0.0433789			0.016711		0.043379	
proportion of skilled	1.1344	***	0.1114419	***	proportion of skilled	1.1344	***	0.111442	***
	0.014622		0.0361726			0.014622		0.036173	
prop of skilled female	-0.28128	***	-0.0251818		prop of skilled Male	0.281275	***	0.025182	
	0.014542		0.0442218			0.014542		0.044222	
Switcher					Switcher				
Switch_male	0.063943	***	-0.0296715		Switch_male	0.063943	***	-0.02967	
	0.018152		0.020152			0.018152		0.020152	
Switch_female	-0.00304		0.0185345		Switch_female	-0.00304		0.018535	
	0.02105		0.0230149			0.02105		0.023015	
Switch_eq	0.054953	***	0.0046135		Switch_eq	0.054953		0.004614	
	0.01422		0.0146263			0.01422		0.014626	
Variable					Variable				
constant	Yes		Yes		constant	Yes		Yes	
firm age	Yes		Yes		firm age	Yes		Yes	
Log exports	Yes		Yes		Log exports	Yes		Yes	
small	Yes		Yes		small	Yes		Yes	
disadvantaged	Yes		Yes		disadvantaged	Yes		Yes	
Industry and Year Effects	Yes		Yes		Industry and Year Effects	Yes		Yes	
Industry Fixed effect	Yes		Yes		Industry Fixed effect	Yes		Yes	
Region Dummies	Yes		Yes		Region Dummies	Yes		Yes	
Fixed year effects	Yes		Yes		Fixed year effects	Yes		Yes	
R square	0.3713		0.003		R square	0.3713		0.003	
observations	96008		96008		observations	96008		96008	

Table A.3: Pooled OLS and Fixed Effects for male majority firms

Dependent variable: lnprod	Pooled OLS		Fixed Effects		Dependent variable: lnprod	Pooled OLS		Fixed Effects	
	[1]		[2]			[1]		[2]	
Female proportion	-0.3278	***	-0.03794		Male proportion	0.327804	***	0.037941	
	0.016728		0.043988			0.016728		0.043988	
proportion of skilled	1.13872	***	0.107952	***	proportion of skilled	1.13872	***	0.107952	***
	0.014647		0.036983			0.014647		0.036983	
prop of skilled female	-0.26362	***	-0.02793		prop of skilled Male	0.263622	***	0.027932	
	0.014616		0.04523			0.014616		0.04523	
Switcher					Switcher				
Switch_male	0.060203	***	-0.03265		Switch_male	0.060203	***	-0.03265	
	0.015225		0.017908			0.015225		0.017908	
Switch_female	0.031463		-0.00901		Switch_female	0.031463		-0.00901	

	0.025908		0.032717			0.025908		0.032717	
Switch_eq	0.076727	***	0.007875		Switch_eq	0.076727	***	0.007875	
	0.018406		0.018907			0.018406		0.018907	
Variable					Variable				
constant	Yes		Yes		constant	Yes		Yes	
firm age	Yes		Yes		firm age	Yes		Yes	
Log exports	Yes		Yes		Log exports	Yes		Yes	
small	Yes		Yes		small	Yes		Yes	
disadvantaged	Yes		Yes		disadvantaged	Yes		Yes	
Industry and Year Effects	Yes		Yes		Industry and Year Effects	Yes		Yes	
Industry Fixed effect	Yes		Yes		Industry Fixed effect	Yes		Yes	
Region Dummies	Yes		Yes		Region Dummies	Yes		Yes	
Fixed year effects	Yes		Yes		Fixed year effects	Yes		Yes	
R square	0.3685		0.0029		R square	0.3685		0.0029	
observations	96331		96331		observations	96331		96331	