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## PAY, RISK, AND PRODUCTIVITY.
## THE CASE OF FINLAND,
## 1980-1996

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**ABSTRACT:** In this paper we report on four topics. (1) To what extent are piece-rate systems used among manufacturing workers in Finland? (2) What is the effect on the average pay level of using piece- versus time-rate systems? (3) How much wage risk is associated with a piece-rate system? (4) How much of the pay differential between piece- and time-rate workers is compensation for extra effort and how much is compensation for bearing additional risk? How do the studied years 1980, 1990, and 1996 differ with respect to the four questions? We have access to unique individual-level data on payment system (piece- versus time-rate) and occupation from several thousand establishments and more than a quarter of a million individuals engaged in the private sector in Finland. The central findings are that a majority of the studied employees work on time rate only and that there has been a shift from mixed piece-rate schemes to only piece-rate schemes between 1980, 1990 and 1996. Second, there is a substantial extra payoff from working at a piece-rate scheme. Third, piece-rate jobs entail a risk of loss: A non-negligible percentage of the piece-rate workers earn less than the time-rate workers at the same occupation–establishment level. Fourth, there is evidence of risk compensation: The higher the variance of pay at the occupation–establishment level, the higher the average pay at that level is. Finally, most of the pay differential between time- and piece-rate workers is compensation for extra effort and a smaller part consists of compensation for risk, which confirms that there are strong productivity gains from the use of piece rate.

**KEY WORDS:** pay system, productivity, risk, piece-rate pay, time-rate pay

**MEYERSSON-MILGROM**, Eva M. – **PETERSEN**, Trond – **ASPLUND**, Rita, **PALKAT, RISKIT JA TUOTTAVUUS SUOMESSA VUOSINA 1980-1996**. Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2000, 26 s. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; No. 743).

**TIIVISTELMÄ:** Käsittelemme tässä raportissa neljää eri teemaa: (1) Missä määrin suorituspalkkausta käytetään Suomen tehdasteollisuudessa? (2) Miten suorituspalkkauksen käyttäminen vaikuttaa keskipalkkatasoon aikapalkkaukseen verrattuna? (3) Miten suuri palkkariski liittyy suorituspalkkaukseen? (4) Kuinka suuri osa suoritus- ja aikapalkkaustyöntekijöiden välisestä palkkaerosta on korvausta ylimääräisistä ponnisteluista, ja kuinka suuri osuus taas on korvausta ylimääräisestä riskinotosta? Miten tarkasteltavien vuosien, 1980, 1990 ja 1996, tilanne eroaa näiden neljän kysymyksen osalta? Meillä on pääsy ainutlaatuiseen palkkaustapaa (suoritus- tai aikapalkka) ja työtehtävää koskevaan yksilötason tilastoaineistoon. Kyseinen aineisto sisältää tiedot useista tuhansista yksityisen sektorin toimipaikoista Suomessa ja kattaa yli neljännesmiljoona työntekijää. Saadut tulokset osoittavat, että suurin osa tutkituista työntekijöistä työskentelee pelkästään aikapalkalla, ja että vuosien 1980 ja 1996 välillä on tapahtunut siirtymä yhdistetyistä suorituspalkkajärjestelmistä (suoritus- ja aikapalkkojen yhdistelmistä) puhtaisiin suorituspalkkoihin. Lisäksi suorituspalkan havaitaan tuottavan työntekijälle huomattavan ansiolisän. Edelleen havaitaan suorituspalkkaukseen liittyvän myös riski menettää rahaa: tietty, ei aivan vähäpätöinen, prosentti-osuus suorituspalkkalaisista ansaitsee vähemmän kuin vastaavalla työtehtävä-yritys -tasolla olevat aikapalkatut työntekijät. Tätä riskiä kompensoi kuitenkin havainto, että palkat ovat tietyllä työtehtävä-yritys -tasolla sitä korkeammat, mitä suurempi palkkojen vaihtelu on sillä tasolla. Lopuksi huomataan, että suurin osa suorituspalkkaus- ja aikapalkkaustyöntekijöiden välisestä ansioerosta pohjautuu kompensaatioon ylimääräisestä ponnistelusta, ja vain pieni osa perustuu korvaukseen riskinotosta. Siten suorituspalkkauksen käyttö selvästi kasvattaa tuottavuutta.

**ASIASANAT:** palkkajärjestelmä, tuottavuus, riski, suorituspalkka, aikapalkka

# Content

# 1. INTRODUCTION

Performance-related pay such as piece rates and production bonuses are common in many jobs. This has especially been the case in blue-collar occupations in the manufacturing industries and in sales positions within retail trade. These reward systems during the last few years not only have been refined but also have become more important in clerical work, such as work done on computers.

These continuous output-related pay systems serve a number of purposes.[1] First, they sort workers into various payment systems, namely the system the worker finds most appropriate. A second purpose is to induce the workers to expend more effort, so as to increase output. A third purpose is to allocate some of the risk at the point of production to the workers, so that wages go up and down with productivity, even when variations in productivity are not entirely within the workers' control.

In this paper we try to answer four questions.

1. To what extent were piece-rate systems used among manufacturing workers in Finland during the years 1980, 1990 and 1996?
2. What is the effect on pay level of using piece- versus time-rate systems, and how has this effect changed between the studied years?
3. What is the amount of risk associated with being employed in a piece-rate system, and how has this effect changed between the studied years?
4. To what extent does the pay differential between piece- and time-rate workers primarily reflect compensation for extra effort versus compensation for bearing additional risk?

We have access to unique individual-level data on payment system (piece- versus time-rate) and occupation from several thousand establishments and more than a quarter of a million individuals engaged in the private sector in Finland. This means that productivity differences between employees can be assessed in a relevant way at the occupation–establishment level, because productivity is determined by both the individual and the occupation (Granovetter 1981).

In section 2 we discuss theories about pay systems and present the Finnish institutional framework, the data, and our methods. In section 3 we show the effect of output-related pay on total pay. In section 4 we present the risks involved with output-related pay, and in section 5 we trace the premium compensation with output-related pay into risk-induced and effort-induced compensation. Finally in section 5 we discuss the results.

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[1] Continuous output pay systems are different from discrete output pay systems. In the latter, workers are compared to an exogenous set standard and fired if they do not meet the standard. The continuous output pay system is based on the worker's continuous effort (see Lazear 1996, 1998).

# 2. CONTINUOUS OUTPUT-RELATED PAY, PRODUCTIVITY, AND RISK

Output-related pay systems are one of the most thoroughly studied labor market institutions. Sociologists have examined their operation for more than half a century, in a series of important studies (see, e.g., Mathewson 1931; Roethlisberger and Dickson 1939; Roy 1953; Whyte 1955; Lupton 1963; Burawoy 1979). More recent studies are by Granovetter and Tilly 1988; Stinchcombe 1990 chapter 7; Sørensen 1994. Similarly, a broad economics literature has emerged over the last twenty years addressing the theoretical properties of such systems (see, e.g., Stiglitz 1975; Holmström 1979; Holmström and Milgrom 1991; Shavell 1979; Milgrom and Roberts 1992, chapter 7; Lazear 1998).

In spite of the extensive empirical studies in the sociology and organizations literature and the impressive theoretical studies in the economics literature, there is a striking paucity of studies addressing in a comprehensive empirical manner perhaps the most salient features of such systems: their effects on productivity and wage levels.[2]

These effects are essential to workers as well as to employers and, more generally, to the overall functioning of the labor market.[3] The current study attempts to fill part of this gap.

It is difficult to measure individual productivity, in part because it is hard to observe. Where productivity in principle is unambiguous, it is rare that researchers have access to records thereof. More often, what constitutes productivity is ambiguous, as in many types of service and professional work, and how to measure it at the individual level is clear neither to employers nor to social scientists.

Nevertheless, in some work settings one has better access to reasonable measures of productivity than in others. Where piece-rate work is performed, wages earned on average should match productivity, so that variation in wages, for the same work for the same employer, in principle should reflect variations in productivity. As Phelps Brown (1977, p. 269) stated: "Wherever workers are on piece rates or any form of 'payment by results', differences in the outputs credited to them individually result in differences of earnings." On the basis of this premise, that wages paid at piece rates should match productivity differences when the payment is for the same work for the same employer, one can in fact make some investigations into potential productivity effects of payment systems.[4]

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[2] There are some exceptions, however. Pencavel (1977) studied wages for 183 punch-card workers in a Chicago factory. Seilert (1984) studied workers in the shoe industry. Mitchell, Lewin and Lawler III (1990) report on average wage differentials between different pay schemes in a number of industries, and Petersen (1991, 1992) studied production workers in nonferrous industries. Östros (1990) studied the manufacturing industry, and another study was carried out by le Grand (1989), who used the Level of Living Survey (LNU) from 1981 in Sweden (see also le Grand 1991). Moreover there are empirical studies of factors that influence the design of compensation contracts (such as Jensen and Murphy 1990a, b; Meyersson 1994, 1998). In Finland empirical studies have increasingly focused on potential productivity effects from the introduction of profit sharing in the firms' pay systems and the influence of profit-sharing pay systems on overall labor market flexibility (see Alho 1998).

[3] As Holmlund (1991, pp. 40–41, our translation) writes: "This lively theoretical analysis has however resulted in surprisingly few studies of the relationship between payment systems and productivity…. Here there is beyond doubt considerable room for more refined studies."

[4] Holmlund (1991, pp. 36–39), using aggregate-level data on 25 Swedish industries in the period 1970–1984, concluded that the estimate of the impact of piece-rate systems on productivity is quite comparable to those obtained from using the type of individual-level wage data we use here.

Even though output-related pay systems have decreased in use in most western countries since 1960, there is a renewal of interest in the application of these systems not only for the traditional blue-collar workers but also for white-collar employees and professionals. Kanter (1990, p. 152) notes a "move toward reducing the fixed proportion of pay and increasing the variable portion". In the Nordic countries, for instance in Sweden, since 1983, with the dissolving of the central bargaining system, an increased interest in variable pay has been expressed. In the Swedish productivity investigation (SOU 1991, p. 33), it is claimed that a well-functioning pay system influences the use of capacity, employment, and productivity. In Finnish firms the use of variable pay has expanded over the past few years (Alho 1998). For instance, in manufacturing about one-third of the employees are covered by some mode of profit-sharing pay systems, in other sectors the share is one-half or even higher. The portion of these pay systems in the total wage sum is nevertheless still modest. During the recession in the Finnish economy in the early 1990s, interest declined somewhat (see Santamäki-Vuori and Parviainen 1996).[5]

The rapidly growing interest in variable pay reflects firms' desire to increase productivity and profitability, to react to the need for internal organization changes, to integrate especially high-skilled workers into the performance and success of the firm, and to improve the firms' ability to adjust to fluctuations in the economic activity level. Individualized pay has become more attractive both to white- and blue-collar workers.[6]

Allocating output risks at the point of production to employees creates risk for the worker. Faulty materials, machine breakdown, and other variables can affect output, regardless of the workers' effort. For a given level of effort, therefore, there is risk with respect to the amount produced and hence earned, because of the uncertainties over which the worker has less control than over his or her own effort. We shall attempt to assess the extent to which the wage differential between piece-rate and time-rate workers is due to compensation for risks, not only to compensation for extra effort.[7]

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5 In 1990 deferred profit-sharing schemes aimed at promotion of economic democracy and deepening co-operation were introduced in Finland. The Act on Personnel Funds, covering deferred profit-sharing, applies to companies employing at least 30 people. According to the Act, the personnel of a company or a smaller unit in the business can establish a fund, provided that the company has introduced a profit-related pay scheme. The establishment of the funds is voluntary. The funds are owned and run by the personnel, but the act leaves scope for variation in the coverage of the fund, the division of the capital into individual joint shares and the investment policy of the fund. The deferred profit-sharing scheme provides tax incentives to employers, as payments into the funds made by employers are not liable to payroll taxes. About 5% of all employees (90 000) are covered by the existing 40 personnel funds. During the recession, interest declined, and a few funds have been suspended. The majority of personnel funds were established in large manufacturing companies that had already introduced a comprehensive cash-based profit-sharing system. Such systems continued to exist alongside the deferred profit-sharing system of the investment funds. Staff funds are less common in small and medium-sized companies and in the service sector (see Santamäki-Vuori and Parviainen, 1996 p. 61).

6 Rajan and Zingales (1998) argue that the new types of human capital intensive firms (such as the ones in Silicon Valley) in combination with scarcity of top talent change not only the organization design but also how to pay employees in order to attract them and make them want to stay.

7 Meyersson (1994) reports on compensation for risks among executives, and Petersen (1991) does so for production workers.

*The Finnish Institutional Framework*

Finland belongs to the Nordic group of welfare societies where the labor market is highly regulated by legislation and agreements between the labor unions and the federations of employers.[8] The degree of centralization of collective bargaining has varied during the period 1980–1996, when the collective agreements covered between 1 and 2 years. More decentralized bargaining took place at the industry level and for the years 1980, 1983, 1994, and 1995. Unionization is high, between 88% and 97% over the period 1980–1996.[9] The employees have had access to generous unemployment benefits based on both insurance and assistance principles. There was a major change in 1985, when both insurance benefits and the basic allowance became liable to tax and insurance benefits became earnings-related.[10]

In fall 1990 a serious economic recession struck the Finnish economy, resulting in a decline in output of 12% for 3 years. Between 1990 and 1993, unemployment increased from 3.4%, one of the lowest rates in Europe at the time, to 18.4% . This was the most severe economic drop recorded in any OECD country in recent decades. Employment decreased by a total of 8%. A weak recovery began in 1993, and productivity growth has steadily improved, but unemployment lagged for a long time (see Santamäki-Vuori and Parviainen 1996).[11]

The changes in individual wage dispersion have been moderate for the period 1980–1996 (Asplund 1995, Santamäki-Vuori and Parviainen 1996, Table 10 p. 43). By international comparison the inter-industry wage dispersion in Finland has been at the average European level and clearly larger than in Sweden, Norway and Denmark (Asplund 1995).

The pay range seems to have widened somewhat during the late 80s and narrowed again during the recession of the early 90s. The rise in wage inequality that preceded the recession was associated with large changes within almost all age and gender groups, industries, and educational categories, although the weak tendency of rising wage inequality is the result of growing within-group rather than between-group wage differentials (Eriksson and Jäntti 1995). Two reasons are given for this development. One is related to various additional wage payments, which increased in the boom years and shrank during the recession: As these cash-based profit-sharing systems, bonuses and overtime payments (which affected mostly employees belonging to the highest decile) decreased during the recession, the overall pay distribution tended to narrow. Another reason was related to the higher incidence of unemployment among those with the lowest wages. For instance, 46% of the women who became unemployed in 1992 had been in the lowest quintile of the pay distri-

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8 Finland had a population in 1980 of 4.788, in 1990 of 4.99, and in 1996 of 5.2 million, in 1980 2.4, in 1990 2.5 and in 1996 2.5 million were in the labor force. Furthermore, 25–30 % of the labor force is in the public sector (the lowest share among the Nordic countries). About 8% of the men and 11% of the women worked fewer than 30 hours per week in 1995.

9 The higher figure when student and nonpaying union members are accounted for.

10 In 1994 basic unemployment allowances were changed with the introduction of a qualifying condition relating to employment record and a maximum payment duration.

11 The explanations for the deep recession in Finland are many and inconclusive. The most common ones are a collapse in domestic demand, external shocks such as recession in the world economy, a collapse in exports to the former Soviet Union, deterioration of price competitiveness in Western markets, worldwide overcapacity of the forest industry, a reversal of favorable terms of trade, inefficiencies in the economy such as low rate of return on investments, and deregulation of financial markets. Financial liberalization was associated with a self-enforcing spiral of credit expansion and asset inflation, as firms' and households' debts increased sharply as did their exposure to the risks attached to interest rates, exchange rates, and asset prices (see Santamäki-Vuori and Parviainen 1996 for a survey).

bution in 1991. As the proportion of the lowest wage groups in the pay comparison drops, the dispersion appears to become narrower (Santamäki-Vuori and Parviainen 1996, p. 43).

Output-related pay systems have spread rapidly in private-sector businesses in Finland during the past two decades. Nevertheless, few studies have explored the economic implications of different pay systems. Most studies in Finland on pay compensation schemes have investigated whether workers paid according to some kind of piece-rate scheme earn, on average, more than workers having a normal monthly, weekly or hourly wage. The approach used has simply been to supplement the estimated individual-level wage equation with a dummy variable for working at a piece-rate (e.g. Asplund 1993, 1994, 1998). Kettunen (1994) compared output-related pay with time-rate pay among Finnish manufacturing workers in 1990, and found that even when a broad set of individual and job-related background factors are controlled for, output-related pay schemes offer the manufacturing workers a considerable pay advantage over time-rated systems. Simultaneously, however, the variation in output-related wages is larger than in time-rate wages. Kettunen (1994) also investigated the choice of pay schemes within Finnish manufacturing for the years 1980, 1985 and 1990. In recent years, the focus has increasingly been on the pros and cons of profit-sharing systems. Alho (1998), for instance, has investigated the potential productivity effects from the introduction of profit sharing in the firms' pay systems and the influence of profit-sharing systems on overall labor market flexibility.

*Data*

We will use an extensive and unique data set from Finland covering the period 1980–1996. For pure practical reasons we have picked three years – 1980, 1990 and 1996 – where two are compatible with Norwegian and Swedish data (1980 and 1990). We have access to the whole wage database gathered by the Confederation of Finnish Industry and Employers (TT).[12] This unique individual-level data is compiled from the employers' wage registers, guaranteeing a high degree of reliability, and contains information about all those employed at the time of the inquiry. TT undertakes inquiries among its member firms four times a year for blue-collar workers. In this study we use data for the fourth quarter, i.e., the period October–December, to avoid problems caused by seasonal workers. The database covers several thousand establishments, representing on average some 75% of Finnish manufacturing. The missing 25% consist mainly of very small employers, which for one reason or another are not members of any employer organization although for all practical purposes they are covered by the same wage agreement as the organized firms. The TT data thus underrepresent small firms and workplaces. The coverage of the service sector is minor too.

The database contains detailed information on the composition of each blue-collar worker's wage: the number of piece-rate and time-rate hours actually worked and the corresponding (gross) wage sum. In addition, the TT wage data comprise information on a broad set of individual and job-related characteristics, such as education and occupation,

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[12] Four major employer organizations and three smaller ones exist in Finland. In 1996 for instance, in the private sector almost 700 000 employees work in firms that are members of the two largest confederations. The larger one, the Confederation of Finnish Industry and Employers (TT), consists of 28 member associations representing about 6 000 member companies with 450 000 employees, mainly in manufacturing industries, transport, and construction. The second largest confederation is the Employers' Confederation of Service Industries in Finland (PT). In the public sector there are four employer organizations that sign collective agreements on behalf of the state, municipalities, the church, and various public institutions.

and firm-related characteristics, such as industry affiliation. The data that we have access to do not cover any of the profit-sharing schemes.

**Table 2.1 Distribution on payment system, for all, by sex, and by year**

| | 1980 | | | 1990 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|
| Payment system: | All | Men | Women | All | Men | Women | All | Men | Women |
| Time-rate | 47.1 | 49.8 | 41.2 | 46.6 | 47.5 | 43.8 | 51.6 | 51.9 | 50.6 |
| Piece-rate | 15.4 | 16.9 | 12.2 | 22.8 | 24.2 | 18.4 | 27.0 | 28.5 | 22.6 |
| Mixed-rate | 37.5 | 33.3 | 46.6 | 30.6 | 28.3 | 37.8 | 21.4 | 19.6 | 26.8 |
| Sum | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| N | 270 826 | 185 233 | 85 593 | 295 266 | 223 866 | 71 400 | 213 621 | 159 219 | 54 402 |

*Notes:* There are three groups of workers: (1) Only time-rate workers, where total wage is earned on time-rate jobs, (2) Only piece-rate workers, where all wages are earned on piece-rate jobs, and (3) Mixed-rate workers, where part of the wages is earned on time- and another part on piece-rate jobs. The sample has been truncated for each year as follows.
In 1980 all observations with an hourly wage over FIM 80 have been taken out, i.e., 7 076 observations (2.6%).
In 1990 the limit is FIM 120, and 11 309 (3.8%) observations have been taken out.
In 1996 the limit is FIM 150, and 4 151 (1.9%) observations have been taken out.
These "extreme" observations were considered to have arisen mainly from the following reason. The wage sum covers the period October–December. Among certain categories of blue-collar workers as well as within certain industries, such as construction, the compensation for work is commonly paid as a "lump sum", with some time-lag. Therefore worked hours were performed before October, but the pay is made in the October–December period.

*Method*

We perform two analyses.[13] In the first we analyze data on workers in the same occupation and the same establishment, but some are paid on time rates and others on piece rates. We will analyze the probability of whether or not a worker paid by output receives a wage less than (a) the lowest-paid time-rate worker, or (b) the average-paid time-rate worker, where the comparable time-rated workers work in the same occupation and establishment. These analyses will give some insight into the amount of pay risk faced under output-related pay systems.

Our second analysis looks at how the amount of risk in pay at the occupation–establishment level among output-paid workers influences (a) the wage premium they receive relative to time-rate workers and (b) the average pay earned by output-paid workers. Thus we can see whether the pay premium for piece-rate work is higher when the amount of variance in wages is higher. We also assess whether the output-paid workers who face larger

[13] Throughout we overlook the presence of a potential sorting problem. This is for two main reasons arising from the fact that we study blue-collar workers in manufacturing jobs. First, there is no indication whatsoever of manufacturing workers choosing their job and employer based on the pay system in use. Instead the workers' often highly specialized skills determine the job match irrespective of the system according to which the job is paid. Second, in the manufacturing job that the worker holds, the pay system is given, that is, the worker has no opportunity to choose and shift between pay systems.

uncertainties in pay also tend to earn higher average wages, a comparison made among output-paid workers only.[14] As our measure of risk (uncertainty) we choose the variance in wages among piece-rate workers at the occupation–establishment level, a measure that is simple and whose properties are known.[15]

In summary, the main objective of this part of the analysis is to assess the extent to which a part of the compensation workers receive under output-related payment systems is for the increased pay risk they face.

The analysis above assesses the role of risk-sharing under output-related payment systems. And it estimates the amount of the output-related pay that is due to compensation for risk-sharing and thereby the part of the expected wage differential between output-related pay and time-rate workers that is due to risk-sharing.

We shall finally attempt to assess the amount of the wages due to productivity effects of output-related payment systems. This goal requires specifying a model for the preferences of workers and what goes on at the point of production. Nevertheless, with some simplifying assumptions, assumptions that are not unreasonable, it is possible to derive a decomposition of the part of the wage that is due to risk compensation. Building on a model by Petersen (1991), which in turn was derived from Holmström and Milgrom (1987), we can do so. Fortunately, from the viewpoint of the statistical analysis, this decomposition is quite simple. So even if one does not accept the assumptions used to derive and justify the specific interpretation given to the measures, the reported measures make sense and are of interest in themselves.

The central idea in this analysis is that the part of the wage differential between output-related pay and time-related pay not due to risk-sharing is due to compensation for extra effort and hence productivity, assuming the wage differential consists of only two parts, a risk-sharing and an effort part.[16] This analysis hence provides insight into the nature of the institution studied: Is it one that primarily induces workers to expend more effort, or is it one that primarily allocates risks at the point of production to the workers? The analysis attempts to assign weights to the relative importance of the two aspects for wage differences between the two groups. In summary, the main objective of this part of the analysis is to assess the extent to which the productivity effects versus the risk-sharing effects are more important in the wage premium that piece-rate workers receive, given that the workers receive a premium.

## 3. USE OF PIECE-RATE SYSTEMS

For the analysis, the blue-collar workers are divided into three groups, one group for each of three wage forms.[17] The first group is those workers who receive all their wages from time-rate work, called time-rate workers. The second group is those workers who receive all their

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[14] These analyses as well as those above will also be done for workers who spend part of their time on time-paid work and another part of their time on output-paid work. In such cases one may make intra-individual comparisons of the impact of piece-rate work on wages.

[15] See Hey (1979, p. 52) for a discussion of when the variance is an appropriate measure of uncertainty.

[16] Differences in productivity may come about in many ways. For instance, some people may be lazy but talented, others vice versa.

[17] It should be pointed out that this division is not identical to the one commonly used by employee and employer organisations, including TT.

wages from piece-rate work, called piece-rate workers.[18] The third group contains those workers who receive part of their wage from piece-rate work, and part from time-rate work, here called mixed-rate workers. These workers perform tasks that are paid partly according to a piece-rate and partly to a time-rate.[19]

Table 2.1 above also gives the distribution of workers on the three pay systems, as categorized here, first for all workers, and then separately by sex. Comparing 1980 with 1996 we see a moderate increase in the use of only time-rate pay systems, from 47.1% in 1980, with a downward trend to 46.6% in 1990, to 51.6% in 1996. Most workers who receive pay from output-related pay systems, were employed under mixed-rate systems, receiving part of their pay from piece- and part from time-rates, except in 1996. The employees on mixed-pay systems have decreased and in 1996 were surpassed by the only piece-rate pay system. Exactly how the trend operated in the 17-year period from 1980 to 1996 with the blue-collar workers categorized in this way, is of course unclear because we have used data for only three of the years.

We can also study the use of pay systems from the perspective of a unit of analysis other than the individual worker. In Table 3.1 we show to what extent the pay systems are used in industries, establishments, occupations, and occupation–establishment units. At those levels there are seven possibilities for the use and combination of the three pay systems: 1. only time rates are used, 2. only piece rates are used, 3. mixed rates are used, 4. only time rates and only piece rates are used, 5. only time-rate and mixed-rate systems are used, 6. only piece-rate and mixed-rate systems are used, and 7. all three pay systems are used.

**Table 3.1 Distribution of Industries, Establishments, Occupations and Occupation–Establishment units on combinations of wage systems in use**

| **1980** | Industry | Establishment | Occupation | Occupation–Establishment |
|---|---|---|---|---|
| *Combination of wage system in use:* | 1 | 2 | 3 | 4 |
| 1. Time rates | 0.0 | 35.5 | 9.9 | 51.5 |
| 2. Piece rates | 0.0 | 2.3 | 0.4 | 8.2 |
| 3. Mixed rates | 0.0 | 2.5 | 1.3 | 16.5 |
| 4. Time rates and piece rates | 0.0 | 4.4 | 6.0 | 1.7 |
| 5. Time rates and mixed rates | 0.0 | 28.6 | 5.6 | 13.1 |
| 6. Piece rates and mixed rates | 0.0 | 2.3 | 1.4 | 4.5 |
| 7. All three systems | 100.0 | 24.4 | 75.4 | 4.5 |
| **Sum** | 100.0 | 100.0 | 100.0 | 100.0 |
| N | 22 | 4 013 | 535 | 34 979 |

*Notes:* The entries give the distribution on the combination of wage systems used within industries, establishments, occupations, and occupation–establishment units. For example, in column 2, the number 35.5 in line 1 means that 35.5 percent of the establishments pay all their workers on time rates, and line 7 means that 24.4 percent of the establishments use all three wage systems. For column 4, the number 51.5 in line 1 means that 51.5 percent of the occupation–establishment units pay all their workers on time rates, and line 4 means that 1.7 percent of units pay some of their workers on time rates and others on piece rates.

[18] For these workers all hours worked are recorded as piece-rate hours in the data used. Piece-rate, in turn, refers both to traditional piece-rate pay and to premium-based pay.

[19] Mixed pay system is applied on jobs that typically consist of tasks such as maintenance, where time rate is practical, and straight production, where piece rate is suitable.

**Table 3.1 (cont.)**

| **1990** | Industry | Establishment | Occupation | Occupation–Establishment |
|---|---|---|---|---|
| *Combination of wage system in use:* | 1 | 2 | 3 | 4 |
| 1. Time rates | 4.3 | 37.5 | 16.0 | 49.8 |
| 2. Piece rates | 2.1 | 4.1 | 0.4 | 11.4 |
| 3. Mixed rates | 0.0 | 2.7 | 2.5 | 14.3 |
| 4. Time rates and piece rates | 0.0 | 5.6 | 6.0 | 2.7 |
| 5. Time rates and mixed rates | 0.0 | 19.7 | 10.8 | 11.3 |
| 6. Piece rates and mixed rates | 0.0 | 3.6 | 1.4 | 5.0 |
| 7. All three systems | 93.6 | 26.8 | 62.9 | 5.5 |
| **Sum** | 100.0 | 100.0 | 100.0 | 100.0 |
| N | 47 | 5 880 | 668 | 39 290 |

*Notes:* The entries give the distribution on the combination of wage systems used within industries, establishments, occupations, and occupation–establishment units. For example, in column 2, the number 37.5 in line 1 means that 37.5 percent of the establishments pay all their workers on time rates, and line 7 means that 26.8 percent of the establishments use all three wage systems. For column 4, the number 49.8 in line 1 means that 49.8 percent of the occupation–establishment units pay all their workers on time rates, and line 4 means that 2.7 percent of units pay some of their workers on time rates and others on piece rates.

**Table 3.1 (cont.)**

| **1996** | Industry | Establishment | Occupation | Occupation–Establishment |
|---|---|---|---|---|
| *Combination of wage system in use:* | 1 | 2 | 3 | 4 |
| 1. Time rates | 3.8 | 41.2 | 15.3 | 52.5 |
| 2. Piece rates | 1.9 | 5.5 | 1.8 | 15.2 |
| 3. Mixed rates | 0.0 | 3.3 | 1.2 | 10.9 |
| 4. Time rates and piece rates | 0.0 | 4.7 | 8.1 | 2.2 |
| 5. Time rates and mixed rates | 3.8 | 18.5 | 10.5 | 8.6 |
| 6. Piece rates and mixed rates | 0.0 | 4.4 | 1.6 | 6.0 |
| 7. All three systems | 90.5 | 22.4 | 61.5 | 4.6 |
| **Sum** | 100.0 | 100.0 | 100.0 | 100.0 |
| N | 53 | 3 337 | 346 | 22 388 |

*Notes:* The entries give the distribution on the combination of wage systems used within industries, establishments, occupations, and occupation–establishment units. For example, in column 2, the number 41.2 in line 1 means that 41.2 percent of the establishments pay all their workers on time rates, and line 7 means that 22.4 percent of the establishments use all three wage systems. For column 4, the number 52.5 in line 1 means that 52.5 percent of the occupation–establishment units pay all their workers on time rates, and line 4 means that 2.2 percent of units pay some of their workers on time rates and others on piece rates.

At the industry level, in 1980 0% use time rates only, whereas in 1990 4.3% and in 1996 3.8% used time rates only.

About 60% of all establishments had more than one pay system in 1980 and the trend has been down; in 1996 the figure was 50%.

At the occupation–establishment level 51.5% in 1980 used only time rates whereas in 1990 the figure was 49.8% and in 1996 52.5%, rather stable over time.

An interesting phenomenon is the use of more than one system at the same time at the occupation–establishment level; in 1980 23.8% of all occupation–establishment pairs had more than one system in existence at the same time, and this percentage was roughly stable over time.

What Table 3.1 also shows is that at the establishment level and at the occupation–establishment level in particular, it is quite common that only one wage system is in use. For example, at the occupation–establishment level in 1980 51.5% used time rates alone and in 1996 the percentage was almost the same or 52.5%. From the workers' viewpoint this means that the opportunities to choose between pay systems are minor or non-existent and that any change of pay system would usually require a change of either occupation or establishment, or both.[20] As such, this finding is hardly surprising. The use of various pay systems can reflect technological possibilities, which tend to vary more between than within establishments. At the same time, even where more than one system is technologically feasible within the same establishment or occupation–establishment unit, it may be more costly to operate two or three systems than only one. Each system has its administrative costs in addition to its incentive and motivation properties, and those costs must be factored in when choosing especially how many systems to operate at the same time.

## 4. EFFECTS OF PAY SYSTEM ON PAY LEVEL

Next, we address the impact of the pay system on the pay received. This is of course especially important to the employees. It documents the extent to which there is a wage payoff from working under piece-rate systems. We make several comparisons.

Before we proceed, a brief overview of the wage data may be useful. Table 4.1 gives the mean and the standard deviation for hourly wages for each group of employees. We see that only piece-rate workers on average earned FIM 20,53 or 14% more than time-rate workers in 1980, in 1990 also 14% more, and in 1996 12% more. Among mixed-rate blue-collar workers, average pay on the piece-rate component was FIM 20,96 or 16% higher than on the time-rate regime, in 1990 17% higher, and in 1996 12% higher.

At the same time the standard deviation of pay is higher for only piece-rate than for only time-rate workers, during all studied years. This reflects more dispersion in pay among only piece-rate workers than among only time-rate workers. The standard deviation of the piece-rate component for mixed-rate workers is very large, but the standard deviation of the total hourly pay of those workers, combining pay on piece- and time-rate tasks, is slightly lower but still higher than the standard deviation of pay of only time-rate workers. This relationship is stable over the studied years.

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[20] This finding lends further support for the arguments put forth in footnote 13 above of sorting being a more or less negligible problem in this context.

**Table 4.1 Descriptive statistics for pay by wage system, FIM**

| | | | | Mixed-rate workers | | |
|---|---|---|---|---|---|---|
| | | Only Piece-Rate workers | Only Time-Rate workers | Total wages | Piece-Rate component | Time-Rate component |
| | | 1 | 2 | 3 | 4 | 5 |
| **1980** | Mean | 20,53 | 18,02 | 19,47 | 20,96 | 17,89 |
| | SD | 3,94 | 3,20 | 4,47 | 6,50 | 4,05 |
| | N | 41 801 | 127 390 | 101 635 | 101 635 | 101 635 |
| **1990** | Mean | 48,35 | 42,44 | 46,26 | 49,55 | 42,47 |
| | SD | 11,88 | 8,85 | 11,95 | 15,11 | 10,45 |
| | N | 67 340 | 137 672 | 90 254 | 90 254 | 90 254 |
| **1996** | Mean | 56,84 | 50,86 | 54,62 | 56,94 | 51,84 |
| | SD | 9,54 | 9,33 | 10,82 | 13,52 | 11,30 |
| | N | 57 641 | 110 182 | 45 798 | 45 798 | 45 798 |

*Notes:* Only piece-rate workers receive all their wages from piece-rate jobs. Only time-rate workers receive all their wages from time-rate jobs. Mixed-rate workers receive part of their wages from piece- and part from time-rate jobs.

We now turn to our main task. Table 4.2 compares the two groups of workers on output-related pay systems to those who receive all their pay from time rates. We compute the piece-rate pay as a percentage of the time-rate pay. This we do for five different levels reported in lines 1–5. In the first line we compute the average pay of only piece-rate workers as a percentage of the average pay of only time-rate workers. In the second line we do the same, but now controlling for industry. We first computed the average wages of only piece-rate workers as a percentage of the average wages of only time-rate workers. Thereafter we took the mean of this percentage across industries. In lines 3–5 we make the same types of computations, but now at the establishment, occupation, and occupation–establishment levels respectively. The last line is especially important. Here we computed the average pay for only piece-rate workers as a percentage of the average pay of only time-rate workers for those workers who are employed in the same occupation and establishment. Obviously, not all occupation–establishment units employ piece-rate and time-rate workers side-by-side.

In columns 2–4 we make the same type of comparisons but now between mixed-rate workers and only time-rate workers. Here there are several comparisons. In column 2 we compare the average wages of the two groups. In column 3 we compare the piece-rate component of the wages of mixed-rate workers to the time-rate wages of only time-rate workers. In column 4, we compare the time-rate component of the wages of mixed-rate workers to the time-rate wages of only time-rate workers. These computations are done for each of the five levels; that is, overall, industry, establishment, occupation, and occupation–establishment.[21]

[21] It is worth noting that blue-collar workers at the same establishment–occupation may be paid on different schemes due to differences in time of entry.

**Table 4.2 Relative (in percent) wages of Piece-rate Workers and Mixed-rate Workers versus Time-rate Workers**

| | | | Wages of Mixed-rate Workers to only Time-rate Workers | | |
|---|---|---|---|---|---|
| | | Wages of Piece-rate Workers to Time-rate Workers | Total wages | Piece-rate compared to Time-rate wages | Time-rate compared to Time-rate wages |
| | | (1) | (2) | (3) | (4) |
| **1980** | Overall | 113.92 | 108.04 | 116.43 | 99.27 |
| | Industry | 119.66 | 114.17 | 127.23 | 103.22 |
| | Establishment | 119.62 | 112.97 | 131.58 | 103.17 |
| | Occupation | 112.68 | 107.88 | 119.07 | 100.48 |
| | Occupation–Establishment | 115.63 | 109.68 | 125.22 | 102.61 |
| **1990** | Overall | 113.93 | 109.00 | 116.64 | 100.07 |
| | Industry | 114.01 | 110.73 | 122.09 | 102.24 |
| | Establishment | 122.53 | 117.16 | 132.63 | 106.05 |
| | Occupation | 112.52 | 108.35 | 116.36 | 101.49 |
| | Occupation–Establishment | 122.35 | 112.30 | 126.38 | 104.15 |
| **1996** | Overall | 111.78 | 107.39 | 111.98 | 101.95 |
| | Industry | 113.05 | 109.91 | 117.77 | 101.63 |
| | Establishment | 119.43 | 112.53 | 124.84 | 103.95 |
| | Occupation | 111.38 | 107.26 | 114.79 | 102.64 |
| | Occupation–Establishment | 114.16 | 109.46 | 120.90 | 103.33 |

*Notes:* For definitions of the three groups of workers, see Table 4.1. The numbers in the table give the wages of each group as a percentage of the wages of time-rate workers. For column 1, the first line gives the average wage of piece-rate workers as a percentage of the average wage of time-rate workers. For column 1, the second line is obtained in two steps. First, one computes the average wages of piece-rate workers as a percentage of the average wages of time-rate workers, separately within each industry. Then an average of this percentage is taken across industries. For column 1, lines 3–5 are computed in the same manner, but now for establishment, occupation, and occupation-establishment. For columns 2–4, the computations are analogous to those in column 1. The difference is that the comparison groups differ. The wages of mixed-rate workers are computed to the wages of only time-rate workers. For the mixed-rate workers there are three wage components: Their total wages, their wages from the piece-rate component, and their wages from the time-rate component.

No matter how one looks at it, it pays to be paid on one of the output-related pay systems. Starting with only piece-rate workers, overall they earned significantly more in all years compared to time-rate workers. For instance at the occupation–establishment level they earned between 15 (1980 and 1996) and 22 (1990) percent more than time-rate workers. This is a considerable earnings advantage. And the advantage was maintained even at the occupation and occupation–establishment levels.

Mixed-rate workers did not do quite as well as only piece-rate workers did relative to only time-rate workers, but still they did well. On average, across the two pay systems, mixed-rate workers earned some 9% more in 1980 and 1996 and 12% more in 1990 than time-rate workers at the occupation–establishment level. The piece-rate component in mixed-rate

pay is considerably higher than the time-rate pay of only time-rate workers and even higher than the piece-rate only percentage. The time-rate component in the mixed-rate pay is slightly higher than for the only time-rate workers, at the occupation–establishment level – 2.6% in 1980, 4.5% in 1990, and 3.3% in 1996.

Some unusual opportunities for analysis arise for the mixed-rate workers. We can compare what they make in the piece- versus time-rate component. Table 4.3 gives the same kinds of statistics but for the mixed-rate workers only, comparing their pay from the piece-rate component to their pay from the time-rate component. This is computed for the same levels as in Table 4.2, lines 1–5. Additionally in line 6 we report the following computation. First, for each worker, the piece-rate pay of the worker was computed as a percentage of the time-rate pay of the same worker. Thereafter an average of this percentage was taken across all workers. It shows how much, on average, a worker who is employed on a mixed-rate system earns on piece- compared to time-rate work.

**Table 4.3 Piece-rate pay relative to Time-rate pay of workers on Mixed-rate payment systems (in percent)**

| | 1980 | 1990 | 1996 |
|---|---|---|---|
| Overall | 117.16 | 116.67 | 109.84 |
| Industry | 123.54 | 119.92 | 117.24 |
| Establishment | 128.30 | 126.47 | 121.42 |
| Occupation | 118.50 | 116.12 | 111.95 |
| Occupation–Establishment | 121.64 | 121.03 | 115.04 |
| Intra-Individual | 121.19 | 118.07 | 112.50 |

*Notes:* The numbers in this table pertain to workers who are employed on Mixed-rate payment systems. It gives the relative (in percent) wages from the piece-rate component to the time-rate component. The first line gives the average wages from the piece-rate component as a percent of the average wages of the time-rate component. The second line is obtained in two steps. First one computes the relative (in percent) wages on the piece-rate to the time-rate component separately within each industry. This is derived by taking the average wages on the piece-rate component for all the workers in the industry who are on mixed-rate systems and dividing it by their average wages on the time-rate component (and finally multiplying by 100). Then an average of this percentage is taken across the industries. Lines 3–5 are computed in the same manner, but now for establishment, occupation, and occupation–establishment. The last line is obtained by first computing, at the individual level, the ratio (in percent) of piece- to time-rate wages, and then taking an average of these figures across individuals. This is hence an intra-individual comparison, where individuals are compared to themselves in what they earn on the two separate components of their wage, the piece- and the time-rate component.

Table 4.3 shows that mixed-rate workers earned more on the piece- than on the time-rate component: at the occupation–establishment level the pay differentials are 21.2%, 18.1%, and 12.5% for the three years.

We next turn to a comparison of mixed-rate workers to only piece-rate workers. Table 4.4 gives the same types of statistics but now comparing those two groups of workers. In average pay, across the piece- and time-rate components, mixed-rate workers earned less than only piece-rate workers: At the occupation–establishment level they earned some 2–3% less than piece-rate workers did.

**Table 4.4 Comparison of Mixed-rate workers to Piece-rate workers**

| | | Total wages | Piece-rate compared to only Piece-rate | Time-rate compared to only Piece-rate |
|---|---|---|---|---|
| | | (1) | (2) | (3) |
| **1980** | Overall | 94.84 | 102.09 | 87.14 |
| | Industry | 95.61 | 106.62 | 86.70 |
| | Establishment | 97.20 | 104.52 | 88.63 |
| | Occupation | 95.98 | 105.76 | 89.27 |
| | Occupation–Establishment | 98.05 | 101.73 | 90.67 |
| **1990** | Overall | 95.68 | 102.48 | 87.84 |
| | Industry | 97.32 | 107.82 | 90.73 |
| | Establishment | 94.75 | 103.41 | 86.06 |
| | Occupation | 97.38 | 104.39 | 90.86 |
| | Occupation–Establishment | 97.36 | 103.04 | 89.79 |
| **1996** | Overall | 96.08 | 101.00 | 91.20 |
| | Industry | 96.07 | 104.13 | 90.19 |
| | Establishment | 97.88 | 103.14 | 91.11 |
| | Occupation | 97.17 | 102.92 | 93.07 |
| | Occupation–Establishment | 98.53 | 102.57 | 95.50 |

*Notes:* In column 1 we compare the average wages of mixed-rate workers, across the two wage components, to the wages of only piece-rate workers. In column 2 we compare the wages under the piece-rate component of the mixed-rate workers to the wages of only piece-rate workers. In column 3 we compare the wages on the time-rate component of mixed-rate workers to the wages of only piece-rate workers.

On the piece-rate component, however, mixed-rate workers did somewhat better than the piece-rate workers: At the occupation–establishment level they earned 1.7% more in 1980, 3.0% in 1990 and 2.6% in 1996 than only piece-rate workers. The time-rate component of the pay of mixed-rate workers was considerably below the pay of only piece-rate workers, 9.3% less in 1980, 10% in 1990, and 4.5% in 1996 at the occupation–establishment level.

In summary, there is no question that it pays to be paid on some output-related pay system, be it only piece-rate or mixed-rate systems. And the pay differential is quite substantial. At the occupation–establishment level it was 10–15% in 1980, 12–22% in 1990, and 10–15% in 1996. From the workers' point-of-view, as far as pay is concerned, the advantages are considerable, and they are largest for those who receive all their pay from piece rates.

## 5. RISK AND PAY

In this section we establish the extent to which there is risk in pay for piece- and mixed-rate workers.

One aspect of all output-related pay systems is that they make pay less predictable. The pay goes up and down with productivity. And the productivity depends not only on the ef-

fort of the worker but also on other factors outside the control of the worker. Among these factors are faulty materials, machine breakdown, non-cooperative coworkers, and more. Such risk may lead to piece-rate workers sometimes earning less than time-rate workers.

We have established quite clearly that piece-rate workers on average earn higher pay than time-rate workers do. But that does not mean that all piece-rate workers do so. Some may earn less because of the risk. This was initially documented in Table 4.1, where we showed that the standard deviation of pay among only piece-rate workers and the standard deviation of pay under the piece-rate component of mixed-rate workers were slightly higher than for time-rate workers. That reflects more variability in pay under piece rate.

We now first investigate how often it occurs that the piece-rate earnings fall below the pay of only time-rate workers. Table 5.1 gives the percentage of piece-rate workers for whom the pay fell below the pay of the lowest-paid time-rate worker in the same occupation and establishment. We see that this happened, but not often. Among only piece-rate workers, only some 12% of all cases in 1980 and 1990, and 15% in 1996 earned less than the lowest-paid time-rate workers. The risk of earning less on piece rate than the lowest-paid on time rate is 1 out of 9 in 1980 and 1990 and 1 out of 7 in 1996 for workers in the same occupation–establishment.

**Table 5.1 Percentage of workers, either on Piece-rate or on Mixed-rate systems, for whom wages are lower than for the lowest-paid Time-rate workers in the same Occupation–Establishment Unit**

| | | Piece-rate workers | Total wages of Mixed-rate workers | Piece-rate wages of Mixed-rate workers |
|---|---|---|---|---|
| | | (1) | (2) | (3) |
| **1980** | Not lower | 88.3 | 90.4 | 92.9 |
| | Lower | 11.7 | 9.6 | 7.1 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 15 995 | 68 515 | 68 515 |
| **1990** | Not lower | 88.1 | 90.4 | 92.6 |
| | Lower | 11.9 | 9.6 | 7.4 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 25 087 | 61 897 | 61 897 |
| **1996** | Not lower | 85.0 | 90.1 | 92.1 |
| | Lower | 15.0 | 9.9 | 7.9 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 17 426 | 30 812 | 30 812 |

*Notes:* For mixed-rate workers, we can also compare the wages earned on piece rates to those earned on time rates. Specifically we can compute the percentage of workers who earn lower wages on the piece- than on the time-rate component. In 1980, for 92.9 percent of these workers the piece-rate wages are not lower than the time-rate wages, but for 7.1 percent of the workers they are. The number of workers for which these 1980 statistics are computed is 68 515. This is the same type of intra-individual comparison as was made in the last line of Table 4.3.

Another way to approach this question is to compute the percentage in which the piece-rate pay fell below the mean pay of time-rate workers in the same occupation–establishment.

According to Table 5.2, among piece-rate workers, this happened for 21% in 1980, 26% in 1990, 30% in 1996. That is, in 1980 1 out of 5, in 1990 1 out of 4, and in 1996 1 out of 3 workers on piece rates risked earning less than the average pay of workers on time rate in the same occupation and establishment.

**Table 5.2 Percentage of workers, either on Piece-rate or on Mixed-rate systems, for whom wages are lower than the average wages of only Time-rate workers in the same Occupation–Establishment Unit**

| | | Piece-rate workers | Total wages of Mixed-rate workers | Piece-rate wages of Mixed-rate workers |
|---|---|---|---|---|
| | | (1) | (2) | (3) |
| **1980** | Not lower | 79.0 | 74.9 | 83.1 |
| | Lower | 21.0 | 25.1 | 16.9 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 15 995 | 68 515 | 68 515 |
| **1990** | Not lower | 74.1 | 72.8 | 80.8 |
| | Lower | 25.9 | 27.2 | 19.2 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 25 087 | 61 897 | 61 897 |
| **1996** | Not lower | 70.3 | 69.9 | 76.4 |
| | Lower | 29.7 | 30.1 | 23.6 |
| | Sum | 100.0 | 100.0 | 100.0 |
| | N | 17 426 | 30 812 | 30 812 |

*Notes:* In column 1, for each Piece-rate worker in a given occupation-establishment unit we computed whether or not the worker received a lower wage than the average wage of Time-rate workers in the same occupation-establishment unit. Column 1 then reports the percentage of piece-rate workers for whom this is the case. In column 2, we make the same computation but now for the total wage (on the piece- and time-rate components) of Mixed-rate workers. In column 3, the same computation is done for the wage under the piece-rate component for Mixed-rate workers.

From the evidence in Tables 5.1 and 5.2, one may say that piece rates appear to entail some risk and that this risk has increased over time.

## 6. ARE PIECE-RATE WORKERS COMPENSATED FOR RISK?

In this section we address the two last issues. First, we assess whether there appears to be some compensation for the risk among workers receiving all or some of their pay from piece-rate work, trying to estimate the amount of risk compensation. And second, we attempt to decompose the average pay differential between piece- and time-rate workers into one part that is due to compensation for risks and another due to compensation for extra effort that on average leads to increased output. This strategy gets to the heart of two of the central purposes of output-related pay systems, to induce workers to expend more effort and to allocate some of the risks at the point of production to the workers.

In Tables 4.2 and 4.3 we showed that there was a significant payoff to a piece-rate system. This pay differential may be due to compensation for extra effort: When more effort is exerted, more is produced, and more is earned. That is likely to be the most important aspect of the pay differential, but part of the differential may also be due to compensation for risks assumed under piece rates. To tease out the difference, suppose there is no effort differential between time- and piece-rate workers – for example, when the pace of work is controlled by machinery. In that case, the two groups will on average produce the same, and the pay of a time-rate worker is fixed.

The pay of a piece-rate worker, however, will vary with the amount produced. For a worker in such a situation to be willing to accept piece rates, where pay may be either lower or higher than under time rates, it is often thought that some compensation for the added risk must be offered. The workers will know that on average they will be better paid, or rather, that they can expect to be better off but are not assured that they will be. Without compensation for taking on the risk, the worker will not be willing to accept piece rates. That compensation is referred to as a risk differential or as a risk-sharing differential. Piece-rate workers on average earn somewhat more than time-rate workers, even though some of them may earn less. But on average they come out somewhat better.

In reality, piece-rate workers may also expend more effort. If so, the pay differential relative to time-rate workers will reflect compensation both for extra effort and for risk sharing. In what follows we attempt to estimate the extent to which the pay differential between piece- and time-rate workers reflects compensation for extra effort versus compensation for risk-sharing.

How to explore this issue is not obvious. But there is one straightforward approach. A measure of risk at the occupation–establishment level is the variance of pay among piece-rate workers at that level. It can be computed for occupation–establishment units employing two or more piece-rate workers. We use the so-called unadjusted variance, where one divides by the number of workers rather than by the number of workers minus one.

Then one can next regress the pay of piece-rate workers on the variance of their pay at the occupation–establishment level and on other characteristics, especially dummy variables for occupation. The coefficient for variance of pay gives *how much on average the pay of a piece-rate worker increases when the variance of pay at the occupation–establishment level increases by one unit*, assuming the coefficient to be positive. From this estimate we can determine to what extent risk is compensated.

Table 6.1 gives the result of the regression analyses, presenting an estimate of the coefficient of the variance of pay at the occupation–establishment level on the pay of the worker. Column 1 gives the results for only piece-rate workers. Here the variance of pay is computed for that group of workers and only those workers enter into the regression analysis. Column 2 gives the results for the piece-rate component for mixed-rate workers. Only the piece-rate pay of those workers enters into the computation of the variance and only those workers contribute to the analysis. Finally, in column 3 we combine the two groups from columns 1 and 2. The variance of pay is computed from the pay of only piece-rate workers and the piece-rate pay of the mixed-rate workers.

From Table 6.1 we see that the effects of the variance of pay vary with which group of workers enters into the analysis. The effect is largest among only piece-rate workers. Note that the many decimal points in the coefficient reflect that the variance is large.

**Table 6.1 Effect of variance of wages at the Occupation–Establishment level among Piece-rate workers on wages**

| | | Piece-rate workers | Mixed-rate workers | Piece-rate and Mixed-rate workers |
|---|---|---|---|---|
| | | (1) | (2) | (3) |
| *Model 1: No additional control variables* | | | | |
| Variance of wages | 1980 | .0803* | .0834* | .0828* |
| | 1990 | .0734* | .0681* | .0697* |
| | 1996 | .0355* | .0509* | .0448* |
| *Model 2: Controlling for occupation–establishment* | | | | |
| Variance of wages | 1980 | .0373* | .0389* | .0322* |
| | 1990 | .0161* | .0231* | .0189* |
| | 1996 | .0161* | .0183* | .0197* |
| *Mean of variance of wages within occupation–establishment units* | | | | |
| | 1980 | 3,63 | 12,05 | 9,87 |
| | 1990 | 28,74 | 56,97 | 47,87 |
| | 1996 | 23,12 | 47,13 | 36,12 |

*Notes:* * Statistically significant at .0001 level (two-tailed tests).

The dependent variable in the regression is the hourly wages. In column 1, the analysis is based on only piece-rate workers and in column 2 on the piece-rate component of mixed-rate workers; in column 3 the two groups are combined, using the wages of piece-rate workers and the piece-rate component of wages for mixed-rate workers. In Model 1, we control only for the variance of wages. In Model 2, we have in addition controlled for occupation by a set of dummy variables. The entries in the table give the estimated coefficient for the variable variance of wages as measured at the occupation–establishment level among only piece-rate workers or the piece-rate component of the wages of mixed-rate workers. We use the unadjusted variance, where we divide by the number of workers on piece rates in the occupation–establishment unit. In the adjusted variance one would divide by the number of workers minus 1.

To understand what these numbers mean, it is useful to calculate how much the average pay of piece-rate workers increases when the risk (i.e., variance of pay) increases. Those workers who are employed in occupation–establishment units where there is considerable risk of pay, as here measured by the variance, on average will earn somewhat more than those in settings with less risk. Some of the workers in high-risk settings will make less pay and some will make more, but on average they will make more than those in low-risk settings. They are compensated, on average, for the risk.

Table 6.2 gives some examples. When one goes from an occupation–establishment unit where the variance of pay equals zero to one where it equals its mean, the average hourly pay increased by FIM 0,37 in 1996, with the amount of increase varying with the specification, that is, in columns 1–3. When the risk increases by an amount equal to two means, then the mean hourly pay increases by twice as much (FIM 0,74).

**Table 6.2 Estimated amount of increase in average hourly wages for different values of the variance of wages at the Occupation–Establishment level, FIM**

| **1980** | Piece-rate workers | Mixed-rate workers | Piece-rate and Mixed-rate workers |
|---|---|---|---|
| Amount of variance in wages | (1) | (2) | (3) |
| *From model 1: No additional control variables* | | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean ($\sigma 2$) | 0,29 | 1,00 | 0,82 |
| Mean ($\sigma 2$) times two | 0,58 | 2,00 | 1,64 |
| *From model 2: Controlling for occupation–establishment* | | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean ($\sigma 2$) | 0,14 | 0,47 | 0,32 |
| Mean ($\sigma 2$) times two | 0,28 | 0,94 | 0,64 |

*Notes:* The numbers in the table are obtained by multiplying the coefficient for the variance of wages by various values for the variance of wages. In column 1, the coefficient comes from column 1 of Table 6.1, .0803 in model 1 and .0373 in model 2, and the values for variance of wages also come from column 1 of Table 6.1, the mean being 3.63. Thus the coefficient for variance of wages, .0803, times the mean value of variance of wages, 3.63, gives the entry in the table in line 2 of column 1, namely 0,29. It says how much the average wage increases when uncertainty increases from a value of zero, no uncertainty, to its mean value, 3.63. In column 2, the coefficient and the values for variance of wages come from column 2 of Table 6.1. In column 3 the numbers are taken from column 3 of Table 6.1. The last line gives the mean of the variance of wages at the occupation–establishment level, where the mean is computed across all occupation-establishment units employing two or more workers paid under the same wage scheme.

**Table 6.2 (cont.)**

| **1990** | Piece-rate workers | Mixed-rate workers | Piece-rate and Mixed-rate workers |
|---|---|---|---|
| Amount of variance in wages | (1) | (2) | (3) |
| *From model 1: No additional control variables* | | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean ($\sigma 2$) | 2,06 | 3,88 | 3,34 |
| Mean ($\sigma 2$) times two | 4,12 | 7,76 | 6,68 |
| *From model 2: Controlling for occupation–establishment* | | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean ($\sigma 2$) | 0,46 | 1,31 | 0,90 |
| Mean ($\sigma 2$) times two | 0,92 | 2,62 | 1,80 |

*Notes:* The numbers in the table are obtained by multiplying the coefficient for the variance of wages by various values for the variance of wages. In column 1, the coefficient comes from column 1 of Table 6.1, .0734 in model 1 and .0161 in model 2, and the values for variance of wages also come from column 1 of Table 6.1, the mean being 28.74. Thus the coefficient for variance of wages, .0734, times the mean value of variance of wages, 28.74, gives the entry in the table in line 2 of column 1, namely 2,06. It says how much the average wage increases when uncertainty increases from a value of zero, no uncertainty, to its mean value, 28.74. In column 2, the coefficient and the values for variance of wages come from column 2 of Table 6.1. In column 3 the numbers are taken from column 3 of Table 6.1. The last line gives the mean of the variance of wages at the occupation–establishment level, where the mean is computed across all occupation-establishment units employing two or more workers being paid under the same wage scheme.

**Table 6.2 (cont.)**

| **1996** | Piece-rate workers | Mixed-rate workers | Piece-rate and Mixed-rate workers |
|---|---|---|---|
| Amount of variance in wages | (1) | (2) | (3) |
| *From model 1: No additional control variables* | | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean (σ2) | 0,82 | 2,40 | 1,62 |
| Mean (σ2) times two | 1,64 | 4,80 | 3,24 |
| *From model 2: Controlling for occupation–establishment* | *Not lower* | | |
| Zero variance | 0,00 | 0,00 | 0,00 |
| Mean (σ2) | 0,37 | 0,86 | 0,71 |
| Mean (σ2) times two | 0,74 | 1,72 | 1,42 |

*Notes:* The numbers in the table are obtained by multiplying the coefficient for the variance of wages by various values for the variance of wages. In column 1, the coefficient comes from column 1 of Table 6.1, .0355 in model 1 and .0509 in model 2, and the values for variance of wages also come from column 1 of Table 6.1, the mean being 23.12. Thus the coefficient for variance of wages, .0355, times the mean value of variance of wages, 23.12, gives the entry in the table in line 2 of column 1, namely 0,82. It says how much the average wage increases when uncertainty increases from a value of zero, no uncertainty, to its mean value, 23.12. In column 2, the coefficient and the values for variance of wages come from column 2 of Table 6.1. In column 3 the numbers are taken from column 3of Table 6.1. The last line gives the mean of the variance of wages at the occupation–establishment level, where the mean is computed across all occupation-establishment units employing two or more workers being paid under the same wage scheme.

*Compensation for Risk-Sharing Versus for Extra Effort?*

We end by trying to assess the extent to which the pay differential between piece- and time-rate workers is due to compensation for extra effort or to compensation for risk. The average pay of time-rate workers was about FIM 50,86 per hour in 1996, and for piece-rate workers it was about FIM 56,84 per hour (see Table 4.1). Hence a piece-rate worker in 1996 earned on average FIM 5,98 more than a time-rate worker did. At the same occupation–establishment level a piece-rate worker earned almost 15% more than time-rate workers in 1996 (Table 4.2).

In Table 6.2 we documented the amount of risk compensation under different schemes of piece-rate pay. When risk increases from zero to its mean value 23.12 in 1996, the amount of risk compensation is FIM 0,82 for piece-rate workers and FIM 2,40 for mixed-rate workers.

Therefore, one can say that the pay differential in 1996 between piece- and time-rate workers of FIM 5,98 (the difference in mean pay for the respective pay schemes, see Table 4.1, columns 1 and 2) consists of about FIM 0,82 for piece-rate workers and FIM 2,40 for mixed-piece rate workers in risk compensation. The remainder of the pay differential, FIM 5,16 for the piece-rate workers and FIM 3,58 for the mixed-pay workers, is the compensation for extra effort. Thus, in 1980 close to 12% of the pay differential was compensation for risk, whereas 88% was compensation for extra effort (for 1990 the percentages were 35 and 65, and for 1996 14 and 86). These computations are depicted in Table 6.3 for each year.

This means that output-related pay systems primarily lead to increased output, which is translated into higher pay. Risk compensation is not absent, it is just not a substantial part of the pay differential. One institutional factor that without doubt affects this outcome and

that, moreover, is present in many countries is the "base" pay that piece-rate workers are often guaranteed. In Finland part of the risk that else would be carried by the piece-rate worker has been eliminated in collective wage agreements.[22]

**Table 6.3 Decomposition of the average hourly wage differential of Piece- versus Time-rate workers and Piece- versus Time-rate component of Mixed-rate workers into one part due to risk compensation and another due to effort compensation**

| | | Only Piece-rate versus only Time-rate workers | | Piece- versus Time-rate component of wages for Mixed-rate workers | |
|---|---|---|---|---|---|
| | | FIM | Percent | FIM | Percent |
| **1980** | Wage differential | 2,51 | 13.93 | 3,07 | 17.16 |
| | *The two parts:* | | | | |
| | Risk compensation | 0,29 | 11.6 | 1,00 | 32.5 |
| | Effort compensation | 2,22 | 88.4 | 2,07 | 67.5 |
| | Sum | 2,51 | 100.0 | 3,07 | 100.0 |
| **1990** | Wage differential | 5,91 | 13.92 | 7,08 | 16.67 |
| | *The two parts:* | | | | |
| | Risk compensation | 2,06 | 34.8 | 3,88 | 54.8 |
| | Effort compensation | 3,85 | 65.2 | 3,20 | 45.2 |
| | Sum | 5,91 | 100.0 | 7,08 | 100.0 |
| **1996** | Wage differential | 5,98 | 11.75 | 5,10 | 9.83 |
| | *The two parts:* | | | | |
| | Risk compensation | 0,82 | 13.7 | 2,40 | 47.1 |
| | Effort compensation | 5,16 | 86.3 | 2,70 | 52.9 |
| | Sum | 5,98 | 100.0 | 5,10 | 100.0 |

*Notes:* The average wage differentials are taken from the average wages presented in Table 4.1. In 1980, for only piece-rate workers the average hourly wage was 20,53; for only time-rate workers 18,02; for mixed-rate workers 20,96 on the piece-rate component and 17,89 on the time-rate component. Comparing Piece-rate to Time-rate workers, the average wage differential is 2,51 or Piece-rate workers on average earn 13.9% more than Time-rate workers do. According to Table 6.2 column 2, for model 1, FIM 0,29 of this difference is due to risk compensation, that is, 11.6% of the wage differential of 2,51. The rest is compensation for effort. The average risk-sharing compensation is taken from Table 6.2, line 2. The part of the wage differential not due to risk-sharing compensation is due to compensation for effort or productivity. Thus the average effort compensation is the average wage differential minus the average risk compensation. The average wage differential between Piece-rate and Time-rate workers is 2,51 (20,53 – 18,02),. Similarly, the average wage differential between the piece- and time-rate components for Mixed-rate workers is 3,07 (20,96 – 17,89).

[22] A "piece-rate guarantee" guarantees the piece-rate worker a pay that is at least 20% higher than the corresponding pay earned at a time-rate, irrespective of how badly the piece-rate worker is performing.

# 7. CONCLUSIONS

We first reported the use of output-related pay systems such as piece rates and how it has changed between the three studied years 1980, 1990 and 1996, in Finland. Most blue-collar workers who are paid on some output-related pay system, are either on piece-rate or on an alternating time-rate and piece-rate pay system. Piece-rate work was more frequent in 1996 than in 1990 and 1980, while mixed-pay work was less common in 1996 than in either of the other years studied. Workers on output-related pay systems have switched from mixed-rate to piece-rate systems. The frequency of time-rate work has changed only marginally over the period investigated.

Second, we have shown that there is a substantial average payoff from working on a piece-rate system. The workers who are on only piece-rate pay earn on average about 14 percent more per hour than those on only time-rate pay, when working in the same occupation–establishment unit. The pay advantage to workers on mixed-rate systems is not as pronounced, 9.4 percent, even though the piece-rate component of the mixed-pay system is substantially higher (21 percent) than the pay for time-rate workers at the same occupation–establishment level.

Third, we have shown that there is risk in pay associated with working on piece rates. A non-negligible percentage of the piece-rate workers earn less than the time-rate workers in the same occupation–establishment unit. In a related finding, we documented that there is some risk compensation for working on piece rates. The higher the risk of pay at the occupation–establishment level, the higher is the average pay at that level.

Fourth, and finally, we showed that the pay differential between time- and piece-rate workers mostly consists of compensation for extra effort, and a smaller part consists of compensation for risk. Of the 11.8 percent pay differential per hour between piece-rate and time-rate in 1996, about 86 percent or FIM 5,16 is compensation for extra effort, whereas only some 14 percent or FIM 0,82 is compensation for risk. The two years 1980 and 1996 are similar with respect to risk compensation; in 1990 risk compensation was significantly higher, or 35 percent.

The last result makes sense. There would, at least from the employer's point-of-view, be little point in using an output-related payment system if it primarily allocated risks to the workers and only secondarily increased output. With no or little increase in output, there would be little point in paying the workers the risk compensation associated with working on piece rates. It would increase the average paycheck, increase variation in pay among workers, but it would not lead to an increase in output. The only observable change would be in profits, which would go down. The employer would be worse off and the workers would not be better off.

Our first finding was that there was a rather stable distribution of pay systems, as categorized here, over time in Finland. Even though mixed pay has decreased and piece rate increased, still some 50 percent are on time-rate work. In other words, the main shift in the use of pay schemes among blue-collar workers in manufacturing jobs has not been between time- and piece-rate systems but within piece-rate systems, which in turn reflects changes both in the content and organization of work.

Our second finding was that there is a substantial payoff in terms of average wages to working on piece rates. Given this substantial pay advantage, it is perhaps surprising that there has been no notable increase in the use of such a system. We will not speculate at

length on the causes. Nevertheless, one explanation might be that a further expansion of piece-rate pay is not feasible simply because the jobs now paid on time rates do not allow productivity to be measured in a meaningful way. Another observation that may be argued to cast some light on the observed development is the increased use of profit-sharing schemes in private-sector businesses in Finland. Possibly they have crowded out other types of continuous output-related pay systems. And in conjunction with organizational changes such as multi-tasking, which make piece-rate schemes complicated and more costly, the profit-sharing schemes may be more practical. On the other hand, we do not know if profit-sharing schemes are equally instrumental in enhancing productivity.

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