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Does Worker Turnover Improve Productivity Growth?

Abstract:

We examine the relationship between worker turnover and total factor productivity growth using a matched worker-plant data from Finnish manufacturing. The total turnover rate (sum of hiring and separation rates) is negatively, whereas inflow of new workers is positively, and outflow of workers negatively associated with productivity growth. This is consistent with general human capital. Excess worker turnover or churning that measures separations that lead to replacement hiring speeds up productivity growth. This indicates that worker turnover leads to better matches of available jobs and potential employees and therefore to higher productivity.

Key words: worker turnover, total factor productivity, linked employer-employee data

1. Introduction

The turnover of employees may affect productivity in various ways. The emphasis both in labor economics and management literature has traditionally been on the costs of worker separations. Since the early 1980s the management research has, however, examined also the possible positive consequences of this kind of turnover (e.g. Staw, 1980). This approach has been less common in traditional labor economics although the view that turnover may have positive affects appears in modern personnel economics (e.g. Lazear, 1998). The human resource management literature often uses the term turnover for employee separations (or even more restrictively for quits), whereas in labor economics turnover sometimes denotes separations, but perhaps more commonly it is measured as the sum of hiring and separation. We follow the labor economics tradition, but show that it is useful to examine also the various components of total turnover separately to assess their possible productivity impacts.

The management literature has described the alternative views on turnover with the concepts of functional and dysfunctional turnover (e.g. Dalton, Todor, and Krackhardt, 1982; Abelson and Baysinger, 1984). Separation is dysfunctional, when those high-productivity workers whom the organization would like to keep, are leaving. Besides direct hiring and retraining, there are other costs involved e.g. in the form of disruption of informal communication structures. Costs may be caused also by employer-initiated separations in the form of firing costs. Especially costs in the form of lost production lead to a measurable negative relationship between turnover and productivity. This is the traditional labor economics view of the effects of turnover. These negative effects are formally modeled by including quits in the production function with a negative impact (e.g. Pencavel, 1972) or with adjustment costs related to hiring and separation in dynamic labor demand models (e.g. Hamermesh and Pfann, 1996). Linear adjustment costs in the form of training cost of new workers appear in efficiency wage models (e.g. Salop, 1979) or in the form of hiring and firing costs in labor demand models (e.g. Bentolila and Saint-Paul, 1994). The firms should aim at avoiding the negative effects of separations with for example wage policy or by optimizing hiring and firing.

Separation is functional, when it is in the interest of the organization, e.g. because low productivity workers quit or their separation from the firm is initiated by the employer.

Replacing the leavers by new workers also brings new ideas and knowledge to the firm. It can also be used for internal mobility of the employees or for cost-cutting e.g. by replacing full-time employees by part-time employees. One argument is that there is an inverted U-shaped relationship between separations and productivity: low and very high separation rates are harmful, whereas moderate separation enhances productivity (Alexander, Bloom, and Nuchols, 1994). With low level of separations, there is not enough functional separation, whereas with high separation rates there is too much dysfunctional separation.

Since turnover can have, besides costs, also positive impacts on the firm, it is essential to compare its costs and benefits. Since the impacts of separations and hiring of new workers are different, it is important to consider their effects separately. Our paper aims at measuring one aspect of the potential net benefits, the impact of turnover on productivity growth. The connection between turnover and productivity can be analyzed through the impact of turnover on the composition of the work force. There are various theories that relate worker characteristics, such as age, education, and experience, to wages and productivity. There is also empirical evidence that worker characteristics influence firm- or plant-level productivity (e.g. Hellerstein, Neumark and Troske, 1999, Ilmakunnas, Maliranta, and Vainiomäki, 2003). If there is no turnover in the personnel of the firm, the observable characteristics of the employees can only change because of aging and increases in firm-specific work experience. These can naturally have an effect on productivity. The issue of aging and productivity has been debated and the evidence is mixed (see Waldman and Avolio, 1986; McEvoy and Cascio, 1989). Experience gained in the firm, on the other hand, typically enhances productivity through learning by doing.

Over time, a more important change in the characteristics of the employees happens through the inflow and outflow of employees. If all employees were equal (or perfect substitutes) worker turnover would be dysfunctional since it would just cause costs without having a positive impact on productivity. In practice, however, workers differ in terms of many characteristics. For example, the average educational level of the employees changes when the educational level of the inflow differs from that of the outflow. Gautier, van den Berg, van Ours, and Ridder (2002) find that during downturns the average skill level of firms increases because there is a rise in the outflow rate of less educated workers. The same applies to the age structure, gender composition, general work experience, and many other features of the work force that may affect productivity.

The role of employee performance in worker separations has been examined in several management studies (see e.g. McEvoy and Cascio, 1987; Williams and Livingstone, 1994); but less in labor economics (see, however, Bishop, 1990). It has been argued that the poor performers are more inclined to quit, since they fear the risk of being fired. This turnover would be beneficial, since the firm can try to replace the leavers by average or strong performers. On the other hand, the best performers have more outside opportunities and may therefore have high quit rates. This may lead to a U-shaped relationship between probability of separation and job performance (Jackofsky, 1984).

The firms can influence this turnover process and thereby productivity with their hiring, layoff, and wage policies. It is useful to analyze the firms' policies and the connections of turnover and productivity with three views of wage setting that have been used in labor and personnel economics (e.g. Lazear, 1998), i.e. specific and general human capital, and incentive wages. They have implications on the hiring and layoff behavior of firms. If human capital is firm-specific, workers with low tenure have less specific human capital and lower productivity. They also have more incentives to quit, since they have no accumulated specific skills to lose. However, the firms should encourage them to stay and accumulate experience by using a wage that exceeds productivity. On the other hand, during a fall in demand firms would lay off first the younger and less experienced workers. Because specific human capital has less value in other firms, the senior, high productivity workers have no incentive to quit. However, if productivity falls with age, also the oldest workers are "overpaid". Under these conditions, firms should lay off the youngest and the oldest workers and keep the "middle-aged" ones when demand falls. This worker outflow would raise productivity. In an expansion, new hires would include workers who have no firm-specific experience and therefore have lower productivity. All in all, the implication of firm-specific skills is that hiring of new workers tends to decrease productivity, whereas separations increase it. This further has the implication that productivity should change countercyclically.

If human capital is general, skills can easily be transferred to other firms. The more productive workers may be inclined to quit if they find better paid jobs elsewhere. Therefore the firms have to use a wage policy that corresponds to productivity to keep the productive workers. The order of layoffs should be related to productivity, but not to tenure in the firm. The total outflow of workers from a firm would increase average productivity if it is dominated by layoffs of poor performers, but may decrease productivity if quits dominate and more productive workers leave. Inflow of new workers, in turn, is likely to increase productivity, because firms can benefit from the experience that the new workers have gained in other firms. The overall conclusion is that hiring of new employees is likely to increase productivity, whereas separations may have opposing effects depending on whether they are initiated by the workers or by the firm. It follows that cyclical changes give a boost to productivity, since in downturns low-productivity workers are laid off and they can be replaced by high-productivity workers during upturns.

Under times of rapid structural change, new employees with up-to-date education may be necessary for introducing new technology. This partly compensates their lack of firm-specific or general experience and productivity can improve through the outflow of senior workers and inflow of new workers. The complementarity of the skills of the new and old workers influences their optimal mix (Lazear, 1998).

According to the incentive pay argument, productivity initially increases, but starts to decline with age. Older, more experienced workers are paid above their productivity to keep work incentives high close to retirement, and younger workers are paid below their productivity. When a firm needs to lay off workers, it would therefore prefer to lay off the older workers first, and when new workers are hired, the firm would prefer to hire young ones. As a result, both inflow and outflow would improve profitability, but the impact on productivity depends on the relative productivity of old and young workers.

Yet another way of viewing the turnover-productivity connection is to think of turnover as a sign of an ongoing process of matching employers and employees in the labor market (e.g. Jovanovic, 1979). Employers have imperfect information on the workers before they are hired, and the potential employees imperfect information on the job before they accept it. The fact that some employment relationships are broken shows that either the employer has felt that the quality of the worker does not fit the requirements of the job or the worker has concluded that the job and the wage connected to it do not match his/her requirements, or he/she has found a better (paying) job. Through the turnover of workers, firms can find the workers who are the most productive in the available jobs and high productivity workers can find the jobs that compensate for their productivity. Therefore, the matching process improves productivity, as emphasized by Jovanovic (1979), and others. Given that the outflow consists of bad matches, high turnover would be positively related to productivity.

All these hypotheses of productivity changes that are connected to turnover assume optimal behavior of the firm. However, legal constraints like fixed-term contracts for new workers and permanent contracts for more senior workers, higher cost of laying off workers with long tenures, and insider power of the senior workers can influence the order of layoffs. This may prevent any productivity gains. Shortages of high-productivity workers may, on the other hand, limit the productivity gains from worker inflow. Also the traditional hiring, firing, and other direct costs of turnover may lower the net productivity effect of turnover. There may also be reverse causality. Low productivity firms are more inclined to lay off workers and probably also have higher quit rates. High productivity firms, in turn, are more likely to grow and hire new workers. (We present evidence on this in Ilmakunnas and Maliranta, 2003.)

There have been some tests of the productivity effects of turnover using organization-level data, but the evidence is mixed. Many of the studies are in the management literature, where they examine both productivity and turnover (i.e., separations in these studies) as consequences of human resource management practices of the firms. However, some researchers allow turnover to have also a direct impact on productivity. For example, Huselid (1995) finds that turnover has a negative impact on productivity. According to Arthur (1994) the relationship between performance and turnover is negative, but varies depending on the type of human resource system. Guthrie (2001) finds that employee turnover has a positive impact on productivity in firms that use high-involvement work practices. Alexander, Bloom, and Nuchols (1994) have tested the competing hypotheses of negative vs. inverted U-shaped relationship between turnover and operating efficiency and find support for the former hypothesis. Empirical evidence on the impact of individual worker performance on turnover is reviewed by McEvoy and Cascio (1987) and Williams and Livingston (1994), who conclude that evidence supports the view that poor performers choose to quit more often. This implies that turnover should be beneficial to productivity. McElroy, Morrow, and Rude (2001) examine separately the productivity and profitability effects of voluntary turnover (quits), involuntary turnover (employer-initiated separations), and separations that are caused by downsizing. They conclude that all forms of turnover have negative impacts on performance, but especially downsizing-related turnover is harmful to profitability. Also Koys (2001) finds that turnover has a negative impact on profitability. Many of these management studies are based on specific industries and their results may be difficult to generalize to the whole economy.

Labor economists have studied the issue much less, presumably because of lack of suitable large scale data sets. Kramarz and Roux (1999) have explained labor productivity by the seniority structure of those who stay in the firm and the job spell durations of those who leave the firms. They conclude that high turnover among those with short job spells decrease productivity but increase profitability. On the other hand, their results show that exit of high-tenure workers may increase productivity. Brown and Medoff (1978) find that the quit rate decreases productivity and conclude that a positive effect of unionization on productivity comes partly through a reduced quit rate. Blakemore and Hoffman (1989) use an aggregate approach. They use industry-level data to explain productivity with job tenure and different components of labor flows (quits, layoffs, new hires, and rehires). Their results support the view that firms follow the seniority layoff rules (i.e., last in, first out) because of productivity concerns.

We assess the effect worker turnover and various human capital components on productivity growth at the plant level. We use large panel data set from the Finnish manufacturing plants that is extended with plant-level measures of worker turnover and variables measuring average employee characteristics. We emphasize two issues. First, when analyzing the productivity impacts of turnover, the appropriate measurement of productivity is essential. We propose to use a multilateral total factor productivity (TFP) index. Second, it is useful to examine the inflow and outflow of workers separately and also to account for the portion of turnover that is caused by replacement hiring.

The structure of this paper is as follows. We describe the construction of the linked employer-employee data and the variables in Section 2 and present in Section 3 estimation results on models for productivity growth. We conclude the paper in Section 4.

2. Data set and variables

We used three basic registers maintained by Statistics Finland. The Business Register (BR) database covers registered employers and enterprises and their plants. It includes information on classifications like industry and a limited amount of information on the plants. We used BR for plant codes for linking the other data sources. (A detailed analysis of the data set and the linking of the registers is presented in a separate paper, Ilmakunnas, Maliranta, and Vainiomäki, 2001.)

The Industrial Statistics (IS) was our main source for plant level variables, like output, total employment and capital stock. The plant level data series from the IS are available for the period 1975-1994. They cover basically all plants that have at least five employees. After 1994 there is a major break in the data collection practices, which dictates the final year. We measured output with value added, which we converted into real terms by using corresponding (2- or 3-digit) industry level implicit price indices obtained from the National Accounts (NA). We used actual hours worked as the labor input measure and derived capital input estimates with a perpetual inventory method that makes use of machinery and equipment investment figures. We converted investments into real terms with implicit price deflators obtained from the NA.

The total factor productivity is a useful measure of plant performance as it incorporates efficiency both in labor and capital usage. We measured total factor productivity using the translog multilateral productivity index introduced by Caves, Christensen, and Diewert (1982). It compares plants to “benchmark” plants and allows the technology to vary across plants and industries. We derived the TFP index separately for plants in each 2- or 3-digit industry. When labor and capital inputs are used in the production and there are constant returns to scale, we can calculate the TFP index for plant *i* in year *t* using the following formula:

$$\ln TFP_{it} = \ln\left(\frac{Y_{it}/L_{it}}{\tilde{Y}/\tilde{L}}\right) - \frac{S_{it}+\overline{S}}{2}\cdot\ln\left(\frac{K_{it}/L_{it}}{\tilde{K}/\tilde{L}}\right) \qquad (1)$$

where Y denotes real value added, L labor hours and K capital input. We denote labor productivity of the benchmark plant by $\tilde{Y}/\tilde{L}$ and capital intensity by $\tilde{K}/\tilde{L}$. The benchmark plant is defined by the geometric means of the output ($\tilde{Y}$) and inputs ($\tilde{L}$ and $\tilde{K}$). S_{it}, the cost share of capital input in plant i in year t, is calculated as $S_{it} = KCOST_{it} / (KCOST_{it} + LCOST_{it})$, where $KCOST_{it}$ is the (nominal) capital cost that includes depreciation and rental costs and $LCOST_{it}$ is the cost of labor, covering wages, social security and other supplementary payments. $\bar{S}$ denotes the average capital cost share among all plants in a given industry in the whole period, and we calculated it from the NA by assuming 5 percent interest rate. We adjusted the figures so that in each industry and in each year total capital input share in our sample of plants was in line with that calculated from the NA.

Since there is usually productivity growth even in the absence of worker turnover, we examined the effects of turnover on productivity growth rather than on the level of productivity. We calculated the productivity growth rate as two-year differences of the logarithm of total factor productivity (i.e., $\Delta\ln(TFP_t) = \ln(TFP_t) - \ln(TFP_{t-2})$) over the periods 1988-1990, 1990-1992, and 1992-1994. These represent different cyclical situations. A long period of growth in the Finnish economy came to a halt in 1990. The years 1990-1992 were a period when production dropped dramatically. Finally, in the period 1992-1994 output started to increase in the manufacturing industry.

We obtained information on the structure and characteristics of the plants' work force from our second main data source, the Employment Statistics (ES) database. For each person a unique plant appearing in BR is determined as his/her primary employer during the last week of each year. With this information we can measures the worker flows for each plant during successive pairs of years from the ES. We can identify the number of persons who appear in the same plant in both years (stayers), those who have exited from the plant (worker outflow or separation), and those who have entered during the period (worker inflow or hiring). However, we cannot distinguish between quits and layoffs, since the reasons for separation are not known. We calculated the worker inflow or hiring rate (WIF) and worker outflow or separation rate (WOF) by dividing the respective flows by the average employment in two successive years (following Davis, Haltiwanger and Schuh, 1996). The worker flow or total turnover rate (WF) is the sum of the inflow and outflow rates (WF = WIF + WOF), and the net rate of employment change (NET) is the difference of the inflow and outflow rates (NET = WIF – WOF). The churning rate (CHURN) measures excess worker turnover and is defined at the plant level as the difference of total turnover rate and the absolute value of net employment change (CHURN = WF - |NET|; see Burgess, Lane, and Stevens, 2000). It is excessive in the sense that it is turnover that is not needed for achieving a given net employment change. Essentially, churning represents such worker separations that lead to replacement hiring.

We also calculated plant-level sums or averages of the background characteristics of the employees. For those plants from which we have information on at least two employees, we calculated the following average employee characteristics (in years): age (AGE), plant-specific tenure or seniority (SEN) and schooling (EDU). When we combined worker flows and worker characteristics from ES with the plant level data from the IS, the data period shrank, since ES is available only from 1988 onwards.

Other plant-level control variables from the IS included the ratio of rents paid to the value of machinery, an indicator of foreign ownership, recent investments, average hours per worker, and capacity utilization. For the analysis, we also classified the plants to groups according to their age, since older plants with old vintage capital stock are likely to have lower productivity growth.. We formed six generation groups (cohorts) separately for each industry on the basis of the order of appearance of plants to IS. The newest two groups are decile classes and the rest of the groups are quintile groups. Dummy variables indicate the generations.

The process that led to the final sample of plants was the following. We started with all plants in the IS, about 7000-8000 plants annually. Then we concentrated on active production plants (omitting, e.g., headquarters and auxiliary units). Next we retained only the plants for which it was possible to construct the total factor productivity indicator. An appropriate estimate of capital input (machinery stock) is lacking for a number of plants. Furthermore, we constructed the TFP indicator only for those plants whose real value added per hour and real value added per machinery stock did not differ too much from the corresponding industry average in that year. We picked out outliers of the TFP index in a similar manner. For the regression analysis it was necessary that the worker flows and the characteristics of the work force were available. This dropped the number of plants to some 4000 plants annually. Finally, due to differencing and lags the number of observations in the panel that is used in the estimations dropped further. We ended up with an unbalanced panel with around 10000 plant-year observations.

3. Results

Based on the preceding discussion we can test hypotheses about the impact of turnover on productivity growth by explaining productivity growth by various worker flow variables, which measure the intensity and type of the turnover in each period. To test the hypothesis that aggregate turnover may have an inverted U-shaped relationship to productivity growth, we estimate a model with total worker turnover rate WF and its square included:

$$\Delta \ln TFP_{it} = \alpha + \varphi_1 WF_{it} + \varphi_2 WF_{it}^2 + X_{it}\phi + \varepsilon_{it} \qquad (2)$$

where X includes various control variables, like plant and employee characteristics. The inverted U hypothesis implies $\varphi_1 > 0$, $\varphi_2 < 0$.

Next we consider the components of turnover separately and estimate equation where turnover is decomposed to the inflow rate WIF and outflow rate WOF:

$$\Delta \ln TFP_{it} = \alpha + \beta WIF_{it} + \gamma WOF_{it} + X_{it}\phi + \varepsilon_{it} \qquad (3)$$

The outflow of workers has a negative impact on productivity if the good performers leave and positive if the low productivity workers leave. With general skills, both effects are possible, and the latter would apply in the case of firm-specific skills. However, there are firing costs involved and constraints on the order of layoffs that are likely to outweigh the positive effects. Given that our results reflect average effects in the sample, we expect the negative effects to dominate, i.e. we expect that $\gamma < 0$. Worker inflow in turn will increase productivity if the firm can benefit from fresh education and experience gained elsewhere and lower productivity if the new workers have no skills specific to the firm. However, even in the latter case the firms can choose the best workers among the pool of applicants. This is in contrast to the outflow where employee-initiated quits often dominate and the firms cannot necessarily make the poor performers leave. We therefore expect that β > 0. As a consequence of these hypotheses on the effects of inflow and outflow, the impact of total turnover (sum of inflow and outflow) has an uncertain effect on productivity. That is, our expectations concerning the signs of the coefficients of WIF and WOF do not determine whether the inverted U-shaped relationship between productivity growth and WF holds.

Next we add also the churning rate CHURN:

$$\Delta \ln TFP_{it} = \alpha + \beta WIF_{it} + \gamma WOF_{it} + \delta CHURN_{it} + X_{it}\phi + \varepsilon_{it} \tag{4}$$

The excessive turnover, measured by churning, is the best indicator for the turnover that happens because of the ongoing matching process of workers and jobs. A positive sign for the coefficient of churning, i.e. δ > 0, would be consistent with the view that the through the matching process resources are allocated to efficient use. In a final model we used interactions of the flow components and year dummies.

We included in all models the worker characteristics variables for age, seniority and education both as lagged levels (from period t-2) and their squares, and as changes and their squares. The differenced variables describe the changes that have happened in the characteristics of the work force. This is an indirect productivity effect from worker turnover (and aging). The age and seniority variables worked best in logarithmic form.

In addition, we included lagged level of productivity in the initial year from which the growth is calculated, ln(TFP_{t-2}). The lagged variable controls plant differences in the starting level of productivity growth. We also controlled other plant-specific factors either in levels or in differences. We estimated the models by ordinary least squares pooling all the three periods, 1988-1990, 1990-1992, and 1992-1994, but included period dummies to control the differential productivity growth. We also included the interactions of 4-digit industry dummies and period dummies, which allow productivity growth to vary across industries and over time. We did not use fixed plant effects, but attempted to control them by the plant and worker characteristics variables. In any case, since we studied productivity change, fixed effects were less relevant than in studying productivity levels. In the former case the fixed effects would measure permanent difference in productivity growth rather than permanent productivity differences.

Table 1 shows the estimation results for the productivity growth models (insignificant squared terms of worker characteristics have been dropped and the coefficients of plant characteristic variables are not reported). The squared worker flow WF^2 has a negative impact, but in level form the coefficient of WF was not significantly different from zero and the term has been dropped (column 1). Increases in worker turnover decrease productivity growth at an increasing rate. The result indicates that the relationship between total turnover and productivity is inverted U-shaped but there is no positive optimal level of turnover (the optimum is zero).

INSERT TABLE 1 HERE

When we decompose worker turnover to inflow and outflow, the inflow rate has a positive coefficient, whereas the outflow rate has a negative coefficient (column 2). The outflow effect is clearly stronger than the inflow effect, which is the reason for the negative coefficient of WF in column 1. The positive inflow effect is consistent with the general human capital view. Firms can hire new workers who have experience gained in other firms. This effect outweighs the possible negative consequences of inflow in the form of training and hiring costs. The negative outflow effect may reflect layoffs and quits that are more common among workers with short tenures, i.e. a last-in first-out process, either because of legal constraints that prevent laying off workers with long tenures or the insider power of more senior workers. This lowers productivity growth, if relatively low seniority employees have the highest productivity (as we found in Ilmakunnas, Maliranta, and Vainiomäki, 2003), and therefore works against the interest of the employers. Also this is consistent with general human capital. Our result on the negative effect of outflow is in line with most studies of turnover and performance that study only the separation of workers.

When we included also the churning rate (column 3), its effect is positive, which seems to be in conflict with the impact of the total worker flow. However, the excessive turnover, measured by churning, may be the best indicator for the turnover that happens because of the matching process. Increased worker flows result in better matches of workers and available jobs and thereby to higher productivity growth. In contrast, worker inflow and outflow are more related to the growth and decline of plants, which is not part of the matching process. The churning rate is also more immune to reverse causality, which may affect the interpretation of the coefficients of the inflow and outflow rates. The finding that the churning process affects productivity growth positively has implications for the interpretations of our earlier result (Ilmakunnas, Maliranta, and Vainiomäki, 2003) that high seniority is connected with low productivity. High seniority may be a symptom of a long lasting low churning rate, and the associated slow productivity growth cumulates to a low productivity level.

We also examined whether the components of the worker flow have different impacts in different phases of the business cycle (column 4). The coefficients of the period interaction terms of the flow rates show that the influences of the outflow and churning rates are strongest in periods 1990-1992 and 1992-1994, which were years of the deep recession and just after it. This was a time when many firms downsized their work force. The strong negative productivity effect of outflow in recession is understandable, if the firms have been constrained in the use of layoffs. The inflow rate has strongest impact in the periods 1988-1990 and 1990-1992.

Among the other results, past productivity has a significant negative coefficient. There is most likely a regression to the mean phenomenon working (e.g., Friedman, 1992). Plants that have “good luck” and experience a positive productivity shock in one period are likely to return to normal conditions in the next period. The same applies to plants that experience a negative productivity shock. The result should therefore not be interpreted solely as a catch-up effect or convergence of productivity across plants. Among the level form personal characteristics terms, only the starting levels of age and education have a significant impact. Among the differenced terms, increases in age have a positive influence, whereas seniority growth decreases TFP growth. Change in education contributes to TFP growth only when it is interacted with the period dummies (column 4). Increases in education affected productivity growth positively in the high demand period 1988-1990. The result that the change in education has little impact on productivity growth, whereas the level of education has a positive effect, is consistent with the growth literature (Benhabib and Spiegel, 1994).

We also estimated similar wage growth models in order to study indirectly how turnover affects profitability. Note, however, that since our explanatory variable above was change in TFP and not change of labor productivity, the results are not quite comparable. We briefly comment on the estimations without presenting them in a table. The inflow rate had no impact on wage growth, expect for the period from 1992 to 1994 when the effect was negative. An interpretation of this result is that firms that have a high hiring rate may not be able to choose only the young, low wage employees, but may have to hire workers in different age groups. However, after the deepest recession the firms were able to hire new workers from the pool of unemployed without upward pressures on wages. The outflow rate had a negative impact, but its square a positive impact on wage change. The total impact was close to zero in the relevant range of the outflow variable. There was a positive impact on wage growth only when the outflow was very large. Finally, churning has no impact on wage growth. It seems that productivity gains from better matching are not reflected in wages and the employers have been able to benefit from the gap between productivity and wage growth.

4. Conclusions

We examined the relationships of worker turnover and plant productivity, using a matched employer-employee data from the Finnish manufacturing that includes information on plant and worker characteristics. The results on the effects of turnover are consistent with general human capital, since productivity increases when new workers are hired. The result that worker outflow reduces productivity may reflect legal constraints or insider power that lead to the relatively high productivity low seniority workers being laid off first. The positive influence of churning, or excess worker turnover, on productivity supports the hypothesis that turnover leads to better matching and productivity. This has, however, not led to higher wages.

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TABLE 1

Models for total factor productivity growth, Δln(TFP)

	(1)		(2)		(3)		(4)	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
Intercept	-4.029	-1.81	-3.836	-1.73	-3.794	-1.71	-3.856	-1.74
WF^2	-0.029	-3.29						
WIF			0.099	4.29	0.084	3.55		
WIF*YEAR 1990							0.077	2.19
WIF*YEAR 1992							0.088	2.13
WIF*YEAR 1994							0.055	1.17
WOF			-0.247	-9.04	-0.283	-9.54		
WOF*YEAR 1990							-0.148	-3.02
WOF*YEAR 1992							-0.417	-8.11
WOF*YEAR 1994							-0.290	-5.39
CHURN					0.091	3.12		
CHURN*YEAR 1990							0.027	0.62
CHURN*YEAR 1992							0.159	2.98
CHURN*YEAR 1994							0.120	2.21
$\ln(TFP_{t-2})$	-0.417	-51.04	-0.421	-51.67	-0.421	-51.70	-0.422	-51.77
ln(AGE)	3.191	2.57	3.054	2.47	3.017	2.44	3.141	2.54
$\ln(AGE)^2$	-0.431	-2.49	-0.409	-2.37	-0.402	-2.34	-0.420	-2.43
d[ln(AGE)]	0.085	1.37	0.105	1.70	0.108	1.75	0.104	1.68
ln(SEN)	-0.039	-1.59	-0.015	-0.63	-0.009	-0.37	-0.010	-0.38
$\ln(SEN)^2$	0.004	0.57	-0.003	-0.41	-0.003	-0.42	-0.003	-0.45
d[ln(SEN)]	-0.016	-1.17	-0.012	-0.93	-0.006	-0.46	-0.008	-0.57
$[d[\ln(SEN)]]^2$	-0.012	-2.46	-0.009	-1.81	-0.007	-1.45	-0.007	-1.46
EDU	0.039	6.01	0.040	6.29	0.040	6.20		
EDU*YEAR 1990							0.050	4.45
EDU*YEAR 1992							0.046	4.12
EDU*YEAR 1994							0.026	2.46
d(EDU)	0.001	0.16	0.005	0.55	0.004	0.47		
d(EDU)*YEAR 1990							0.029	1.87
d(EDU)*YEAR 1992							-0.013	-0.84
d(EDU)*YEAR 1994							-0.001	-0.06
Observations	10403		10403		10403		10403	
R^2	0.278		0.283		0.284		0.285	

Note: "d" denotes 2-year difference. All models include the following variables: rents paid / value of machinery, average hours per worker, capacity utilization, plant age group indicators, and year indicators.