

Estimates of Individual Returns to Additional Training Constrained by Internal Labour Market Mobility^{*}

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The work is devoted to estimates of individual returns to additional professional training (APT) on the example of Russian metallurgical enterprise in 2006–2010. Estimates of the Mincerian type earnings functions by the OLS, fixed effects models and difference-in-differences estimates are compared. It is shown that the only APTs which rise the intra firm mobility influence on wages significantly. Gender differences appear in the higher effects for men.

Keywords: earnings function, Mincerian type equation, propensity score, matching, difference in differences, treatment effect, personnel records, panel data, internal labour market, training, retraining, rise of qualification, returns to training, fixed effects.

JEL classification: I24, J24, J31, M51, M53.

1. Introduction

Just for a long time till now some economists try to open the “black box” considering firm in a concept of internal labour market. Concerning the part of the problem in the current paper we try to estimate the linkage of additional professional training (APT) of workers, organised by firm, with workers’ wages inside the same firm. It means that we know everything about their internal mobility and know nothing about outside mobility of the workers and ignore this and other corresponding outcomes of the APTs outside the firm.

The data that we are used are workers’ personnel records of a large metallurgical plant situated not far from the city of Ekaterinburg in Russia. Personal records data give us two

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main advantages in the current research. First of all, we decrease errors compared with survey data set. Secondly, we can rather easily separate retraining and rise of qualification. This is important for our research since the considered kinds of APT have different impact on workers as far as wages and mobility are concerned.

In favour of expected differences in returns on the mentioned above two types of training says the fact, that in the rise of qualification there is a greater component of mandatory types of training regulated by norms of labour legislation, formal rules of labour safety, the safety precautions and other statutory acts. We suspect that mentioned above kinds of training can not increase labour productivity of workers directly, but employer may be interested in an increase of workers' wages by the following reasons. Firstly, it is necessary to stimulate workers to pass the programs of training. Secondly, the given types of training can lower the future costs of enterprise connected with infringement of technology, failure of equipment, workers' traumata, etc. Employer can share potential added value with workers. Thirdly, wages increasing can reduce out-firm mobility.

A regional centre and large settlements (cities-satellites) are situated near the enterprise, this fact and availability of roads and well developed public transport give us possibilities to believe, that the enterprise is not monopsony. The labour market is not constrained by the borders of settlement where the enterprise settles down. However, specificity of manufacture and absence of competing offers of workplaces creates the natural barriers for outflow of firm-specific human capital from the enterprise. The employer is ready to invest both in specific, and in the general human capital. The second type of the investments usually raises workers' competitiveness in open labour market. Our monitoring of the enterprise and the interviews with managers and workers of various categories have shown, that the administration is interested in saving up and developing the manufacture, this is the main reason of high attention to investments into the specific human capital in the firm.

Measuring the returns to APT in a context of an increase of workers' wages is an aim of the present research. The following hypotheses will be tested:

- retraining increases workers' wages,
- rise of qualification has no impact on wages.

2. Literature review

In the review we shall adhere to chronological sequence of works, reflecting a gradual deepening of the analysis and also progress of empirical techniques.

Speaking about the estimates, it is necessary to think first of all what we measure? De Beyer (1990) classified the reasons of observable causality of formal training and workers' wages, named them by *participation effect*, *access to jobs* and *wage effect*. The first consists in decrease in probabilities to lose work or to pass to the part-time working, as well as reduction of duration of stay in unemployment. The second effect — *access to jobs* — consists in increase of mobility as a result of APT. The *wage effect* is the result of employer behaviour — he is forced to pay more to keep worker in a firm, because worker thinks that his productivity was increased after

the APT and expects wage increasing, otherwise he can leave the firm for the other appropriate job with better matching to his increased productivity.

De Beyer (1990) have been made OLS estimates of Mincerian earnings functions for skilled manual workers of some enterprises in 1980 in Kenya and Tanzania. APT was insignificant both in Kenya, and in Tanzania. Three hypotheses were formulated after that: (1) training does not raise productivity, (2) productivity raises, but wages do not, (3) wages raise, but it is not reflected by the APT's dummy.

The first hypothesis has no empirical confirmation De Beyer (1990).

In according to the second hypothesis, the employer covers costs of the training by the difference between the increased productivity of the worker and a level of his wage.

The third hypothesis may be valid if workers with lower wages have got a training, but result of training was alignment of their incomes with highly paid workers who are not trained.

Only the *wage effect* was confirmed by De Beyer (1990), nevertheless she admits that the *access to jobs* is present in her estimates in a form of mobility. The *participation effect* was not measured for the lack of the corresponding data

Empirical confirmation of the second De Beyer's hypothesis was received by Conti (2005). Repeating a theoretical background and a procedure described in works (Dearden, Reed, & Van Reenen, 2000), and Conti (2005), she matched Italian Labour Force Survey 1996–1999 data with the accounting information from the balance sheets provided by the AIDA (Analisi Informatizzata delle Aziende) database. Under the Cobb-Douglas with constant return to scale production function constrains Conti (2005) gave empirical confirmation that worker's productivity increase after APT.

As a result of the carried out research Conti (2005) comes to conclusion that elasticity of productivity in the Italian firms on a fraction of the workers who have got APT is nearby 0.4, and the corresponding wages elasticity equals to 0.1. In comparison, for Great Britain of 1983–1996 Dearden et al. (2000) estimates the corresponding values as 2 and 0.6, respectively.

OLS estimates are suffering from the endogeneity problem for the reason that workers' unobservable abilities are usually correlated with the fact of passing throw the APT (see the discussions in Barnow, 1986; Bartel, 1995; Albert, Garcia-Serrano, & Hernanz, 2010 for example). Like Bartel (1995) says when more able and prospective workers have got involved in APT in a higher extent, then the coefficient of the explanatory variable described an amount of additional training in earnings function contains an effect of abilities and it is overestimated for this reason.

The mentioned above correlation of abilities with the amount of APT is confirmed in a number of empirical studies. For example, Arulampalam, Bryan, and Booth (2004) showed that in Europe (but Belgium) higher educated workers pass the APT more often than others. The same is for Canada (Parent, 2003). Parent (2003) says that that are not only the workers' wished but employers too. According to Bills and Hodson (2007), workers from the higher ladder trained more often than the workers from the lower levels.

In the early works endogeneity of APT was controlled by worker's ability added to the set of explanatory variables in earnings functions (see, for example, Barron, Berger, & Black, 1999).

One of the way to solve the endogeneity problem is the use of the instrumental variables (IV) estimates (see, for example, Wooldridge, 2010). Our experience of applied research shows, that there is trade-off between exogeneity and relevance conditions for instruments for educational level of respondents. More so, IV estimates of return to education are often higher¹ than OLS estimates (Card, 2001). This last can be applied to APT², this is the reason that we do not use IV estimates in the current research.

Partially endogeneity can be controlled by the first differences estimates (Bartel, 1995). All time-invariant effects (both observable and unobservable) will be excluded from the equations in this case. Beside to transition to the first differences Bartel (1995) has controled the effect of promotion by means of appropriating binary variables and has considered heterogeneity of individuals by the individual fixed effects (LSDV estimates). In some models in the work (Bartel, 1995) correlation of on-the-job training with workers' individual unobservables were controlled by the worker's productivity before APT, included in the model as an explanatory variable. As the result Bartel (1995) positive significant influence of on-the-job training³ on the workers' wages.

The work (Bartel, 1995) is the first of known to us of works in which authors have got rid of distinctions in preferences of the specific human capital by different firms, having limited empirical estimates on data from the only one firm.

In work (Goux & Maurin, 2000) the data representatively represented the population of France in the age of 20–64 years are used. Empirical estimates have been made on sample of the private sector workers who passed the programs of training in 1989–1992. It was noted, that selection on programs of training occurs according to both observable, and to unobservable characteristics of workers. In that case endogeneity should affect on the estimates interpretation. Besides that different programs of training have different influence on incomes of the workers who remained in firm and have left firm after training. Within the limits of firm the specific human capital is more valuable, behind its limits — the general knowledge of the worker is more appreciated. In competitive market it is not favourable to firm to invest in the general human capital of the worker, raising his market value (Becker, 1964).

It is interesting, that according to the estimates made by Regner (2002) for Sweden (in models with firm and individual fixed effects) the return on the general training is above, than on the specific training. These results confirm the model of an imperfect labour market when mobility of workers is limited, for example, due to the transaction costs or monopsony. In that cases firm could invest in a general human capital (Stevens, 1994; Acemoglu & Pischke, 1999)

To control for the mentioned above effects, Goux and Maurin (2000) solved the system of three equations. In addition to the earnings function they wrote two binary choice models (for mobility and selection in the training program). They had been received the following results. (1) Firm-provided training in France has insignificant impact on wages. (2) There is no link

¹ in a case of positive correlation of unobservable abilities with schooling

² The search of instruments is aggravated with the binary character of the endogenous explanatory variable in the problem of individual return to APT.

³ Characteristic for the American firm of 1986–1990 types of training continued 2–5 days were considered classified on three categories: “Core Program” (“for any individual in the company whose job involves supervising at least one other employee), “Corporate Employee Development” and “Special-purpose”.

between wages and firm profit. (3) There is no direct influence of firm-provided training on mobility. (4) Workers with a higher unobserved abilities are involved preferably in the programs of training.

Some researches say about \cap -shaped dependence of probability to be trained on age (see, for example, (Bills & Hodson, 2007)). Some of them say the only that probability decreases with age (Fouarge & Schils, 2009).

There are gender differences in participation in training programs by countries and in time. Bills and Hodson (2007) discovered growth of demand of APT from women in the USA. According to Arulampalam et al. (2004) the same is observed in Denmark, Finland, Italy and Spain. In Sweden women less often (in comparison with men) use the system of APT and have smaller compensation after additional training (Evertsson, 2004).

It is necessary to remember, that additional training has two sides — demand and supply. This was noticed, for example, in the work (Harris, 1999). He revealed the greater probability to be trained for workers with the higher tenure. Besides the author has confirmed a hypothesis that large firms less quiver to lose the worker-man after training, for women the opposite effect is observed.

As it was mentioned above, probability to be trained can depend on the worker's ability. One of the possible way to control this are individual trends (Pischke, 2001):

$$\ln w_{it} = x'_{it}\beta + \delta D_{it} + \alpha_i + \gamma_i t + \varepsilon_{it}. \quad (1)$$

where w_{it} is i -s employee wage in the period t , x_{it} is column-vector of control and explanatory variables, β is column-vector of parameters, D is additional training variable (binary or cumulative), δ individual return to training, α_i is time invariant individual unobservable effect (it may be correlated with x and D), ε_{it} is unobservable individual effect that could be different between employees and in time, γ_i is individual trend parameter.

Pischke (2001) analysed returns to training in Germany (German Socioeconomic Panel, 1986–1989). He shows that training undertaken during leisure time has greater return than workplace training, as far as wages are concern. It is explained by the shortening of working hours in the last case .

More so in the works (Pischke, 2001; Budria & Pereira, 2007) the greater effect for men than for women is underlined. It is interesting, that Parent (2003) received the opposite result.

Some authors develop original methods to estimate returns to training. For example, Schone (2001) predicted the duration of workplace training to get the necessary qualification and used it and the average level of workplace training in the firm as explanatory variables in earnings function. With the use of Abowd, Kramarz, and Margolis's (1999) methodology, Schone (2001) received positive impact of workplace training on wages.

In the work (Budria & Pereira, 2007) Portuguese Labour Force Survey (1998–2000) is used. It was supposed that returns to training varies by the levels of education and by experience. They received significant return to training as by OLS and by the use of the model described by the system of equations.

The other way to estimate return to training is the comparison of trained workers' wages

with wages in a control group. Leuven and Oosterbeek (2008) placed in a control group workers with the same as trained workers characteristics by suddenly refused from the training. The survey was made by phone in the Netherlands in January–February, 2001. Persons of the age of 16–54, employed in private sector were included in the sample. Earnings were estimated by OLS and median regressions. They received insignificant returns to training.

Albert et al. (2010) has made first difference (two periods) individual and workplaces (as mobility control) fixed effects estimates. Insignificant return to training was derived. The same result we observe in the case of narrowing of the control group (Leuven & Oosterbeek, 2008).

Errors in explanatory variables could be the other source of inconsistency of estimates of returns to training. Melero (2010) argued that the cumulative duration of training instead of the binary variable can reduce this kind of errors.

Fouarge, Schils, and Grip (2013b, 2013a) controlled endogeneity of training by fixed effects model. As some other authors they write about different return to training for employees with different education. The same result was confirmed by Travkin (2014) with the use of double difference in differences technique.

Fouarge et al. (2013b, 2013a) results are robust to the change of binary to cumulative explanatory variable in earnings function. The other way of robustness check was inclusion of individual unobserved trends (1) and the use of first difference fixed effects estimates. All of the models gave almost the same results.

From the works devoted to the returns to APT in Russia it should be mentioned first of all the publication (Berger, Earle, & Sabirianova Peter, 2001), executed on the basis of the Russia Longitudinal Monitoring Survey - Higher School of Economics (RLMS-HSE)⁴. Berger et al. (2001) discovered higher returns to retraining in new fields in comparison to additional training in worker's current field in Russia of 1994–1996, and 1998. Berger et al. (2001) explained this by the peculiarities of transition economy.

The work (Denisova, Lazareva, & Tsuchlo, 2011) is constructed on results of interrogation of heads about thousand Russian industrial enterprises. The important conclusion of authors is the statement that the Russian state programs of a professional training not always cope with demand of the enterprises for the general and branch training. In such situation the employer is ready to bear costs on training of the worker only if the worker will not leave the enterprise after training. The most obvious ways of deduction of the worker in firm are increase of wage and investments into specific human capital which cannot be rewarded in the labour market out of the firm.

Travkin (2014) estimates individual returns to training on the RLMS-HSE data of 2004–2011. The size of returns to APT depends on worker's individual abilities reflected by his place in wages distribution. It should be noticed that with the use of the questionnaires of the RLMS-HSE it is hardly possible identify exactly retraining and rise of qualification.

⁴ <http://www.hse.ru/en/rlms/>

Table 1. Economic performance of the enterprise

Year	2006	2007	2008	2009	2010
Production, tonnes	49720	51894	33550	25935	35133
Sales, thousands of rubles	1838196	2581822	3137201	1858299	2736761
Gross profit from sales, thousands of rubles	185947	263162	494535	343296	511019
Net profit, thousands of rubles	2323	2884	53498	-75640	117694
Wage fund, thousands of rubles	127167	143330	164009	160814	187396
Average nominal monthly wages, rubles	10774	12201	15018	14914	17142
Average real monthly wages, rubles of January 2006	10550	11162	11459	10116	10812

3. The data

The analysed enterprise is from a group of large metallurgical, was created during the Second World War at a distance of 50 km from the regional centre. Since 1992 the enterprise is the open joint-stock company. Some parameters of activity of the enterprise according to the official reporting and the real wages⁵ calculated by us are shown in table 1.

From the table 1 we can see, that on the majority of formal parameters the enterprise has rather easily passed the crisis of 2008. It has appeared that 2009 was heavier for it. In 2010 all the parameters presented in the table are grown in comparison with 2009

In the current research we use the information on the personnel of the enterprise, collected in February–June, 2011 for the period of 2006–2010 from following sources: personal cards of workers from a personnel department, log-books of additional training and personnel certification, archival data about dismissed workers, accounting reports on of workers' wages, lists of staff of workers and the non-production personnel of a department of work and wages. Officially documented information allowed us to reduce noise in many variables created by us in comparison with a situation if we spent questioning workers.⁶ The choice of the period of supervision (2006–2010) suggests, that we manage to execute comparison of some effects in the pre-crisis and epicritic periods.

For correct formalization and aggregation of the raw data the organizational structure and personnel schedule of the enterprise have been analysed. In particular, numerous interviews with chiefs of various departments of the enterprise and employees of the management company have been lead.

We have grouped the divisions of the enterprise as the basic, auxiliary and supporting manufacture in the created database.

During the period of 2006–2010 at the enterprise worked 1501 person on whom monthly data were collected.

Table 2 shows, that in the structure of a manpower of the enterprise the industrial (basic) sector prevails. If categories were changed the modal value for each worker was registered.

In according to the information from the enterprise executives, employer introduces new

⁵ in roubles of January, 2006 with the use of a regional consumer price index

⁶ The researchers faced with processing of panel data know that respondents in interviews often skew the information in comparison with that which is registered in official records.

Table 2. Categories of employees (number and percentage)

Year	2006	2007	2008	2009	2010
Apprentices	32	22	15	8	18
	3.0%	2.1%	1.5%	0.8%	1.9%
Non-skilled workers	239	235	228	220	204
	22.3%	22.0%	22.7%	22.9%	21.4%
Supporting staff	143	149	143	132	122
	13.3%	13.9%	14.2%	13.7%	12.8%
Skilled professionals	60	63	58	50	54
	5.6%	5.9%	5.8%	5.2%	5.7%
Skilled workers	469	484	450	447	447
	43.7%	45.2%	44.8%	46.4%	47.0%
Supervisors	91	89	88	85	85
	8.5%	8.3%	8.8%	8.8%	8.9%
Middle management	20	18	18	17	18
	1.9%	1.7%	1.8%	1.8%	1.9%
Top management	19	10	4	4	4
	1.8%	0.9%	0.4%	0.4%	0.4%
Total	1073	1070	1004	963	952
	100%	100%	100%	100%	100%

technologies and stake on the qualified employees. So that APT of workers is very actual on the plant.

As it was mentioned we separate retraining and rise of qualification.

In the presented below research we have excluded apprentices spells from the consideration. The given category is heterogeneous in contingent and career prospects. For the majority of them apprenticeship is an intermediate stage on professional ladder. In some cases apprenticeship was not only the period of investments into specific human capital, but also carried out a role of a trial period before permanent appointment. Besides at the enterprise there were many persons who used apprenticeship as temporary employment. For example, some students and secondary school students were temporary employed as apprentices during summer vacations and an industrial practice.

The following forms of APTs we classify as retraining : crane, auto- and electric loader driver; technician; mechanic; electrician; hooker; crusher operator; assistant chemist; cleaner; furnace tender; dogger; machine operator; press operator; shearer; electric and gas welder; burner; forging press operator.

The programs of rise of qualification are the mandatory programs of training regulated by the labour legislation, the safety precautions, labour safety, and Russian Federal Service for Ecological, Technical and Atomic Supervision. Examples of programs of rise of qualification are the following: ecological and radiological safety; preparation on the right of work on dangerous waste and cargoes; mobilization preparation; transport and customs logistics; safety of traffic; safety of welding engineering; course of nurse.

From presented above examples it is visible, that professional retraining allows the worker to master new (including adjacent) a trade and allows the employer to use a manpower more

Table 3. Number of workers who have got APT and their percentage of the total employed in the appropriate category (through fraction: retraining / rise of qualification)

Year	2006	2007	2008	2009	2010
Apprentices	5 / 0 16% / 0%	9 / 0 41% / 0%	5 / 0 33% / 0%	2 / 0 25% / 0%	7 / 1 39% / 6%
Non-skilled workers	36 / 0 15% / 0%	18 / 0 8% / 0%	19 / 0 8% / 0%	9 / 1 4% / 0%	10 / 2 5% / 1%
Supporting staff	5 / 2 3% / 1%	8 / 5 5% / 3%	2 / 3 1% / 2%	3 / 5 2% / 4%	1 / 8 1% / 7%
Skilled professionals	0 / 4 0% / 7%	0 / 6 0% / 10%	0 / 6 0% / 10%	1 / 6 2% / 12%	0 / 5 0% / 9%
Skilled workers	100 / 1 21% / 0%	51 / 1 11% / 0%	53 / 2 12% / 0%	44 / 0 10% / 0%	23 / 7 5% / 2%
Supervisors	1 / 16 1% / 18%	2 / 13 2% / 15%	0 / 27 0% / 31%	0 / 14 0% / 16%	0 / 24 0% / 28%
Middle management	0 / 6 0% / 30%	1 / 5 6% / 28%	1 / 10 6% / 56%	0 / 9 0% / 53%	0 / 6 0% / 33%
Top management	0 / 3 0% / 16%	0 / 0 0% / 0%	0 / 3 0% / 75%	0 / 2 0% / 50%	0 / 2 0% / 50%

flexibly. It could be the compelled actions in conditions of reduction of some productions during the crisis of 2008. At the same time some workers could pass voluntary retraining with objective of the further change of their jobs to increase the wages.

Rise of qualification does not mean change of job or get a new profession by the worker. Such training is often stipulated legislatively. For many categories of workers such training should pass not less often, than time in 5 years, and for some categories of workers such training is necessary for performance of works.

Only some of the above-listed programs of rise of qualification can mean the further expansion of job responsibilities, for which pecuniary compensation is followed. Basically these programs are pointed on compliance with the safety precautions and industrial technology. Hardly the given programs can increase productivity of workers and, as consequence, reception by the worker of a part of the added value arising due to the growth of productivity.⁷ The majority of the listed programs insures the employer against possible losses because of infringement of the industrial technology or a injuries.

Data acquaintance has shown, that intra-firm mobility at the given enterprise is rather low (about 1% from the number of labour episodes), but nevertheless we use the fixed effects as on categories of employment, so on divisions to the control effects of mobility.

Table 3 shows, that in percentage terms retraining prevails in industrial area, rise of qualification — among supervisors and managers.

Table 4 shows distribution of workers on cummulative duration of APT in the period of 2006–2010. Median duration of episodes of training equals to 1 month, but some of them lasted 2–3 and even 6 months.

The majority of episodes of APT of workers of the given enterprise in 2006–2010 were carried

⁷ Added value can shares between the employer and the worker.

Table 4. Length of APT distribution, 2006–2010

Cumulative training (months)	Retraining		Rise of qualification	
	Men, <i>N</i>	Women, <i>N</i>	Men, <i>N</i>	Women, <i>N</i>
0	566	537	682	589
1	127	75	44	33
2	59	17	14	12
3	7	9	17	4
5	2	1	2	1
6			2	
7		1		
8				1

Table 5. Age and experience (in years) statistics of trained workers in 2006–2010

	Retraining				Rise of qualification			
	Men		Women		Men		Women	
	Age	Experience	Age	Experience	Age	Experience	Age	Experience
Mean	28.6	2.3	30.9	3.5	43.1	14.5	42.8	12.3
Standard error of mean	0.6	0.3	0.7	0.5	1.0	0.8	1.1	1.1
Median	24	0	29	1	44	14	44	10
Minimum	16	0	17	0	20	0	21	0
Maximum	56	29	58	30	65	37	64	42

out without discontinuing work. Such workers loose in wages and business hours during the APT, but in month of the termination of training or the subsequent 1–2 months some of them received single rather high payments. Only in 18 cases retraining was off-the-job, thus the average monthly wages were paid to such employees. The similar situation was observed in five cases of rise of qualification.

Descriptive statistics for employees' ages and tenures, who were trained, is shown in table 5. As one would expect, retraining is peculiar to recently employed workers, with the smaller intra-firm experience; rise of qualification — to more skilled workers, both on an operational experience at the enterprise, and on age.

4. Empirical results

4.1. OLS

Being based on experience of the previous researchers, we start with the OLS estimates (giving the appropriate interpretation) and after some while we compare them with the fixed effects models, and the difference in differences estimates based on propensity score matching (Heckman & Vytlacil, 2005).

Preliminary results we have got by the OLS estimator. Despite of the possible threat of inconsistency, OLS estimates have some advantages. Firstly, it is an easy way to follow the dynamics of the returns by years (before and after the crisis of 2008). If the bias of estimates does not changed considerably it does not affect the dynamics. Secondly, simple interpretation

OLS estimates, as between effect, is possible. Thirdly, comparison of the OLS estimates with endogeneity robust estimates will allow us to check an existence of endogeneity problem.

Table 6 shows estimates of Micerian type earnings functions, where dependent variable is the natural logarithm of hourly real (in prices of January, 2006) wages averaged over the year for each worker.

The most of the explanatory variables have self-explanatory names. In the models we the control for the specific human capital (*Tenure* is years of the intra firm experience) and for the general human capital (the educational levels are set of binary variables). Base category for the levels education is completed secondary education. The base category for position is *Non-skilled worker*. Work in the basic manufacture is a base category in classification of industrial divisions. *Auxiliary* and *Supporting* are the binaries for industrial divisions. *Retraining* and *Rise of qualification* are the binaries. Index $t - 1$ means lagged value — training was in a previous year.

The received estimates have not revealed statistically significant differences of hourly wages of the men who passed and not passed APT in a previous year (*ceteris paribus*, according to the explanatory and control variables). Wage is defined basically by the corporate ladder, by the specific human capital (skills and the knowledge which have been saved during the work at the enterprise — the intrafirm experience), by the general human capital (educational level), and by the structural division (the basic, auxiliary or supporting manufacture).

Significant return to APT for women reflects the known fact, that women's education plays the key role in an explanation of distributon of their wages in comparison with men. APT for women is a signal of their abilities, desires and possibilities to study. Besides, during the interviews with workers and managers of the enterprise it has been found, that women were often appointed to valuable jobs due to their greater responsibility and labour discipline.

Table 7 shows the other variant of return to APT estimates —cumulative training of the worker (measured in quantity of months) instead of appropriate lagged binary variable (indicator of facts of APT in previous year) is used. In this case interpretation of the slope coefficient of APT is changed, in comparison with the results of table 6. Now the explaining variable reflects not the fact of APT passage, but the amount of the specific and general knowledge received during the training. Measurement by means of a binary variable of volume of the human capital received during the APT, undoubtedly contains an error of measurement that leads to underestimating of the appropriate return (Melero, 2010; Verbeek, 2012). The use of cumulative values allows to describe more precisely distinctions in volumes of investments into the specific human capital carried out by different programs of training on their duration and types. Nevertheless we completely agree that estimates of slope coefficients of the cumulative explanatory variables can be a little bit overestimated due to the endogeneity problem (Fouarge et al., 2013b, 2013a). Discussion about the possible inconsictecy of the estimates of returns to training showed in tables 6 and 7 will be continued below in sections devoted to the fixed effects models and difference in differences estimates.

Table 6. OLS estimates of hourly earnings functions

	Men				Women			
	2007	2008	2009	2010	2007	2008	2009	2010
Tenure (years)	0.020*** (0.006)	0.011* (0.006)	0.011* (0.006)	0.017** (0.007)	0.002 (0.007)	-0.002 (0.006)	0.006 (0.007)	0.003 (0.006)
Tenure ² /100	-0.049*** (0.017)	-0.023 (0.018)	-0.023 (0.018)	-0.046** (0.019)	0.003 (0.020)	0.014 (0.017)	-0.003 (0.019)	-0.010 (0.016)
Married	0.021 (0.054)	0.075 (0.048)	0.043 (0.045)	-0.016 (0.043)	-0.011 (0.049)	0.048 (0.044)	0.011 (0.053)	0.011 (0.042)
# of children	-0.006 (0.024)	-0.035* (0.021)	-0.018 (0.020)	0.017 (0.022)	-0.014 (0.025)	-0.037 (0.026)	-0.065** (0.026)	-0.019 (0.023)
Incomplete secondary education	-0.100* (0.051)	-0.067* (0.040)	-0.079** (0.038)	-0.142*** (0.049)	-0.036 (0.040)	0.009 (0.047)	-0.011 (0.049)	0.027 (0.046)
Vocational school	-0.142** (0.057)	-0.027 (0.052)	-0.046 (0.064)	-0.014 (0.066)	-0.130*** (0.043)	-0.110** (0.048)	0.020 (0.087)	-0.019 (0.068)
Technical school	0.116 (0.073)	0.150** (0.064)	0.107* (0.056)	0.102* (0.058)	0.073 (0.047)	0.031 (0.052)	0.044 (0.055)	0.050 (0.045)
Incomplete higher education	-0.011 (0.408)	0.093 (0.191)	0.280 (0.261)	0.277** (0.108)	-0.010 (0.107)	-0.004 (0.282)	-0.236*** (0.079)	-0.025 (0.168)
Higher education	0.031 (0.079)	0.161 (0.139)	0.110 (0.085)	0.163* (0.088)	0.302*** (0.108)	0.272*** (0.092)	0.305*** (0.087)	0.400*** (0.074)
Supporting staff	0.445*** (0.150)	0.488*** (0.156)	0.460*** (0.151)	0.622*** (0.156)	0.121** (0.051)	0.116** (0.054)	0.109* (0.060)	0.161*** (0.048)
Skilled professionals	0.458** (0.199)	0.532*** (0.186)	0.530*** (0.175)	0.499** (0.194)	0.122 (0.092)	0.221** (0.087)	0.189** (0.089)	0.187** (0.085)
Skilled worker	0.481*** (0.105)	0.522*** (0.094)	0.528*** (0.108)	0.528*** (0.094)	0.243*** (0.043)	0.226*** (0.044)	0.155*** (0.055)	0.273*** (0.050)
Supervisors	0.929*** (0.132)	0.860*** (0.130)	0.893*** (0.127)	0.866*** (0.111)	0.749*** (0.118)	0.939*** (0.119)	0.748*** (0.114)	0.865*** (0.095)
Middle management	1.142*** (0.177)	1.018*** (0.192)	1.130*** (0.174)	1.058*** (0.145)	0.876*** (0.185)	1.207*** (0.214)	1.073*** (0.191)	1.096*** (0.165)
Top management	1.495*** (0.145)	1.445*** (0.157)	1.424*** (0.141)	1.330*** (0.133)				
Auxiliary	-0.388*** (0.046)	-0.368*** (0.035)	-0.460*** (0.034)	-0.397*** (0.040)	-0.259*** (0.044)	-0.241*** (0.040)	-0.275*** (0.045)	-0.340*** (0.040)
Supporting	-0.297*** (0.085)	-0.472*** (0.084)	-0.382*** (0.099)	-0.477*** (0.079)	-0.237*** (0.054)	-0.243*** (0.053)	-0.174*** (0.060)	-0.174*** (0.049)
Retraining _{t-1}	0.081 (0.062)	-0.020 (0.089)	-0.093 (0.070)	-0.064 (0.056)	0.104** (0.045)	0.029 (0.071)	0.112* (0.063)	-0.037 (0.075)
Rise of qualification _{t-1}	-0.096 (0.066)	0.164 (0.133)	-0.054 (0.069)	0.075 (0.082)	0.204 (0.141)	0.017 (0.130)	0.174 (0.121)	-0.018 (0.124)
Constant	4.108*** (0.106)	4.160*** (0.096)	4.058*** (0.118)	4.105*** (0.101)	3.991*** (0.051)	3.990*** (0.063)	3.872*** (0.072)	3.861*** (0.057)
<i>N</i>	422	417	407	428	411	410	396	382
Adj. <i>R</i> ²	0.52	0.52	0.58	0.51	0.40	0.42	0.35	0.52
<i>F</i> -st.	43.6	42.0	65.8	50.6	16.9	16.8	18.5	27.9

Heteroskedasticity-consistent standard errors (HC_3) in parentheses (Davidson & MacKinnon, 2003)

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 7. OLS estimates of hourly earnings functions (cumulative APT is used as an explanatory variable)

	Men				Women			
	2007	2008	2009	2010	2007	2008	2009	2010
Tenure (years)	0.026*** (0.005)	0.024*** (0.005)	0.024*** (0.005)	0.031*** (0.006)	0.011* (0.006)	0.008 (0.006)	0.015** (0.007)	0.007 (0.006)
Tenure ² /100	-0.064*** (0.016)	-0.057*** (0.016)	-0.054*** (0.014)	-0.078*** (0.016)	-0.020 (0.018)	-0.011 (0.018)	-0.024 (0.020)	-0.016 (0.016)
Married	0.056 (0.045)	0.102** (0.042)	0.069* (0.039)	0.016 (0.043)	0.003 (0.041)	0.017 (0.043)	0.006 (0.048)	0.017 (0.041)
# of children	-0.011 (0.023)	-0.026 (0.021)	-0.004 (0.019)	0.019 (0.021)	-0.026 (0.022)	-0.045* (0.024)	-0.053** (0.026)	-0.028 (0.021)
Incomplete secondary education	-0.134*** (0.045)	-0.085** (0.043)	-0.087** (0.041)	-0.138*** (0.045)	-0.046 (0.050)	-0.013 (0.052)	-0.012 (0.058)	0.041 (0.049)
Vocational school	-0.127** (0.054)	-0.056 (0.051)	-0.089* (0.047)	-0.011 (0.052)	-0.118** (0.056)	-0.090 (0.057)	-0.000 (0.064)	-0.032 (0.056)
Technical school	0.081 (0.056)	0.126** (0.053)	0.086* (0.050)	0.076 (0.054)	0.066 (0.047)	0.045 (0.049)	0.043 (0.054)	0.060 (0.046)
Incomplete higher education	-0.151 (0.263)	0.137 (0.250)	0.459** (0.192)	0.333 (0.210)	0.040 (0.207)	-0.018 (0.257)	-0.245 (0.282)	-0.056 (0.233)
Higher education	0.030 (0.078)	0.156** (0.076)	0.097 (0.069)	0.132* (0.073)	0.295*** (0.068)	0.260*** (0.067)	0.299*** (0.072)	0.399*** (0.061)
Supporting staff	0.385*** (0.114)	0.418*** (0.113)	0.395*** (0.116)	0.602*** (0.122)	0.105** (0.046)	0.128*** (0.046)	0.133*** (0.051)	0.172*** (0.043)
Skilled professionals	0.465*** (0.135)	0.503*** (0.138)	0.439*** (0.130)	0.507*** (0.139)	0.132* (0.074)	0.227*** (0.077)	0.230*** (0.085)	0.218*** (0.070)
Skilled worker	0.438*** (0.071)	0.416*** (0.065)	0.419*** (0.068)	0.456*** (0.071)	0.240*** (0.052)	0.258*** (0.054)	0.169*** (0.062)	0.282*** (0.052)
Supervisors	0.876*** (0.100)	0.768*** (0.094)	0.805*** (0.091)	0.801*** (0.096)	0.822*** (0.083)	0.943*** (0.087)	0.748*** (0.098)	0.857*** (0.084)
Middle management	1.092*** (0.136)	0.934*** (0.131)	1.029*** (0.131)	1.018*** (0.143)	0.860*** (0.194)	0.991*** (0.222)	0.980*** (0.251)	1.112*** (0.173)
Top management	1.445*** (0.161)	1.325*** (0.194)	1.306*** (0.187)	1.254*** (0.205)				
Auxiliary	-0.385*** (0.037)	-0.356*** (0.036)	-0.412*** (0.033)	-0.420*** (0.037)	-0.300*** (0.049)	-0.197*** (0.050)	-0.278*** (0.057)	-0.352*** (0.050)
Supporting	-0.325*** (0.068)	-0.425*** (0.069)	-0.352*** (0.067)	-0.499*** (0.071)	-0.270*** (0.054)	-0.204*** (0.055)	-0.198*** (0.063)	-0.188*** (0.055)
Retraining (cummulative)	0.026 (0.033)	0.047* (0.028)	0.039 (0.024)	0.032 (0.024)	0.058 (0.038)	0.073** (0.033)	0.035 (0.037)	0.031 (0.027)
Rise of qualification (cummulative)	-0.047 (0.070)	0.007 (0.042)	0.001 (0.032)	0.033 (0.030)	0.140** (0.061)	0.055 (0.042)	0.062 (0.042)	0.036 (0.029)
Constant	4.095*** (0.079)	4.117*** (0.074)	3.991*** (0.079)	4.037*** (0.086)	3.945*** (0.060)	3.892*** (0.062)	3.781*** (0.072)	3.818*** (0.064)
<i>N</i>	499	481	482	486	466	449	431	406
Adj. <i>R</i> ²	0.53	0.51	0.56	0.53	0.43	0.42	0.36	0.55
<i>F</i> -st.	30.4	27.4	33.4	30.1	20.9	19.3	14.6	28.5

Heteroskedasticity-consistent standard errors (*HC*₃) in parentheses (Davidson & MacKinnon, 2003)

* *p* < .1, ** *p* < .05, *** *p* < .01

4.2. Unobservables

As it has been noted in works of many authors and it was discussed above, correlation of unobservable individual effects may be the reason of inconsistency of the OLS estimates. Besides that in work (Travkin, 2014) distinctions of trends of wages of respondents with different abilities (correlating with wages) and, accordingly, distinctions of returns to APT training have been shown. In work De Beyer (1990) it has been shown, that profiles of wages of trained and non-trained workers should be non-parallel. Proceeding from the specified reasons, we estimate parameters of earnings functions with unobservable individual fixed effects and individual trends allowing to get more correct estimates of returns to APT δ in the considered enterprise:

$$\ln w_{it} = x'_{it}\beta + D'_{it}\delta + \alpha_i + \gamma_i t + \mu_t + \varepsilon_{it}, \quad (2)$$

where w_{it} — real (in roubles of January of 2006) hourly wage of worker i in month t , D — vector-column which components are cumulative duration of APT of the worker during supervision over him till the month t , inclusive, δ — vector-column of parameters, μ_t — unobservable characteristic of all workers in month t (time fixed effects), the other designations conform to the model (1).

There are several reasons for inclusion the cumulative training variables in the model, instead of the binaries, reflecting the facts of APT. (1) Use of a binary variable leads to loss of a part of the information existing in monthly data. (2) We would like to measure more precisely investments into the human capital in different episodes of training, using for this purpose a proxy — duration of training. (3) Returns to such investments cannot be observed instantly, the delay varies for different workers. In such situation the correct choice of lags of the binary variable describing the fact of APT's passage, looks problematic. (4) Before training, during the training and some time after it significant fluctuations of wages for some workers of the enterprise are observed. Attempts of averaging of the wages with a window of several months width lead to an indispensability of introduction of one more parameter — width of the window, that reduces versatility of interpretation of the received results. (5) Using the cumulative variable we can consider correctly participation of the worker in several episodes of training.

Table 8 shows estimates of β and δ , which were made by the following way: during the estimation time-invariant effects α_i were excluded by the within transformation⁸, individual trends γ_i and time fixed effects μ_t are LSDV estimates (Verbeek, 2012).

The received results (estimates of returns to retraining and rise of qualification) confirm our preliminary assumption that mechanism of wages formation inside the firm allows a worker to raise his wage basically by retraining, that is due to mastering a new job or profession. Rise of qualification provides less possibilities of increase of wages inside the enterprise.

⁸ Within transformation gives us possibilities to increase precision of estimates β and δ due to reduction of mistakes of a rounding off, but has not reduced computer time considerably in comparison with LSDV (Verbeek, 2012) estimates of α_i .

Table 8. FE estimates of hourly earnings functions

	Men	Women
Tenure (months)	0.011 (0.042)	0.009 (0.029)
Tenure ² / 100	-0.024 (0.047)	-0.182 (0.130)
Married	-0.086 (0.160)	-0.466** (0.221)
# of children	0.073 (0.073)	-0.024 (0.189)
Incomplete Secondary Education	-0.400 (0.581)	
Vocational school	-0.529 (0.535)	
Technical school	-0.137 (0.524)	
Incomplete higher education	1.016** (0.449)	
Higher education		1.136*** (0.434)
Supporting staff	-0.119 (0.125)	-0.023 (0.030)
Skilled professionals	-0.011 (0.103)	-0.010 (0.053)
Skilled worker	-0.027 (0.037)	-0.032 (0.036)
Supervisors	0.022 (0.052)	-0.062 (0.070)
Middle management	-0.016 (0.087)	0.065 (0.224)
Top management	-0.045 (0.110)	
Auxiliary	-0.202*** (0.047)	-0.050 (0.051)
Supporting	-0.316*** (0.075)	-0.129** (0.054)
Retraining (cummulative)	0.173*** (0.022)	0.069*** (0.025)
Rise of qualification (cummulative)	0.044* (0.024)	0.039 (0.030)
γ_{it}	Yes	Yes
μ_t	Yes	Yes
Constant	9.987 (8.944)	65.239 (43.504)
<i>N</i>	23388	21758
Groups	752	619
R^2 within	0.133	0.107
R^2 between	0.015	0.018
R^2 overall	0.003	0.001

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

4.3. Difference in differences

Tables 9 and 10 report difference in differences estimates of natural logarithms of real annually averaged hourly wages of workers.⁹ The Kernel-based Propensity Score Matching was used with Epanechnikov kernel function. Information on the intrafirm experience, marital status, number of children, education level, worker's structural division for the propensity score calculates were used.

The method of double differences has not allowed us to reveal statistically significant influence of APT on women's wages (see the right parts in tables 9 and 10).

The more informative are the results received for men. The column $\ln w_t - \ln w_t^+$ in table 9 (where the control groups are marked by the plus-symbol) shows, that men who were retrained had the lower wages than in the control group. From the one hand, Retraining allowed them to change their jobs and raise wages. From the other hand, growth of volumes of manufacture, which was observed up to 2009 (table 1), forced employer to add manpower in the basic manufacture, for this purpose professional retraining of personnel was necessary.

Retraining in 2007–2009 has allowed to reduce a difference in wages of the trained workers and workers from control groups (table 9). During the pre-crisis period of 2006–2007 growth of wages of workers who have been retrained even exceeded the growth of wages of the control group.

The other situation is observed concerning the rise of qualification (table 10). As in the above text it is a question about men, conclusions about significant differences of wages only in two of two-years periods can be made, but only for the differences of wages of the trained workers and workers from the control groups, not for the second differences. Table 10 shows, that (at least up to 2009) workers with relatively high wages took the courses of rise of qualification, that on the one hand allows us to judge that that kind of training is preferable for the more able persons, and on the other hand employer thought to minimize his risks to lose the worker after the training. The given type of training at the considered enterprise is in a greater degree a formal procedure. Comparison with the control groups has not allowed us to reveal significant returns of such forms in terms of wages growth.

The results of the current section allow us to explain, why the OLS estimates (with the other things being fixed, controlled by the explanatory variables) revealed insignificant returns to retraining, see the table 6. The enterprise tried to increase wages of low-qualified workers (or poor paid workers) up to the level of the wages of the higher paid workers. As the result the OLS does not show the difference in wages of restrained and non-retained workers. In econometrics language it means that individual unobservable characteristics of workers have positive correlation with the fact retraining and negatively correlate with the dependent variable. As the result the OLS estimates of returns to retraining are underestimated.

⁹ Stata module *diff*, created by Villa (2011), was used.

Table 9. Difference in differences estimates (DD columns) for retrained workers

t	Men				Women			
	N	$\ln w_t$	$\ln w_t - \ln w_t^+$	DD	N	$\ln w_t$	$\ln w_t - \ln w_t^+$	DD
2006 ⁺⁺	207 ⁺	4.299 (0.028)	-0.060 (0.058)	0.158* (0.007)	151 ⁺	3.801 (0.020)	0.075 (0.047)	0.069 (0.073)
	67	4.239 (0.051)			46	3.876 (0.043)		
2007	198 ⁺	4.443 (0.032)	0.098 (0.070)		140 ⁺	3.951 (0.030)	0.144 (0.051)	
	65	4.541 (0.064)			43	4.095 (0.043)		
2007 ⁺⁺	295 ⁺	4.488 (0.026)	-0.325*** (0.083)	0.197* (0.112)	129 ⁺	3.902 (0.036)	-0.046 (0.074)	0.040 (0.110)
	37	4.163 (0.077)			23	3.856 (0.063)		
2008	284 ⁺	4.586 (0.024)	-0.128 (0.082)		122 ⁺	3.945 (0.034)	-0.005 (0.081)	
	33	4.458 (0.080)			22	3.940 (0.072)		
2008 ⁺⁺	226 ⁺	4.496 (0.029)	-0.163*** (0.060)	0.137 (0.099)	168 ⁺	3.876 (0.031)	0.017 (0.090)	0.127 (0.139)
	39	4.333 (0.053)			18	3.892 (0.085)		
2009	218 ⁺	4.405 (0.028)	-0.026 (0.076)		155 ⁺	3.777 (0.032)	0.144 (0.110)	
	36	4.379 (0.071)			18	3.921 (0.105)		
2009 ⁺⁺	246 ⁺	4.361 (0.027)	-0.210*** (0.067)	0.208** (0.091)	88 ⁺	3.664 (0.038)	0.025 (0.118)	-0.124 (0.151)
	42	4.151 (0.063)			7	3.689 (0.113)		
2010	246 ⁺	4.435 (0.029)	-0.002 (0.061)		81 ⁺	3.773 (0.041)	-0.099 (0.094)	
	41	4.432 (0.052)			7	3.674 (0.084)		

+ — control group, ++ — year of training

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 10. Difference in differences estimates (DD columns) for workers trained in a form of rise of qualification

t	Men				Women			
	N	$\ln w_t$	$\ln w_t - \ln w_t^+$	DD	N	$\ln w_t$	$\ln w_t - \ln w_t^+$	DD
2006 ⁺⁺	70 ⁺	4.784 (0.062)	0.262 (0.112)	-0.082 (0.155)	37 ⁺	4.297 (0.090)	-0.047 (0.192)	0.030 (0.274)
	19	5.046 (0.091)			8	4.250 (0.161)		
2007	69 ⁺	5.002 (0.056)	0.180* (0.102)		33 ⁺	4.464 (0.111)	-0.016 (0.217)	
	19	5.182 (0.083)			8	4.448 (0.181)		
2007 ⁺⁺	52 ⁺	4.663 (0.073)	0.172 (0.202)	-0.082 (0.288)	111 ⁺	4.094 (0.049)	0.440 (0.184)	-0.168 (0.271)
	9	4.835 (0.193)			12	4.534 (0.178)		
2008	51 ⁺	4.746 (0.064)	0.090 (0.216)		102 ⁺	4.168 (0.050)	0.272 (0.211)	
	9	4.836 (0.199)			11	4.440 (0.206)		
2008 ⁺⁺	90 ⁺	4.689 (0.050)	0.417*** (0.090)	-0.100 (0.125)	21 ⁺	4.443 (0.130)	0.264 (0.243)	-0.101 (0.338)
	37	5.106 (0.073)			8	4.707 (0.203)		
2009	87 ⁺	4.623 (0.045)	0.317*** (0.086)		20 ⁺	4.391 (0.137)	0.163 (0.230)	
	37	4.939 (0.075)			8	4.554 (0.187)		
2009 ⁺⁺	28 ⁺	4.944 (0.079)	-0.217 (0.131)	0.119 (0.193)	175 ⁺	3.857 (0.035)	0.311 (0.205)	0.017 (0.284)
	15	4.727 (0.106)			11	4.168 (0.204)		
2010	28 ⁺	4.960 (0.089)	-0.098 (0.135)		167 ⁺	3.934 (0.038)	0.328 (0.203)	
	15	4.862 (0.100)			11	4.262 (0.199)		

+ — control group, ++ — year of training

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

5. Conclusion

In the work individual returns to APT is analysed (in a context of wages growth). It is made in the limits of internal labour market — as an example one of the Russian enterprise of an iron and steel industry has been chosen.

Comparison of OLS with fixed effects and difference in differences estimates were made. Propensity score matching was used in the last case.

The majority of the results speak well for the higher returns to retraining in comparison with rise of qualification. The following explanation of this result can be made. No doubt that retraining gives much more possibilities for professional mobility accompanied with employment in a higher paid workplaces. In a greater degree formal programs of training classified by us as rise of qualification are basically the mandatory types of APT without pecuniary bonuses, and they usually leave worker on the same step of professional ladder.

The considered effects are brighter expressed (from the point of view of the statistical significance) for men, than for women.

It should be noised, that the differences in returns to retraining and rise of qualification have been underlined earlier by Berger et al. (2001). They illustrated this with the use of estimates on the Russian data (RLMS-HSE, 1996–1998) .

Comparison of our results with the similar from the work (Berger et al., 2001) rises up several ideas. First of all, there is an impression, that the enterprise is “frozen” with the old problems of the out-of-date programs of training. On the other hand, the comparison with a transitional economy allows us to come to an optimistic conclusion about the presence of continuous development with the personnel training as one of its tools . It is interesting, that experience of separately taken enterprise repeats the laws observed in economy as a whole.

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