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Abstract

Hungarian legislation provides firms with financial incentives to train apprentices from vocational training schools. In line with these incentives, it is observed that firms increasingly train apprentices over the period 2003-2011, in particular, in the sectors manufacturing, construction, wholesale and retail and hotels and restaurants. However, at the same time, it is observed that firms decreasingly retain the trained apprentices in these four sectors. This finding leads to the hypothesis that apprentices are not profitable in the long run. The formulated hypothesis is known in the previous literature as the 'substitution strategy'. This recruiting strategy is particularly observed among firms that replace their low-skilled labour with apprentices in order to reduce the cost of wages. For these firms it is not beneficial to hire an apprentice after accomplishing his training, because then he becomes a low-skilled worker paid at higher wages. This paper investigates the effect of the share of days worked by apprentices on productivity and gross profits of Hungarian firms by using a unique matched employer-employee dataset. Different approaches that allow us to estimate the effect are discussed among which fixed effects first-difference models and system GMM. The results indicate that apprentices decrease productivity and gross profits of Hungarian firms. These negative effects on firm performance were more prominent and robust before (2003-2007) than after the financial crisis (2008-2011).

JEL: I21, J24, L25

Keywords: apprenticeship training, firm performance, panel data

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Tanoncok foglalkoztatásának hatása a magyar vállalatok termelékenységére

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Összefoglaló

A magyar szabályozási környezet pénzügyileg ösztönzi a vállalatokat a szakiskolai tanoncok képzésére és a magyar kormány kiemelt prioritásának tekinti a duális szakképzés fellendítését. Ezen ösztönzőkkel összhangban 2003 és 2011 között a magyar vállalatok egyre nagyobb arányban vettek részt a tanoncképzésben, elsősorban a feldolgozóipar, építőipar, kereskedelem és a szálloda és vendéglátóipar területén. Azonban a növekvő vállalati tanoncképzés ellenére, a vállaltok egyre kisebb arányban alkalmazták az általuk képzett tanoncokat a szakvizsga megszerzése után ebben a négy szektorban. E megfigyelések alapján arra következtethetünk, hogy a tanoncok alkalmazása hosszabb távon nem kifizetődő a vállalatok számára. Az irodalom ezt vállalati viselkedést „helyettesítési stratégiának" nevezi. A helyettesítési stratégiát követő vállalatok tanoncokkal helyettesítik az általuk alkalmazott alacsonyan képzett munkaerő egy részét a bérköltségek csökkentésének érdekében. Azonban ezen vállaltok számára nem kifizetődő a tanoncok szakvizsga utáni alkalmazása, mivel ilyenkor a nekik fizetendő bérek megemelkednek. Tanulmányunk azt vizsgálja, milyen hatással van a vállaltoknál alkalmazott tanoncok által ledolgozott napok aránya a vállalatok bruttó profitjára és termelékenységére. Elemzésünkhöz kacsolt dolgozói-céges adminisztratív adatbázis használtunk. A fenti hatás megbecsléséhez több különböző identifikációs stratégiát is alkalmaztunk (többek között fixhatás és system GMM modelleket). Eredményeink szerint a tanoncok alkalmazása csökkenti a magyar vállaltok profitját és termelékenységét. Továbbá a megfigyelt negatív hatások erősebbek voltak a gazdasági válság előtt (a 2003-2007 között), mint a válság utáni időszakban (2008 és 2011 között).

JEL: I21, J24, L25

Tárgyszavak: tanoncképzés, vállalati teljesítmény, panel adatbázis

1. INTRODUCTION

Previous literature indicated the complex net cost puzzle of training apprentices with firm specific skills (Acemoglu and Pischke, 1998; Dionisius et al., 2009; Muehlemann et al., 2010). Firms may be reluctant to train apprentices, whereas training is costly and time-intensive, and return on investment is insecure. Nonetheless, many firms are training apprentices (Eichhorst et al., 2012). It is observed in the European Union (28 countries) in 2015 that about 10.3 million of students (47.3 percent) followed a vocational education or training programme (VET) at the level of upper secondary education (Eurostat, ec.europa.eu, June 2017). Among these EU-28 countries, Finland (71.3 percent), Croatia (70.4 percent), and Austria (69.5 percent) capture largest shares of students enrolled in upper secondary VET. Contrary, EU-28 countries with rather low shares are Malta (12.7 percent), Cyprus (15.6 percent), and Hungary (23.2 percent).

There are at least two particular reasons why firms train apprentices despite the costs and risks associated with it (e.g. Beckmann, 2002). First, firms invest in the human capital of students in order to reveal the competences and abilities of the trained apprentices (Acemoglu and Pischke, 1998; Muehlemann et al., 2016). At the end of the training period, good apprentices can be retained, while at the same time, firms get return on the trained specific skills. Moreover, it can result in better match quality and lower turnover rates (Muehlemann et al., 2016). This recruiting strategy of firms is called the 'investment strategy'. Second, firms that wish to reduce the wage bill can choose for replacing low-skilled workers with apprentices. It is then implicitly assumed that apprentices can perform as well as low-skilled workers on the job, if, and only if, firms wish to sustain productivity and gross profit. This recruiting strategy of firms is called the 'substitution strategy'. According to Mohrenweiser and Backes-Gellner (2010), in Germany, 18.5 percent of firms follow a substitution strategy, while 43.7 percent follow an investment strategy.

There are relatively few studies that estimate the causal impact of apprentice training on firm productivity and performance (Bajgar and Criscuolo, 2016). Nonetheless, the previous literature provides some empirical evidence on the (lack of) profitability of both types of recruiting strategies. Best-evidence is presented by Mohrenweiser and Zwick (2009). The authors combine an administrative dataset on the employees with company survey data in order to construct a matched employer-employee dataset. The dataset covers the period 1997 to 2002. Different identification strategies are applied in order to aim at causal effects, including fixed effects, first-difference models, and system GMM. Mohrenweiser and Zwick (ibidem) find that, on the one hand, an increase in the share of apprentices in the training company relative to low-skilled workers negatively impacts firm performance in the sector manufacturing. They attribute this negative sign to the efficiency of the apprenticeship system in Germany, namely: employers are willing to bare a net cost when: (1) apprentices are more likely to stay in the training company after the training period; (2) the skills learned at the training company are firm-specific; and (3) it is difficult to find employees skilled for the job on the external labour market. On the other hand, the authors estimate a positive impact of training apprentices in the short-run in the sectors commercial & trade and crafts & construction. It is argued that apprentices, who are trained with more general skills, and who face higher between-firm mobility on the labour market, more likely substitute away low-skilled workers when apprentices are (at least) as productive for the company as low-skilled workers. However, it should be noted that retention rates of about 77 percent are mentioned for the sector manufacturing. These rates can be compared with 72 percent for the sector trade & commercial and 61.5 percent for the sector crafts and construction (Mohrenweiser and Zwick, 2009, p.632, footnote 5). As such, in Germany mean retention rates are high for sectors with high shares of apprentices, not directly providing evidence for strong between-firm mobility in sectors that apply substitution strategies.

Another explanation for the negative impact of apprenticeship training on firm-level productivity and gross profits in the manufacturing sector in Germany can be found in Dionisius et al. (2009). These authors compare the apprenticeship training net cost in Germany with Switzerland, and, therefore, they estimate matching models for average treatment effects. They rely on data from two firm-level surveys with the reference year 2000. Dionisius et al. (ibidem) indicate negative net costs associated with training apprentices in Germany, but positive net costs in Switzerland. From their results, it is argued that the (lack of) profitability of training apprentices in the short-run can be explained by how productive the tasks, allocated to apprentices, are. In particular, allocating more productive tasks to apprentices (in Switzerland) is better for firm performance. Other factors than can explain differences in the net cost between Germany and Switzerland are relative wages and different regulations of the VET-system. Apprentices in Switzerland earn higher wages than in Germany, which can partly be explained by the fact that apprentices also conduct more productive tasks within the training company. Furthermore, Swiss companies are enforced to employ apprentices in a cost-efficient way due to less employment protection legislation in Switzerland compared to Germany. This, in turn, can stimulate Swiss firms to apply substitution recruiting strategies more frequently than German firms (for a discussion particular on the influence of labour market regulations on the investment/substitution strategy, see also Muehlemann et al., 2010).

This paper contributes to the previous literature in several ways. First, we estimate the effect of apprentice training on firm performance in another European Union country than Germany or Switzerland, namely: Hungary. Similarly to other European countries, increasing apprenticeship training is a special priority for the Hungarian government (Muehlemann, 2016; Kis et al, 2008). However, the Hungarian vocational education and training (VET-) system is unique compared to other OECD countries. For example, all firms have a financial incentive (provided by the government) to train apprentices (Section **Hiba! A hivatkozási forrás nem található.**). In line with Beckmann (2002), financial incentives can be important for encouraging firms to train apprentices.

Second, the unique administrative matched employer-employee dataset for Hungary covering the period 2003-2011 is a particular strong contribution to the previous literature. Owing to the Hungarian legislation, we can precisely identify individual apprentices still studying in vocational training schools in the data.[1] We observe the full work history of all individuals (incl. apprentices and regular workers) working at the training establishment. Owing to this information, we are able to distinguish between unexperienced apprentices (< 1 year of experience), and experienced apprentices (>1 year of experience). In this respect, Bajgar and Criscuolo (2016) argue that firm productivity may depend on the stage in the apprentice training progress, since apprentices with more experience at the firm are more likely to perform productive tasks. Finally, owing to detailed dataset on firms, it is possible to estimate the productivity effects of apprenticeship training on firms directly, using detailed firm balance sheet data.

Third, in line with previous findings from the literature on Switzerland and Germany, it is hypothesized that, in the short-run, during the training period, investment strategies yield negative effects of employing apprentices on firm performance. Here, the idea is that firms are willing to incur a net cost in the short-run, because they can retrieve the benefits of training by hiring apprentices with revealed firm-specific skills in the long-run. Contrary, substitution strategies yield positive effects, whereas these firms are production-oriented and cost-efficient. These strategies often go along with allocating productive tasks to apprentices, including firm- or government- financed training opportunities in general skills, and, hereby, low retention rates in the long-run owing to higher between-firm mobility. It is tested in this paper whether these results hold for Hungary by using similar identification strategies as in Mohrenweiser and Zwick (2009).

We find that the net cost puzzle is even more complex for Hungary. We observe that apprentices are increasingly trained in the sectors manufacturing; construction; wholesale, retail and repair; and hotels and restaurants over the period 2003-2011. At the same time, we observe that retention rates are relatively low (just above 20 percent in 2003), at least compared to Germany, for example, and are falling to nearly 10 percent in 2011. These two observations taken together indicate substitution strategies. Horn (2016) found that there is no significant difference in employment opportunities between students participating in school-based and workplace-based practical training during the year after graduation, which

[1] Hungarian legislation stipulates that apprentices have to work with special government regulated contracts.

is also in line with substitution strategies. However, we estimate negative or zero effects of apprenticeship training in Hungary on firm performance, which would be more indicative for investment strategies. Noelke and Horn (2014) found that that declining employer involvement in apprenticeship training leads to higher unemployment on graduation, which indicates that (at least some of the) firms use apprenticeship training as screening process for potential new employees. Additional investigations indicate that the negative effects on firm performance were more prominent and robust before (2003-2007) than after the financial crisis (2008-2011).

This paper proceeds as follows. In Section 2, we describe the Hungarian VET-system and legislation. Section 3 presents the empirical strategy for estimating the effect of apprentice training on firm performance. Data and descriptive statistics are discussed in Section4, and the results in Section 5. Section 6 concludes.

2. THE HUNGARIAN VET SYSTEM

The Hungarian VET-system combines school-based vocational education and employer-provided workplace based training. Generally, after completing lower secondary education, at 14 year-old, VET-oriented students choose between vocational training schools (szakiskola), that offer dual system VET, or vocational secondary schools (szakközépiskola). Approximately 65% of students choose some form of VET education after finishing 8th grade, of which around 40% continue in vocational secondary schools and around 25% in vocational training schools. However the total number of enrolled students consistently decreased over the examined time period. (Hungarian Ministry of Human Resources (2012))

Only vocational secondary schools deliver diplomas to students that qualify for admission to higher education. As such, obtaining a vocational diploma from vocational training schools does not qualify for entry to higher education. Vocational training schools generally aim at training students for low- and semi-skilled blue collar occupations such as: cook, construction worker, waitress, bellhop, hairdresser or electrician.

Vocational training school programs between 2003 and 2011 provided general and pre-vocational education and training in the first two years; that were followed by one to three (generally two) years of practical training at ISCED 2C or 3C level to obtain a vocational qualification.[2] (CEDEFOP, 2011) The practical training part of the program can be school-based, or workplace-based. School-based training is where the school organizes the training using their vocational teachers in workshops (which can be, but necessarily be physically in the school building). Workplace-based training is where the school or the student herself organize the practical training at a private firm. In this case a special tri-party contract is

2 In September 2010 'early VET programmes' (előrehozott szakiskolai képzés) were introduced which offer three years of vocational training right after completion lower secondary education.

required ("tanulószerződés") between the firm, the student and the vocational training school. There is no clear rule which allocates students between school-based and workplace based practical training and we know relatively little about these allocation mechanisms. (Horn, 2016) In 2011 about 60% of the 11th 12th grade vocational training school students participated in workplace-based training programs and 40% of them in school-based practical training (based on KIR-STAT 2011, table a05t24).

Since selection into the different types of practical training is highly decentralized (students can organize their own workplace-based training themselves) it might not be random. However, Horn (2016) found that after taking local labour market conditions into account, individual background characteristics do not determine the decision to participate in work based or school based training.

Training firms are required to compensate apprentices for their work, although the magnitude of this compensation is very small. The required payment is 20% of the minimum wage per month, which was about 50 euros in 2011.

Hungarian firms have financial incentives to train apprentices from vocational training schools, facilitated by the Hungarian legislation. All employers are required to pay a compulsory "VET contribution" (szakképzési hozzájárulás) to the government, which is 1.5% of the total payroll of the firm. However, employers are also allowed to spend their VET contribution on training apprentices themselves, by offering direct support to a VET institution, or by training their own employees[3] (Kis et al, 2008). This unique legislative environment likely increases the number of firms training apprentices, hence making Hungary a viable candidate for our analysis.

3. EMPIRICAL STRATEGY

We estimate a Cobb Douglas Production Function that includes indicators for human capital and physical capital and also accounts for the firms' state of technology. In particular, we estimate:

$$ln(\pi_{jt}) = \beta_0 + \beta_1 share\ man_{jt} + \beta_2 share\ cons_{jt} + \beta_1 share\ retail_{jt} + \beta_1 share\ hotels_{jt} + \beta_1 share\ skill(m)_{jt} + \beta_1 share\ skill(h)_{jt} + \beta_1 \ln(depr_{jt}) + \sum \gamma_k X_{kjt} + (\nu_j + \rho_j \tau_t) + \varepsilon_j \quad , \quad (1)$$

where outcome measure $ln(\pi_{jt})$ is the value of total production per worker (VTP) (i.e. gross profit) of firm j in year t. The same specification written in Equation (1) will also be estimated

[3] For the former two options firms cannot use the whole amount of their mandatory VET contribution. They can use up to 70% of the total contribution for offering direct support for secondary institutions and 35% for supporting tertiary institutions. Larger firms can use up to 33% and small and medium enterprises up to 60% of the total contribution to train their own workers. Also the possibility of training own employees ended in 2012 Jan because of a legislation change, but this does not affect our analysis.

for the outcome variable total productivity per worker of firm j in year t. Total productivity is computed as gross profit minus the wage bill of the firm.

In order to increase homogeneity across firms, and in line with Mohrenweiser and Zwick (2009), we solely focus on four sectors (industries) that heavily employ apprentices in Hungary, namely: manufacturing; construction; wholesale, retail and repair; and hotels and restaurants.

With respect to the specification of human capital, we adhere to the previous work of Dearden et al. (2006) and Mohrenweiser and Zwick (2009). These authors compare the value of marginal productivity (VMP) of apprentices with VMP of semi- and low-skilled employees working at a firm. Apprentices and semi- and unskilled employees are usually expressed in percent shares, however, the firm-level data also allows us to express these indicators in days worked at the firm within a particular year. Hereby, we can be more accurate on actual productivity of the employees.

The parameters $share\ man_{jt}$; $share\ cons_{jt}$; $share\ retail_{jt}$; $share\ hotels_{jt}$ denote the percent share of days worked by apprentices in the sectors manufacturing; construction; wholesale, retail and repair; and hotels and restaurants, respectively. The reference category is then the share of days worked by regular employees at the firm. We also include $share\ skill(m)_{jt}$ and $share\ skill(h)_{jt}$ in order to compare the share of medium (or semi-) and high skilled workers with the share of low skilled apprentices. This way the reference category becomes the share of days worked by low skilled regular employees at the firm. These control variables can be particularly interesting for statistical inference on replacing cost-intensive semi- and low-skilled labour for apprentices at the time of a negative shock on gross profit. This will be discussed in the next paragraph.

Factual comparing the VMP of apprentices with 'regular' employees can hamper statistical inference because of two specific reasons (Bajgar and Criscuolo, 2016). First, the estimates are liable to omitted variables bias and self-selection bias due to unobserved background characteristics like ability and motivation. Second, correlational estimates are most likely biased due to the firms' endogenous recruiting process (Cabus and Somers, 2017). For example, firms could have altered the human capital mix in response to the financial crisis of 2008 and Great Recession, in essence an exogenous aggregate activity shock on the labour market that also impacts firms' performance. It is observed that Hungary immediately felt the consequences of economic contraction on the labour market (Eurostat, 2016). Because of economic contraction, firms may have replaced cost-intensive semi- and low-skilled labour for apprentices, while, at the same time, a negative shock on revenue (VTP) can be observed. One may then wrongly conclude that increasing the percent share of apprentices in the firm declines VTP. These endogeneity issues (or 'simultaneity of events') usually tend to over- or underestimate the 'true' effects of employing apprentices at the firm on VTP.

We deal with these aforementioned issues in several ways. First, we estimate a Cobb Douglas Production Function that controls for trends and time invariant (unobserved) information with respect to the shares of days worked by apprentices over time (τ_t); the industry wherein the firm operates (ρ_j); and the firm (ν_j). Doing so, in particular, we estimate the change in percent share of (or days worked by) apprentices between time $t-1$ and t on the change in VTP. This corresponds to a first-difference model. Second, it is acknowledged that estimating a first-difference model does not solve the issue of endogeneity. Therefore, it is proposed by Blundell and Bond (1998) to instrument the change in percent share of (or days worked by) apprentices with the fourth lag of the corresponding variable. Indeed, contemporary exogenous aggregate activity shocks have no effect on lagged variables.

As such, the instrument lag of apprentices $(t-1)$ has been instrumented by using the change in share of apprentices between time period $(t-2)$ and $(t-3)$, so that we need at least four subsequent periods of observation (from time t to time $t-3$) of one firm. Hereby, we estimate a dynamic panel data model and, according to Blundell and Bond (1998), optimal moment (or instrument) conditions are found by applying general methods of moments (GMM). We have applied the same empirical strategy to the share of days worked by apprentices in the four industries manufacturing; construction; wholesale, retail and repair; and hotels and restaurants. Taking all these equations together, our chosen empirical strategy is often referred to as system GMM.

With respect to the specification of physical capital, we include an indicator for the logarithm of yearly depreciation denoted by $\ln(depr_{jt})$. This variable is included in order to control for differences between firms with respect to (optimal) size and economies of scale. Hereby, it is acknowledged that smaller firms will have a more rapid a decline in marginal revenue from employing an additional worker (i.e. an apprentice or semi- or low-skilled worker).

The vector X_{kjt} denotes a set of control variables. In particular, we control for the firm workforce composition in terms of share of days worked by prime aged (25-55) and older workers (55+) and share of days worked by people in a second job. We also include other control variables measured at the level of the firm, namely: the firm size; year of the firm entry into the dataset; whether the firm is exporting production and/or services to foreign countries; and an indicator for foreign ownership.

To conclude, a standard Cobb Douglas Production Function includes the firms' state of technology by including a fixed parameter (often denoted by: A). Higher technological advances are associated with capital-intense production, more high-skilled- and fewer low-skilled workers. We control for these potential differences across firms and across industries in several ways. First, in the short-run, the state of technology can be considered constant over time. A first-difference model then controls for technological advances. Second, in case there would be some variation over time, we control for capital expansion by including the variable yearly depreciation. Third, by using the fourth lag as an instrument for change in percent share of apprentices, one avoids the effects of contemporary capital expansion on (endogenous) hiring decisions of the firm (Blundell and Bond, 1998). To conclude, we estimate a first-difference instrumental variables specification that also includes a constant parameter. It is argued that the constant of the regression captures the variation that cannot be explained by the aforementioned variables.

4. DATA

We use unique Hungarian administrative data that matches employer information to employee information. The baseline dataset is a 50% sample of the whole population aged 5-74 in 2003. The employee data contains monthly observations of basic demographic information and complete work and social transfer history at monthly basis on all individuals between January 2003 and December 2011. Furthermore, we have yearly balance sheet data on private firms that correspond to the employees in the data.

We can identify apprentices working with the special student contract required for apprenticeship training mention in the previous section in the data. Unfortunately the dataset does not contain educational background information for all individuals, only for people who were registered as unemployed between 2003 and 2011 (completed level of education) and for people who studied in or after 2009. Therefore we only considered apprentices who were at most 19 years old at the end of their apprenticeship in order to rule out apprentices in tertiary education. We also excluded people working as apprentices in the educational sector, because we suspect these are firms specializing in apprentice training working closely with private vocational training schools, doing basically private, school based practical training.

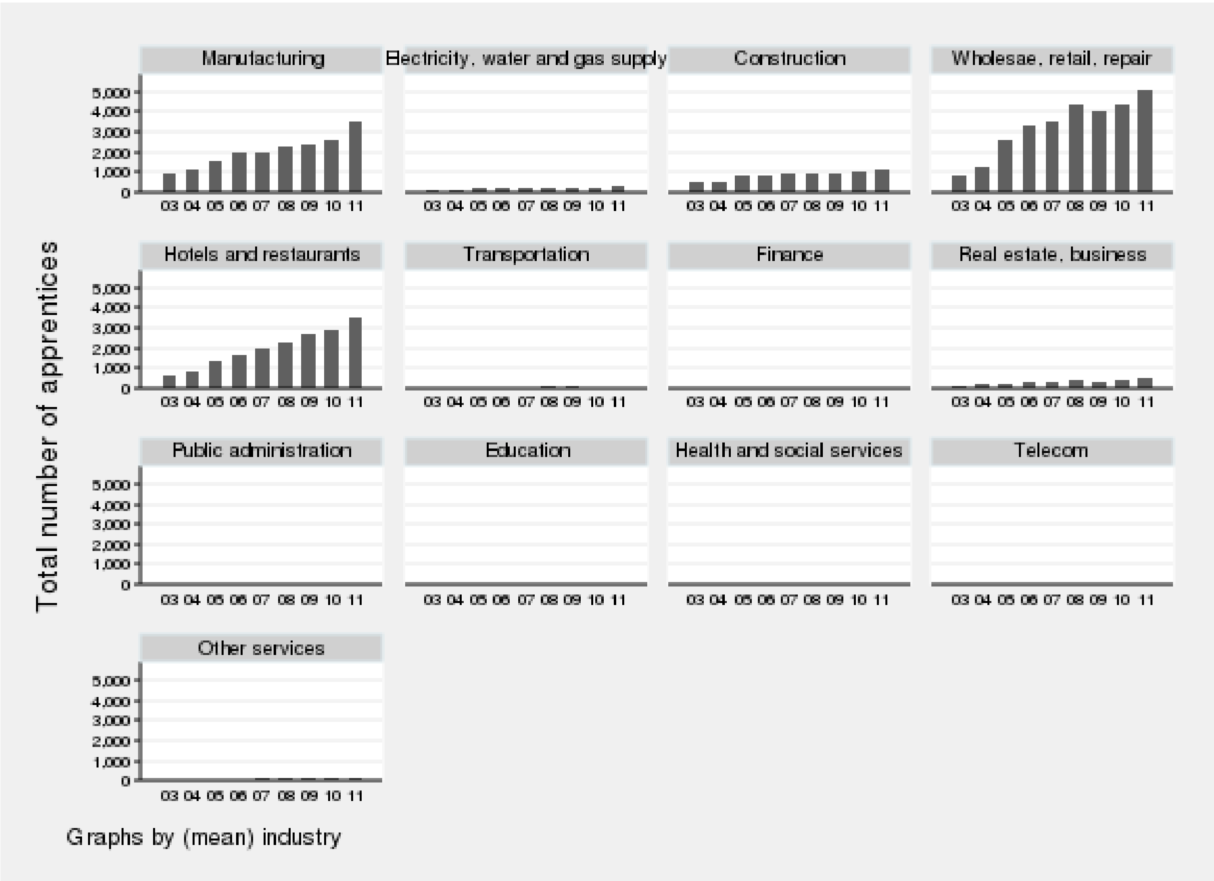
Based on KIR-STAT (2011; Table a05t24) there were 36 960 younger than 19 years old students completing practical training in private firms with special student contracts in 2011. In our data (which is a 50% sample) we found 16 824 apprentices in 2011, so we are able to identify over 90 percent of all apprentices.

To estimate the effect of apprentice training on firm performance we constructed a yearly firm panel from our baseline dataset. We computed the share of apprentices and days worked by apprentices in every year. We also calculated shares of low skilled, medium skilled and high skilled workers in the firms[4] and the shares of young workers (younger than 25 years old), prime aged workers (25-55 years old) and older workers (older than 55 years old).

In our sample we only used firms with minimum 5 number of employees on average to reduce measurement error from using worker shares. Furthermore, because requirements of the two-step system GMM specification (Section 3) we restricted our analysis to firms with at least four observations in the dataset with no bigger gaps than three years between observations.

Figure 1.

Total Number of Apprentices by Industry



Finally, as you can see from Figure 1., there are only four broadly defined industries with significant number of apprentices in firms in our data: manufacturing, construction, wholesale and retail and hotels and restaurants. These four sectors cover on average 93 percent of all apprentices in total. Therefore we restricted our analysis to these four sectors. Table A1. (appendix) indicates the number of observations and firms in each stage in our data selection process. The final sample consists of 43 214 firms and 308 327 observations.

4 To estimate skill level of the different workers we used the highest skilled job between 2003 and 2011, based on occupational codes, as a proxy for skill level. We also used the available limited educational information to improve the classification.

Table 1. presents the descriptive statistics of the variables used for the empirical analysis. The most important findings from this table is that the majority of the firms in Hungary do not train apprentices. The share of firms with at least one apprentice in every year increased consistently over the examined time period from 2 percent in 2003 to 8 percent in 2011.

Table 1.

Basic Descriptive Statistics

	Observations	**Mean**	**Std. Dev.**
Low skilled share	308,327	0.127	0.184
Apprentice share	308,327	0.006	0.041
Apprentice share in manufacturing	308,327	0.001	0.017
Apprentice share in construction	308,327	0.001	0.018
Apprentice share in wholesale	308,327	0.002	0.020
Apprentice share in hotels	308,327	0.002	0.026
Medium skilled share	308,327	0.632	0.267
High skilled share	308,327	0.241	0.252
Young share (<25)	308,327	0.099	0.155
Prime aged share (25-55)	308,327	0.821	0.201
Old share (>55)	308,327	0.076	0.147
Second job share	308,327	0.022	0.093
Log(productivity)	291,263	7.775	0.940
Productivity (in 1000 HUF)	307,020	3711.123	36677.81
Log(gross profits)	242,060	6.798	1.354
Gross profits (in 1000 HUF)	305,546	1703.415	36258.35
Log(depreciation)	300,824	8.028	1.749
Depreciation (in 1000 HUF)	302,720	31384.75	621476.20
Foreign	308,327	0.115	0.319
Exporting	308,327	0.272	0.445
Firm size			
5-10	308,327	0.413	0.492
11-20	308,327	0.247	0.431
21-50	308,327	0.147	0.354
51-300	308,327	0.082	0.274
301-	308,327	0.012	0.111

5. RESULTS

5.1 OLS

Table A2. (appendix) presents the baseline OLS results (without controlling for firm fixed effects). The share of days worked by low skilled regular workers is the reference category.

Consequently, the estimates for the apprentice share across industries in Table A2. (and all other tables below) should interpreted as 'substituting away from low-skilled regular workers towards training/employing apprentices'. Hereby, we apply a direct way of testing for the influence of the substitution recruiting strategy on firm performance (Section 3). For example, we find negative and significant correlations between the share of days worked by apprentices and both productivity and gross profit in all four industries. From this, we can then conclude that substituting away from low-skilled labour towards apprentices is associated with a decline in firm performance.

Table 2.

Fixed Effects Results

	Model (1) Productivity	**Model (2) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**
Apprentice Share Manufacturing	-0.133	-0.583***	-0.154	-0.641***
	(0.101)	(0.214)	(0.100)	(0.198)
Apprentice Share Construction	0.092	-0.015	0.085	-0.038
	(0.090)	(0.159)	(0.087)	(0.151)
Apprentice Share Wholesale and Retail	-0.110	-0.275	-0.110	-0.245
	(0.098)	(0.168)	(0.099)	(0.166)
Apprentice Share Hotels and Restaurants	-0.283***	-0.812***	-0.265***	-0.693***
	(0.084)	(0.174)	(0.084)	(0.172)
Share of medium skilled	Yes	yes	yes	Yes
Share of high skilled	Yes	yes	yes	Yes
Log Depreciation	Yes	yes	yes	Yes
Industry-year dummies	Yes	yes	yes	Yes
Share of different age groups			yes	Yes
Share of people in second jobs			yes	Yes
Firm controls			yes	Yes
Observations	286,647	239,290	286,647	239,290
Number of firms	42,740	41,134	42,740	41,134
Adjusted R-squared	0.068	0.030	0.098	0.086

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

Table 3.

System GMM Results

	Model (1) **Productivity**	**Model (2)** **Gross Profit**	**Model (3)** **Productivity**	**Model (4)** **Gross Profit**
y(t-1)	0.289***	0.278***	0.277***	0.242***
	(0.007)	(0.006)	(0.007)	(0.006)
Apprentice Share Manufacturing	-0.573**	-2.314***	-0.099	-1.487***
	(0.285)	(0.484)	(0.280)	(0.425)
Apprentice Share Construction	-0.597***	-1.240***	-0.311	-1.015***
	(0.219)	(0.386)	(0.212)	(0.373)
Apprentice Share Wholesale and Retail	-1.952***	-2.827***	-1.188***	-2.116***
	(0.195)	(0.466)	(0.184)	(0.422)
Apprentice Share Hotels and Restaurants	-0.723***	-1.874***	-0.311*	-1.058***
	(0.167)	(0.417)	(0.167)	(0.404)
Share of medium skilled	yes	yes	yes	yes
Share of high skilled	yes	yes	yes	yes
Log Depreciation	yes	yes	yes	yes
Industry-year dummies	yes	yes	yes	yes
Share of different age groups			yes	yes
Share of people in second jobs			yes	yes
Firm controls			yes	yes
				yes
Observations	238,080	183,217	238,080	183,217
Number of firms	41,377	37,453	41,377	37,453
Number of instruments	336	336	346	346
Wald chi2	20,405	3.189e+06	1.450e+07	19,008
Arellano–Bond test for AR(1) in first differences (p-value)	0.00	0.00	0.00	0.00
Arellano–Bond test for AR(2) in first differences (p-value)	0.00	0.00	0.00	0.00
Hansen test of over-identification restrictions (p-value)	0.00	0.00	0.00	0.00

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

5.2 FIXED EFFECTS

As presented in Section 4, only a selected number of firms participate in apprenticeship training and selection into training is endogenous, so we should definitely control for firm-specific characteristics. Table 2. demonstrates the results using a firm fixed effects model. Columns (1) and (2) show the results of the baseline specification, and columns (3) and (4) add additional control variables dealing with the share of different age groups, the share of people in second jobs, and other (non-fixed) firm control variables.

For the outcome variable 'per capita productivity', we only found significant and negative correlations in the hotels and restaurants sector. For example, the coefficients in Table 2., column (3), indicate that a 1 percentage point increase in the share of days worked by apprentices (compared to the share of the share of days worked by low skilled regular employees) correlates with a decrease of 0.265 percent in firm per capita productivity. For the outcome variable 'gross profits', the estimate is also significantly negative for the manufacturing sector, even though we find no significant negative correlation between share of days worked by apprentices and per capita productivity. There are no significant correlations estimated for the sector construction and wholesale and retail.[5]

5.3 SYSTEM GMM

In order to further control for potential problems with simultaneity, mostly present in times of economic crisis (Section 3), Table 3. presents the results from using system GMM. We have applied xtabond2 in the statistical software package of Stata (Roodman, 2006). In addition, we imposed common factor restrictions using a minimum distance estimator in order to obtain a single coefficient for all covariates in the dynamic model (Blundell and Bond, 1998). We have done this by using the user created stata command md_ar1 (Söderbom 2009).

The results from Table 3. indicate that a 1 percentage point increase in the share of days worked by apprentices (compared to the share of days worked by low skilled regular workers) decreases the firms' gross profit per capita in all four industries by 1 to 2 percent. However the negative effects on productivity are much smaller. After controlling for all firm specific characteristics we have only found strongly significant effects for the wholesale and retail sector. In case of the other three industries the negative effect on productivity disappeared.

We should mention that the Hansen test of over-identification restrictions indicate p-values of 0.0000. However, in line with Roodman (2006), we claim that these p-values are mainly due to the fact that we have a large amount of data. Indeed, we have much more observations than Mohrenweiser and Zwick (2009) who also used system GMM in order to

[5] For Table 2, we ran the regressions jointly for the four industries. However as a robustness check we estimated the regressions separately as well. Our results remained basically the same, the only difference that the negative productivity effects in the manufacturing sector became significant as well.

control for simultaneity. To test our claim, we estimated our results on a 5% random sample of data. Doing so, the estimated coefficients remained similar, although with much larger standard errors, and the test statistics of the Hansen test became very similar to the ones reported in Mohrenweiser and Zwick (2009). Moreover, Roodman (2006) argues that the Hansen test is prone to weakness, certainly when using many instruments on a small dataset. Therefore, the tests on instrument validity should be interpreted with caution. To conclude, we argue that system GMM still can be considered first-best, besides fixed effects or first-difference models, in terms of estimating potentially causal effects.

Since we have full work history for the workers in our dataset, we are able to distinguish between unexperienced apprentices (<1 year of experience at the firm) and more experienced apprentices (>1 year of experience at the firm). It expected that in particular experienced apprentices can perform skilled tasks during their apprenticeship, and, hereby, replace regular low-skilled workers. Table 4. presents the results in line with Table 3., but then for experienced and unexperienced apprentices separately.

The results indicate that for the sectors construction and wholesale and retail both types of apprentices have similar, negative, impacts on firms' gross profits. Contrary, for the sectors manufacturing and hotels and restaurant, it does matter for gross profit whether you train/employ an unexperienced or an experienced apprentice. The estimated coefficient for experienced apprentices for the sector hotels and restaurant and manufacturing has a positive sign, not significant for the former sector, and significant at 10-percent level for the latter sector.

To conclude, for the sectors manufacturing, and wholesale and retail, training experienced apprentices decrease productivity more than training unexperienced apprentices. Although taking the standard errors into account the estimated coefficients do not differ that much, most of the confidence intervals overlap. So it seems that hiring apprentices decreases the firms per capita productivity in case of both experienced and unexperienced apprentices. However in the manufacturing and the hotels and restaurants sector the increase of the share of experienced apprentices increases or at least does not decrease gross profits of the firm.

Table 4.

System GMM Results for unexperienced and experienced apprentices

	Model (1) Productivity	**Model (2) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**
y(t-1)	0.261***	0.291***	0.245***	0.276***
	(0.006)	(0.007)	(0.006)	(0.007)
Apprentice Share Manufacturing				
Unexperienced	-1.586	-2.835***	-0.058	-2.235***
	(1.580)	(0.383)	(1.346)	(0.376)
Experienced	-2.689***	-0.092	-2.781***	0.581**
	(0.785)	(0.302)	(0.656)	(0.291)
Apprentice Share Construction				
Unexperienced	-2.572***	-1.235***	-2.125***	-0.804**
	(0.591)	(0.339)	(0.661)	(0.355)
Experienced	-2.205***	-1.061***	-1.777***	-0.721**
	(0.743)	(0.278)	(0.655)	(0.285)
Apprentice Share Wholesale and Retail				
Unexperienced	-1.845	-2.271***	-1.278	-1.601***
	(1.177)	(0.489)	(1.069)	(0.480)
Experienced	-3.026***	-2.512***	-3.070***	-1.268***
	(0.724)	(0.289)	(0.665)	(0.278)
Apprentice Share Hotels and Restaurants				
Unexperienced	-3.060***	-1.203***	-1.265	-0.736**
	(1.183)	(0.396)	(0.906)	(0.381)
Experienced	-4.943***	-0.266	-1.601**	0.174
	(0.884)	(0.318)	(0.760)	(0.298)
Share of medium skilled	yes	yes	yes	yes
Share of high skilled	yes	yes	yes	yes
Log Depreciation	yes	yes	yes	yes
Industry-year dummies	yes	yes	yes	yes
Share of different age groups			yes	yes
Share of people in second jobs			yes	yes
Firm controls			yes	yes
Observations	238,080	183,217	238,080	183,217
Number of firms	41,377	37,453	41,377	37,453
Number of instruments	448	448	458	458
Wald chi2	1.280e+07	8204	31563	3.930e+06
Arellano–Bond test for AR(1) in first differences (p-value)	0.00	0.00	0.00	0.00
Arellano–Bond test for AR(2) in first differences (p-value)	0.00	0.00	0.00	0.00
Hansen test of over-identification restrictions (p-value)	0.00	0.00	0.00	0.00

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

5.4 FIRM SIZE AND OWNERSHIP

Earnings and mobility patterns may substantially differ by firm size or organizational type (Bougheas and Georgellis, 2004). Therefore, we estimated our previous specifications separately for different subgroups of firms by size[6] and ownership[7]. We find that our results are mainly driven by small domestic firms (see Table A3 and A4. in the appendix). For medium sized firms, we find negative effects on productivity and gross profit per capita only for firms operating in the wholesale and retail sector. For big firms, the results were similar as for medium sized firms, but additionally we find significant negative effects on gross profit for the manufacturing sector as well.

The results for domestic firms are very similar to our results for the whole sample presented in Table 3. For foreign firms we only found somewhat larger and significant negative effects for gross profits in the wholesale retail and the hotels and restaurant sector. Our sample of foreign firms is much smaller and there are significantly less foreign firms participating in apprenticeship training, so these results may be driven by a few special firms.

5.5 FINANCIAL CRISIS

In Table 5. we show our system GMM results separately for before (2003-2007) and after (2008-2011) the financial crisis. We can conclude that our results are mostly driven by the pre-crisis period. After 2008, we only find significant negative effects for gross profit in the wholesale and retail sector. All other estimated negative effects disappear.

Based on these results we argue that while initially firms hired apprentices despite the negative effects on gross profits, a larger fraction of training firms followed the investment strategy to gain future employees with firm specific human capital. Over time, however, more firms, that initially followed the investment strategy, switched to the substitution strategy in order to substitute away from low-skilled regular workers towards cheaper apprentices to perform basic skilled tasks. This particularly holds for the sectors manufacturing and hotels and restaurants.

[6] Small firms – less than 10 employees; Medium sized firms – 10-50 employees; and Big firms – more than 50 employees.

[7] Domestic majority ownership or foreign majority ownership.

Table 5.

System GMM results for before and after the crisis

	2003-2007		2008-2011	
	Model (3) Productivity	**Model (4) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**
y(t-1)	0.242***	0.235***	0.321***	0.215***
	(0.010)	(0.008)	(0.012)	(0.010)
Apprentice Share Manufacturing	-0.388	-1.051	0.704	0.076
	(0.470)	(0.670)	(0.779)	(0.605)
Apprentice Share Construction	-0.413	-1.630***	0.532	0.155
	(0.435)	(0.606)	(0.426)	(0.653)
Apprentice Share Wholesale and Retail	-1.362***	-2.438***	-0.599	-1.366*
	(0.232)	(0.547)	(0.472)	(0.782)
Apprentice Share Hotels and Restaurants	0.008	-1.366**	-0.468	0.437
	(0.216)	(0.624)	(0.358)	(0.762)
Share of medium skilled	yes	yes	yes	yes
Share of high skilled	yes	yes	yes	yes
Log Depreciation	yes	yes	yes	yes
Industry-year dummies	yes	yes	yes	yes
Share of different age groups	yes	yes	yes	yes
Share of people in second jobs	yes	yes	yes	yes
Firm controls	yes	yes	yes	yes
Observations	119,616	93,471	87,126	65,435
Number of firms	36,152	31,524	32,804	27,138
Number of instruments	110	110	71	71
Wald chi2	19,257	12,435	17,742	10,498
Arellano–Bond test for AR(1) in first differences (p-value)	0.00	0.00	0.00	0.00
Arellano–Bond test for AR(2) in first differences (p-value)	0.00	0.00	0.00	0.00
Hansen test of over-identification restrictions (p-value)	0.00	0.00	0.321***	0.215***

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

Figure 2.

Substitute away from low skilled labour towards hiring apprentices

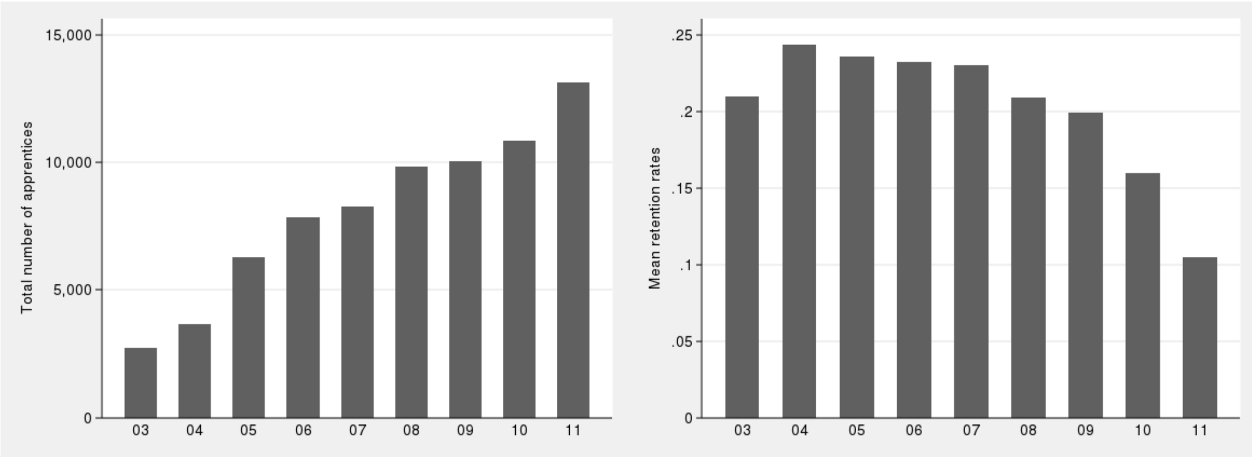


Figure 2. demonstrates that firms hired an increasing number of apprentices over the examined time period, while, at the same time, the retention rate declined from around 20% in 2003 to around 10% in 2011. These numbers are much slower than the 61.5%-77% reported in Mohrenweiser and Zwick (2009) for Germany. As mentioned in the introduction Horn (2016) provides direct evidence that students graduating from vocational training schools face similar employment chances regardless of their place of practical training. His findings also indicate that the majority of firms use apprentices simply as a cheaper substitute for low skilled regular workers. Our results also suggest that after the crisis following substitution strategy among firms became even more prominent.

Figure 3.

Separation and hiring rate of low skilled workers in firms with apprentices

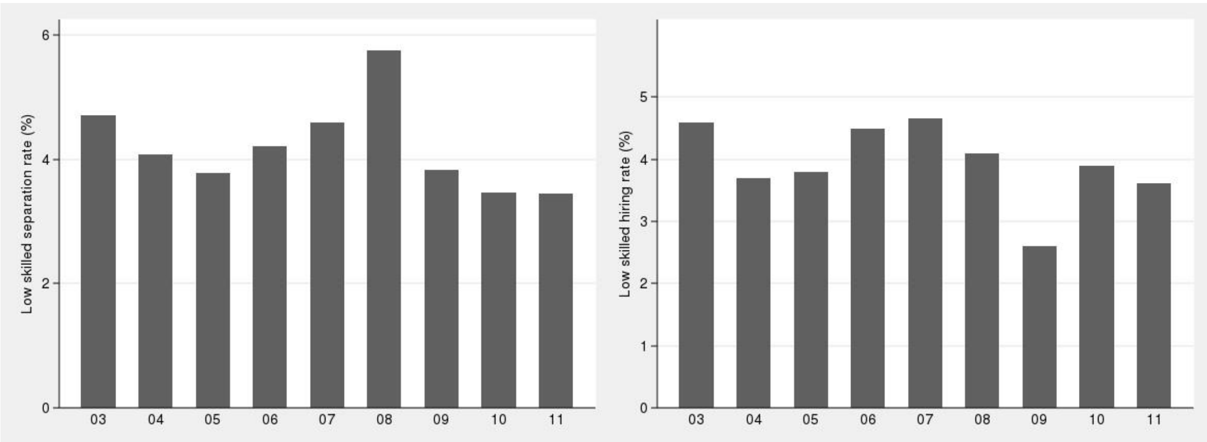


Figure 3. shows the change in separation (on the left) and hiring rates (on the right) of low skilled workers over time in firms who also participated in apprenticeship training (had at least one apprentice). It can be seen that in 2008, presumably because of the financial crisis there was spike in separation of low skilled workers and a big decline in hiring rates in

the following year. In 2010 and 2011 labour turnover seems to be going back to the previous levels, however in Figure 2. we observe a steady increase in the number of hired apprentices between 2008 and 2011. These patterns also support our claim that in the time of the crisis firms increasingly used apprentices as substitutes for low skilled regular workers.

6. CONCLUSION

This paper provides first time evidence on the effectiveness of apprentice training in Hungary in terms of per capita productivity and gross profit. Using different empirical methods that facilitate a causal interpretation of our results, we conclude that apprentices are not profitable for most Hungarian firms. Compared to regular low-skilled workers, apprentices, in particular, those who have less than one year of experience at the firm, decrease firm productivity and gross profits in particular in the sectors manufacturing and wholesale and retail. The estimated effects are generally small. Contrary, experienced apprentices increase gross profits in manufacturing, a sector that witnessed a substantial shift over time from the investment strategy to the substitution strategy. Additionally, our results indicate that firms changed strategy after the financial crisis in 2008 and followed substitution strategy more and more.

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APPENDIX

Table A1.

Sample Selection

	Number of observations	Number of firms
Baseline sample of private firms	1,751,279	415,657
Firms with at least 4 observations	1,386,202	212,361
Min 3 year gap between observations	1,341,924	203,265
Mean number of employees > 5	47,979	63,141
Only 4 industries with most apprentices	308,327	43,214

Table A2.

OLS Results

VARIABLES	(1) Productivity	(2) Gross Profit	(3) Productivity	(4) Gross Profit
Apprentice Share Manufacturing	-1.106***	-2.008***	-0.534***	-1.444***
	(0.115)	(0.260)	(0.109)	(0.209)
Apprentice Share Construction	-0.695***	-1.300***	-0.324***	-1.040***
	(0.095)	(0.193)	(0.088)	(0.172)
Apprentice Share Wholesale and Retail	-2.057***	-3.336***	-1.124***	-2.108***
	(0.141)	(0.288)	(0.114)	(0.213)
Apprentice Share Hotels and Restaurants	-0.386***	-1.154***	-0.051	-0.961***
	(0.089)	(0.206)	(0.088)	(0.180)
Share of medium skilled	yes	yes	yes	yes
Share of high skilled	yes	yes	yes	yes
Log Depreciation	yes	yes	yes	yes
Industry-year dummies	yes	yes	yes	yes
Share of different age groups			yes	yes
Share of people in second jobs			yes	yes
Firm controls			yes	yes
Observations	286,647	239,290	286,647	239,290
Adjusted R-squared	0.323	0.312	0.373	0.411

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

Table A3.

System GMM results by firm size

	Small		**Medium**		**Big**	
	Model (3) Productivity	**Model (4) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**
y(t-1)	0.251***	0.203***	0.345***	0.287***	0.564***	0.385***
	(0.009)	(0.009)	(0.014)	(0.010)	(0.029)	(0.020)
Apprentice Share Manufacturing	-0.256	-1.924**	0.505*	-0.849	-0.533	-4.024***
	(0.354)	(0.827)	(0.303)	(0.709)	(0.701)	(1.556)
Apprentice Share Construction	-0.506	-1.061	-0.381	-0.886	-0.675	-0.506
	(0.280)	(0.459)	(0.289)	(0.610)	(0.826)	(2.029)
Apprentice Share Wholesale and Retail	-0.662***	-1.865***	-0.988***	-2.255***	-1.634***	-8.007***
	(0.244)	(0.537)	(0.283)	(0.743)	(0.603)	(1.740)
Apprentice Share Hotels and Restaurants	-0.311	-1.090**	-0.010	-0.095	-0.068	1.274
	(0.167)	(0.540)	(0.229)	(0.510)	(0.858)	(1.740)
Share of medium skilled	yes	yes	Yes	yes	yes	yes
Share of high skilled	yes	yes	Yes	yes	yes	yes
Log Depreciation	yes	yes	Yes	yes	yes	yes
Industry-year dummies	yes	yes	Yes	yes	yes	yes
Share of different age groups	yes	yes	Yes	yes	yes	yes
Share of people in second jobs	yes	yes	yes	yes	yes	yes
Firm controls	yes	yes	yes	yes	yes	yes
Observations	103,324	77,053	86,494	69,366	22,494	18,149
Number of firms	24,359	20,947	20,636	18,033	4,516	4,003
Number of instruments	342	342	342	342	342	342
Wald chi2	13414	9183	16061	9829	3.108e+06	560894
Arellano–Bond test for AR(1) in first differences (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Arellano–Bond test for AR(2) in first differences (p-value)	1.22e-08	7.78e-08	6.02e-07	1.59e-08	0.365	0.148
Hansen test of over-identification restrictions (p-value)	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent (*).

Table A4.

System GMM results by ownership

	Domestic		Foreign	
	Model (3) Productivity	**Model (4) Gross Profit**	**Model (3) Productivity**	**Model (4) Gross Profit**
y(t-1)	0.262***	0.234***	0.421***	0.371***
	(0.007)	(0.006)	(0.022)	(0.020)
Apprentice Share Manufacturing	-0.139	-1.745***	1.147	0.817
	(0.275)	(0.442)	(0.916)	(1.261)
Apprentice Share Construction	-0.356*	-1.084***	2.036	3.639
	(0.212)	(0.371)	(4.209)	(6.382)
Apprentice Share Wholesale and Retail	-1.118***	-1.848***	-1.343	-7.232**
	(0.171)	(0.414)	(1.849)	(3.339)
Apprentice Share Hotels and Restaurants	-0.390**	-1.201***	0.638	-3.095**
	(0.164)	(0.407)	(1.218)	(1.357)
Share of medium skilled	yes	yes	yes	yes
Share of high skilled	yes	yes	yes	yes
Log Depreciation	Yes	yes	yes	yes
Industry-year dummies	yes	yes	yes	yes
Share of different age groups	yes	yes	yes	yes
Share of people in second jobs	yes	yes	yes	yes
Firm controls	yes	yes	yes	yes
Observations	210,732	162,482	25,605	19,497
Number of firms	37,145	33,658	5,023	4,313
Number of instruments	345	345	330	330
Wald chi2	22875	14326	3997	486548
Arellano–Bond test for AR(1) in first differences (p-value)	0.00	0.00	0.00	0.00
Arellano–Bond test for AR(2) in first differences (p-value)	0.00	0.00	0.0739	0.0258
Hansen test of over-identification restrictions (p-value)	0.00	0.00	0.00	2.26e-09

Notes: Productivity and gross profit are measured per capita. The share of days worked by low skilled regular workers is the reference category. Significance level presented at 1-percent (***); 5-percent (**); and 10-percent.