Profit sharing and firm profitability

The differential impact of underlying firm profitability on the wage-profit elasticity

Matthias Strifler
School of Business and Economics, University of Jyväskylä, Jyväskylä, Finland

Received 28 February 2018
Revised 12 June 2018
19 July 2018
23 September 2018
Accepted 24 September 2018

Abstract

Purpose – This purpose of this paper to examine how profit sharing depends on the underlying profitability of firms. More precisely, motivated by theoretical research on fair wages and unionized labor markets, profit sharing is estimated for six different profitability categories: positive, increasing, positive and increasing, negative, decreasing and negative or decreasing.

Design/methodology/approach – The paper exploits a high-quality linked employer–employee data set covering the universe of Finnish workers and firms. Endogeneity of profitability and self-selection of firms in different profitability categories are accounted for by an instrumental variables approach. The panel-structure of the data is used to control for unobserved heterogeneity (spell and individual fixed effects).

Findings – Profits are shared if firms are profitable or become more profitable. The wage-profit elasticity varies between 0.03 and 0.13 in such firms. However, profits are not shared if firms make losses or become less profitable. There is no downward wage adjustment.

Research limitations/implications – Because of the instrumental variables approach the question of external validity arises. Further empirical research on profit sharing with an explicit focus on firm profitability is warranted. The results of the paper indicate a connection between rent sharing and wage rigidity, as suggested by union and fair wage theory.

Originality/value – This is the first paper to consistently estimate the extent of profit sharing depending on the underlying profitability of firms.

Keywords Profitability, Endogeneity, Wages, Instrumental variables, Profit sharing, Wage rigidity

Paper type Research paper

1. Introduction

A large body of literature quantifies the effect of firm profitability on wages. Evidence of that association has been found using industry-level data (e.g. Dickens and Katz, 1987; Blanchflower *et al.*, 1996), firm-level data (van Reenen, 1996; Hildreth and Oswald, 1997; Long and Fang, 2012; Egger *et al.*, 2013) and, to a lesser but growing extent, linked employer–employee data (Kramarz, 2003; Guertzgen, 2009; Rusinek and Rycx, 2013; Card *et al.*, 2014)[1].

The vast majority of these studies estimate profit sharing irrespective of the firms' underlying profitability. Thus, the documented effect of firm profitability on wages is the average effect of the firms exhibiting profitability; that is positive and increasing profitability, on the one hand, and decreasing or even negative profitability, on the other hand. The main finding of this literature is that profit sharing increases wages; more precisely, studies using linked microdata show the wage-profit elasticities to range from 0 to 0.06 (for a short overview,

JEL Classification — J31, L25, M52, E24, C23, C26

The author is grateful to Ari Hyytinen, Jaakko Pehkonen, Pekka Ilmakunnas, Jari Vainiomäki, Juuso Vanhala, Takao Kato and two anonymous referees for their valuable comments and suggestions. The author also thank the participants at the EEA Annual Congress 2016, the VfS Annual Congress 2016, the Annual Meeting of the Finnish Economic Association 2016, the Summer Seminar of Finnish Economists 2016 and the Allecon Seminar 2016 for helpful comments.

Journal of Participation and Employee Ownership
Vol. 1 No. 2/3, 2018
pp. 191-220

2514-7641
DOI 10.1108/JPEO-02-2018-0007

see Card *et al.*, 2014). There is, however, little knowledge on the extent to which the profit sharing of firms varies with their underlying profitability; for instance, the extent of the wage-profit elasticity of firms making positive profits or increasing profits, or, on the opposite side, whether negative profits are also shared, which implies downward wage adjustments.

This is particularly interesting given the theoretical research on fair wages and unionized labor markets which suggests that profit sharing varies with underlying profitability in a systematic way (Danthine and Kurmann, 2007, 2010; Strifler and Beissinger, 2016; Strifler, 2018). Positive and increasing profits should reflect in wage increases whereas negative and decreasing profits should leave wages unaffected. As profits increase, workers feel entitled to a fair share of the increase in profits and push for participation (Kahneman *et al.*, 1986). However, as profits decrease, firms refrain from (downward) wage adjustments knowing their detrimental effect on worker motivation and effort.

There are several reasons for this gap in the empirical literature. First, the major obstacle to estimating the causal effect of firm profitability on wages is the endogeneity of firm profits. Only a small number of studies have been able to address this problem (e.g. see Abowd and Lemieux, 1993; Estevao and Tevlin, 2003; Card *et al.*, 2014). Second, the endogeneity problem appears far more complex when estimating the average profit sharing as well as the extent to which profit sharing varies with the underlying firm profitability.

To the best of my knowledge, only Martins (2009) and Arai and Heyman (2009) have estimated the effect of profitability on wages separately for firms with increasing and decreasing profits. While both papers belong to the above-mentioned group of studies addressing profit endogeneity, the authors face another unresolved endogeneity problem because they divide the data into subsamples based on the endogenous regressor (Heckman, 1979). The endogeneity in the increasing and decreasing profitability categories is accounted for, but the fact that the firm's own decisions influence and potentially decide the category in which it ends up in the first place is neglected.

The contribution of this paper is straightforward. This is the first paper to consistently estimate the extent to which profit sharing varies with the underlying firm profitability. More precisely, based on theoretical research, profit sharing is estimated for six different profitability categories: positive, increasing, positive and increasing, negative, decreasing, and negative or decreasing. Two sources of endogeneity are accounted for: per-worker profits within, and per-worker profits between, the categories of profitability. This allows for determining not only the extent of profit sharing in firms with, for example, high profitability, but also whether the firms are able to share, for example, negative profits. Four instruments based on exchange rates and oil price are used to instrument three endogenous regressors. This also allows for testing the overidentifying restrictions and therefore the validity of instruments. Fixed effects methods are used to control for worker- and firm-level unobserved heterogeneity.

Using a comprehensive linked employer–employee data set covering all private sector workers and firms in the Finnish labor market from 2000 to 2012, this paper finds economically significant profit sharing in firms that are profitable or show increasing profits. In such firms, the mean wage-profitability elasticities range from 0.03 to 0.13. However, if firms are not profitable (i.e. make losses) or show decreasing profits, no profit sharing occurs. In fact, the results indicate no downward wage adjustment.

In the light of theoretical evidence on the fair wage theory and internal references, the results suggest that workers focus on the per-worker profits as reference in good times (increasing profitability) and resist wage cuts in bad times (decreasing profitability).

The paper is structured as follows. Section 2 provides background information as to why Finland is an ideal economy to study profit sharing, as well as a short theoretical motivation. Section 3 presents the data used, discusses the empirical strategy, and provides a solution to the endogeneity problem. Section 4 presents the results, while robustness checks are conducted in Section 5. Section 6 concludes the paper.

2. Background and theoretical motivation

2.1 Background

Finland is an interesting economy to study profit sharing mainly for two reasons. First, profit sharing is a common feature in the Finnish labor market. Second, the quality of register data is outstanding, having precise measures of several key variables.

Profit sharing can be formal or informal. Formal profit sharing refers to explicit pay schemes where at least a part of employee remuneration is tied to company performance. Generally this includes profit sharing plans (cash plans), employee stock ownership plans (deferred plans) and team incentive plans (Kato, 2016; Kruse, 1993; Jones and Kato, 1995; Hamilton *et al.*, 2003). According to the Fifth European Working Conditions Survey in 2010, about 23.6 percent of Finnish workers were covered by such an explicit profit sharing scheme, against the EU average of 12.5 percent (Eurofound, 2012). This makes Finland the top user of profit sharing schemes in the EU, followed by France and Sweden. Several large economies such as the UK and Germany exhibit a slightly lower use of explicit profit sharing than the EU average[2].

Besides explicit profit sharing, further types of pay-augmenting schemes such as incentive- and performance-related pay are common in Finland and have become increasingly popular (Kato and Kauhanen, 2018; Jones *et al.*, 2017; Piekkola, 2005; Kauhanen and Piekkola, 2006). According to Kauhanen and Napari (2012) there is substantial variation in how performance is measured in such pay schemes. Typical performance measures focus on profitability but also productivity, quality and (personal) development goals. Measurement takes place at various levels, ranging from the company level to the individual worker. Furthermore incentive pay is often determined on the basis of a combination of performance measures (Kauhanen and Napari, 2012). As such, specific performance-related pay schemes can be seen as formal profit sharing while others are more informal.

Finally, profit sharing occurs also through bonus payments, pay increases (through collective bargaining), and other channels which do not require an explicit mechanism. This is also referred to as informal, respectively implicit profit sharing (Kato, 2016).

As the main focus of the paper is on the effect of underlying firm profitability on employees' pay, a broad understanding of profit sharing is adopted. Thus we consider not only explicit but also implicit profit sharing[3].

The substantial variation in profitability of Finnish firms makes the study of profit sharing in different profitability situations particularly interesting. During the period 2000–2012, Finland experienced expansionary periods as well as recessions, especially after the financial crisis, and several structural shocks (Statistics Finland, 2017). Table I provides an overview of the entire Finnish private sector firm profitability measured by per-employee operating profits.

	(1) All data	(2) Positive	(3) Negative	(4) Negative decreasing	(5) Decreasing	(6) Increasing	(7) Positive increasing
Share of firms in %	100	85.6	14.3	9.7	45.3	44.3	41.0
π/n	0.234	0.319	−0.274	−0.269	0.135	0.338	0.385

Notes: The columns describe the per-worker operating profits. The first column contains all data; the second, only positive profits; the third, only negative profits; and so on. The data are based on firm-year observations. The change in per-worker profit is calculated on a year-to-year basis. Thus there is, e.g., no information on whether profits increase or decrease in the year 2000. π/n is the per-worker operating profit divided by 100,000. Operating profits are defined as the operating margin minus other operating income. See the data section and Appendix 1 for more detailed descriptions

Table I.
Per-worker operating profit by category

The first row shows how firms are distributed over different profitability categories. Over the entire time span of the data, roughly 14 percent of all firms witness negative profits, while a large majority of firms realize positive profits (over 85 percent). Decreasing per-worker profits are approximately as common as increasing profits[4]. A total of almost 10 percent of firms are subject to both negative and decreasing profitability, while almost all firms with increasing per-worker profits also realize positive profits (93 percent). For all these categories, the second row of Table I reports a substantial variation in per-worker profits. The profitability in 100,000 euros varies from −0.274 in firms with negative profits to 0.385 in firms with positive and increasing per-worker profits. Firms with increasing profitability are over 2.5 times more profitable than those struggling with decreasing profitability. From this simple observation of data, the following two questions naturally arise: What is the extent of profit sharing that varies with the underlying profitability? Does any profit sharing occur if it implies losses for the workers?

2.2 Theoretical motivation

Economic theory suggests six different models explaining profit sharing: friction, risk sharing, human capital and turnover, incentive, bargaining and fairness (Long and Fang, 2012; Martins, 2009). All models predict a positive correlation between firm profitability and wages whereas only the latter two simultaneously imply wage rigidity.

In search theory, frictions in the labor market can lead to a positive wage-profit correlation as high productivity firms offer high wages to reduce search time and save search costs. The frictions alone, however, do not provide a rationale for the absence of wage adjustments in case of negative or decreasing profits (McLaughlin, 1994). In risk sharing models, a part of the fixed wage is substituted by a variable profit sharing component (Weitzman, 1984, 1987; Bellmann and Möller, 2010). Thereby firms are better able to align labor costs with fluctuations in the ability to pay which suggests higher wage flexibility. This type of model family is closely related to the concept of formal profit sharing. According to Kruse (1993, 1996), firms' motivations for (formal) profit sharing are often flexibility and productivity related. Human capital and labor turnover models indicate that firms engage in profit sharing in order to attract and retain highly qualified employees. While this high-road approach to worker relations suggests a positive wage-profit relationship it does not provide a rationale for wage rigidity (Kochan *et al.*, 1993; Azfar and Danninger, 2001; Long and Fang, 2012). The incentive model is related to the human capital and labor turnover argument. However, here the motivation behind profit sharing is not so much based on worker attraction and retention but on the behavioral effects of incentives (Weitzman and Kruse, 1990). Profits are (explicitly) shared in order to encourage productivity-augmenting behavior such as worker cooperation, information sharing and peer monitoring. Similar to above, the incentive model suggests a positive wage-profit relation but has no implication for potential wage rigidity.

Unionization and wage bargaining are among the most often cited reasons for (implicit) profit sharing and are commonly held responsible for generating wage rigidity (Guertzgen, 2009; Rusinek and Rycx, 2013; Böckerman *et al.*, 2007). Unions transfer rents to the worker in times of high profitability and the bargained wage restricts firms to adjust wages downward in bad times (Martins, 2009; Arai and Heyman, 2009; Layard *et al.*, 1991). Finally, fair wage considerations suggest a positive wage-profit correlation as well as wage rigidity (Danthine and Kurmann, 2007, 2010; Koskela and Schöb, 2009). Workers feel entitled to a fair share of the firm's profit but resist wage cuts in times of low or declining profitability (Kahneman *et al.*, 1986; Clark and Oswald, 1996; Bewley, 1999; Agell and Bennmarker, 2003, 2007; Brown *et al.*, 2008).

The focus of this paper is on profit sharing under different profitability situations. Therefore, the latter two model families, wage bargaining and fair wages, are particularly interesting because they suggest a connection between profit sharing and wage rigidity. Along the profitability categories presented in Table I, the theoretical considerations just discussed allow to deduct the following. As the profits increase over time, a positive effect on wages can be expected because employees try to obtain their fair share of profits. However, as the profits decrease, one might expect no effect (or even a negative effect) since employees try to resist wage cuts. In the same spirit, the categories of positive and negative profits are used. Firms' profits turn negative (or positive) only temporarily, that is, for one period. Nevertheless, this might induce management to try to adjust wage costs. If the fair wage theory holds, one can expect no effect or a smaller effect on wages in case of negative profits. The following categories are used to determine profit sharing and wage rigidity at the outer ends: positive and increasing profits and negative and decreasing profits. The difference between these two categories should be larger than between any other.

This paper follows Egger *et al.* (2013) and Strifler and Beissinger (2016), who consider firm profitability, that is, per-worker profits, central to employee wage considerations. The fairness of a wage offer is judged by firms' profitability. The stylized wage equation can be written as:

$$w = \pi/n + \omega. \tag{1}$$

An increase in per-worker profits π/n is reflected in wages w. However, the opposite does not necessarily hold: as π decreases, firms rely on layoffs, leading to a simultaneous decrease in n, ultimately leaving wages unchanged. ω includes the basic wage-setting model variables, such as earning opportunities outside the firm, employment rate and unemployment benefits.

3. Data and empirical strategy

3.1 Data description

The data used in this study cover all the private sector employees and firms in Finland from 2000 to 2012. The employee information used is gathered mainly from the employment register and a wage structure survey. Firm information comes from the business register and balance sheet panel. All microdata are from Statistics Finland. Employees are linked to their employer through a unique firm identifier. With few exceptions, almost all data are register data. For the construction of instruments, the Finnish Customs trade data are linked to firm data. The data on bilateral exchange rates are from the ECB Statistical Data Warehouse, and the data on oil prices are from (www.investing.com).

Only full-time employees working for more than 35 hours per week are considered for analysis[5]. The lowest and highest percentile of wage and profit distribution are excluded. Similarly, firms with less than two employees are excluded. This leaves a total of over 1m employees from almost 20,000 firms. In total, the study considers 1.5 munique worker-firm combinations or spells and over 5m observations. The high quality of data enables the precise measure of worker and firm characteristics. The employment history of individuals can be traced back to 1970, thus providing detailed information on the work experience of most of the population. The local unemployment for 70 different regions is calculated and linked to the workers' place of residence. The study uses the detailed firm equity and assets data and financial figures.

Wage data are from the annual tax as well as wage structure statistics. The latter draw on information from the last quarter of each year. The main wage measure is (log) total earnings per hour based on the total time worked, including multiple pay supplements, fringe benefits, and performance and achievement-based pay components[6]. Several pay components such as overtime pay and shift bonuses are separately available in the data which provides the basis for extensive robustness checks.

The profit measure used for analysis is operating profits. It is calculated as the operating margin minus other operating income. Operating margin is defined as the firm's operating result excluding the financial items, taxes and depreciation[7]. Operating profits are chosen as the profit measure for the following reasons. Since the profit measure is based on the firm's operating margin, it measures the firm's performance at its core activities. In addition, because it forms the basis of potential profit sharing, the employers and employees are likely to have some basic knowledge on the firm's operating profit, for example, whether it is increasing or decreasing. Furthermore, because the financial items, taxes and extraordinary items such as the sale of fixed assets are not included, the operating profits are also a measure to which the workers directly contribute to[8]. Since the regular weekly working hours data have been collected, the number of full-time equivalent employees in each firm is available. Along with the register data, the financial statements panel data enable the precise measure of profits per (full-time) worker.

Finally, the trade data set obtained from Finnish Customs contains detailed information on the origin and destination of imports and exports. Moreover, it reports the details of product types traded based on the Standard International Trade Classification (SITC)[9]. This data set provides the basis for the instruments presented in detail in Section 3.4.

3.2 Basic strategy: subsample fixed effects

The theoretical wage equation from Equation (1) can be re-written as the following empirical specification based on Abowd *et al.* (1999):

$$w_{it} = \pi/n_{j(i,t)t}\gamma + y_{j(i,t)t}\delta + x_{it}\beta + \alpha_i + \phi_j + \varepsilon_{it}. \qquad (2)$$

Workers, indexed by $i = 1, ..., N$, are observed once a year, $t = 1, ..., T$ in firm $j = 1, ..., J$. Function $j(i, t)$ maps worker i to firm j in year t. The dependent variable w_{it} is the log hourly pre-tax wages and the main regressor of interest $\overline{\Pi}_{j(i,t)t}$ is the yearly per-worker operating profit[10]. $y_{j(i,t)t}$ and x_{it} are respectively the time-variant observable firm- and worker-level covariates, and α_i and ϕ_j are the corresponding observable and unobservable time-invariant variables. Because the unobserved characteristics are correlated with the per-worker profits, the data panel structure is exploited to control for the time-invariant individual- and firm-level heterogeneity[11].

Fixed effects models are estimated for different categories of firm profitability, and the results are presented in Section 4.1. Following Martins (2009) and Arai and Heyman (2009), the effect of the per-worker profits on wages is estimated separately for firms with increasing and decreasing profits[12]. Furthermore the analysis is extended to the categories of positive, negative, positive and increasing and negative and decreasing profitability. Based on the theoretical considerations and the substantial variation in firm profitability as shown in Table I significant differences in profit sharing between the respective categories is expected[13].

This basic strategy leaves two major obstacles unaddressed: the endogeneity of firm profitability, and the construction of subsamples based on the endogenous regressor. In other words, the endogeneity of per-worker profits within and between the different profitability categories is neglected.

3.3 Augmented strategy: interaction instrumental variable fixed effects

Endogeneity of firm profitability leads to biased estimations of profit sharing. The accounting relationship between wages and profits can lead to underestimation of the effect. The literature shows two typical ways to approach this problem: quasi-rents or value added are calculated and used in the estimation (see Abowd and Lemieux, 1993; van Reenen, 1996; and, more recently, Guertzgen, 2009), and, when possible, the profits are instrumented (see Abowd and Lemieux, 1993; Blanchflower *et al.*, 1996; Estevao and Tevlin, 2003; and, more recently, Martins, 2009; Arai and Heyman, 2009; Rusinek and Rycx, 2013; Card *et al.*, 2014).

From the specification of Equation (2), the instrumentation of the per-worker profits allows for consistent estimation of profit sharing independent of the underlying firm profitability. However, what is much more challenging is to obtain consistent results separately for firms in different profitability categories. In the literature of instrumenting profits, only Martins (2009) and Arai and Heyman (2009) focus on firms with increasing as well as decreasing profitability through sample splitting[14]. Thus, the authors can account for the endogeneity of firm profits in each category, but fall short of accounting for the between-category endogeneity. It is likely that firms select themselves into the different profit categories – this depends on the market and also on the firm's decisions whether profits are positive or negative, respectively increasing or decreasing. In other words, it is very problematic to split the data into subsamples based on the endogenous regressor and expect to account for profit endogeneity in its entirety (Heckman, 1979).

The solution to the problem of sample selection (between-category endogeneity) lies in the slight change of specification from Equation (2). Instead of splitting the data by (endogenous) profit category, the interaction of the per-worker profits with a dummy, indicating the respective profit category, is added to Equation (2):

$$w_{itk} = \pi/n_{j(i,t)t}\gamma_{1,k} + \pi/n_{j(i,t)t}\cdot D_k^*\gamma_{2,k} + D_k^*\gamma_{3,k} + y_{j(i,t)t}\delta + x_{it}\beta + \alpha_i + \phi_j + \varepsilon_{it}. \quad (3)$$

D_k^* with $k = 1, 2, 3$ is a dummy for the following profit categories:

(1) $D_1^* = 1$ if $\pi/n_t < 0$, and $D_1^* = 0$ if not;

(2) $D_2^* = 1$ if $\pi/n_t - \pi/n_{t-1} < 0$, and $D_2^* = 0$ if not; and

(3) $D_3^* = 1$ if $\pi/n_t - \pi/n_{t-1} < 0$ or $\pi/n_t < 0$, and $D_3^* = 0$ if not.

D_1^* equals unity if the per-worker profits are negative, D_2^* equals unity if the per-worker profits are decreasing, and finally D_3^* equals unity if the per-worker profits are negative or decreasing. As for the main regressors of interest, for instance, $\gamma_{1,\,1}$ represents the effect of per-worker profits on wages for firms with positive profits and $\gamma_{1,\,1}+\gamma_{2,\,1}$ denotes the effect for firms with negative profits (also see Table II)[15]. In addition to the interaction term, the dummy itself is added to the specification. This allows for the wage equation to have a different intercept in the respective profitability categories.

Similar to the basic strategy this augmented strategy builds on the theoretical rationale of union and fair wage theory. As pointed out in Section 2.2, theoretical research indicates that profit sharing varies with the underlying profitability in a systematic way: positive and increasing profitability reflect in wage increases whereas negative and decreasing profitability leave wages unaffected. The functional form of the augmented strategy allows for the consistent estimation of profit sharing in fortunate times as well as the potential wage rigidity in unfortunate times. However, in contrast to Equation (2), the major challenge is the number of endogenous variables; it is not one, but three.

k	1	2	3
γ_1	Positive	Increasing	Positive and increasing
$\gamma_1+\gamma_2$	Negative	Decreasing	Negative or decreasing

Table II. Interpretation of coefficients

3.4 Instruments

Finland is a small open economy at the periphery of the EU and the Eurozone. Based on exchange rates and the world oil price the following four instruments enable the IV estimation of Equation (3).

In the spirit of Hashmi (2013), the standardized trade-weighted exchange rates for import and export are determined at the firm level, and not at the industry level. The trade weights are calculated from the base year 2000 (first year in the data) with the trade of 26 countries outside the Eurozone[16]. For the first instrument the trade weights are defined as country specific imports as share of outside Eurozone imports calculated from the CIF-value (cost-insurance-freight) before taxation. For the second instrument the trade weights are defined as country specific exports as share of outside Eurozone exports based on the FOB-value (free-on-board) before taxation. The country specific trade weights are interacted with the respective bilateral exchange rate, obtained from the Statistical Data Warehouse of the ECB[17]. Ultimately, standardization takes place through the division of average over time. The first instrument is thus given by:

$$\text{Instrument}_{jt}^{1} = \frac{\sum_{n=1}^{N=26} \text{Import share}_{\text{firm } j,\text{country } n,t=1} \times \left(\text{Currency country } n/\text{EUR}\right)_t}{\sum_{t=1}^{T=13} \sum_{n=1}^{N=26} \text{Import share}_{\text{firm } j,\text{country } n,t=1} \times \left(\text{Currency country } n/\text{EUR}\right)_t / T = 13}. \quad (4)$$

Similarly, the second instrument is given by replacing the import shares with the export shares in Equation (4). As the trade shares in both instruments are taken from the base year 2000 ($t = 1$), the instruments grow weaker from year to year as the actual trade shares change over time. The trade shares differ on the import and export sides, which enables the construction of two instruments from the bilateral exchange rates.

Changes in the exchange rate exogenously impact the cost (through imports) and earnings (through exports) sides and ultimately the profitability of the firm. The instruments should have no other impact on wages since the only variation over time comes from changes in the macro-level bilateral exchange rates of the Euro against 26 other currencies[18].

The third and fourth instruments are built by combining the instruments used by Martins (2009) and Blanchflower *et al.* (1996). Martins (2009) uses Escudo's nominal effective exchange rate interacted with the share of exports in total sales[19]. Blanchflower *et al.* (1996) use the industry-level energy costs and rely especially on oil price fluctuations. Because the detailed trade data used for the construction of the first two instruments also contain information on the type of products traded, the oil import and export shares are calculated. More precisely, the average share of oil imports outside the EU in the total costs and the average share of oil exports outside the EU in the total revenue are determined at the firm level and interacted with the standardized world oil price.

Oil trade refers to products in division 33 of the SITC, which includes petroleum, petroleum products and related materials. The share of oil imports in the total costs, as well as the share of oil exports in the revenue, is averaged over time, leading to an increase in observations, but this ensures that the only time variation of the instrument comes from changes in the oil price. Oil price refers to the yearly crude oil futures of the West Texas Intermediate type traded at the NYMEX (OTC)[20]. Focus on outside EU trade lowers the number of observations but increases the quality of instruments. Similarly to the first two instruments, oil price is standardized by dividing it by its own average. The third instrument is thus given by:

$$\text{Instrument}_{jt}^{3} = \frac{\sum_{t=1}^{T=13} \text{Share of oil imports among costs}_{\text{firm } j,t}}{T = 13} \times \frac{\text{Oil price}_t}{\sum_{t=1}^{T=13} \text{Oil price}_t / T = 13}. \quad (5)$$

Replacing the cost share of oil imports by the revenue share of oil exports in Equation (5) yields the fourth instrument. Average oil imports (costs) and exports (revenue) differ, which enables the construction of two instruments from the oil price.

Similarly to above, instruments 3 and 4 rely on fluctuations of an (exogenous) aggregate variable. Changes in the oil price exogenously impact the cost (through imports) and earnings (through exports) sides of the firm, and thus its profitability. Again, the instruments should have no other impact on wages, because the only variation over time comes from changes in the world oil price[21], [22].

4. Results

4.1 Basic strategy: subsample fixed effects

This section reports the results on profit sharing based on fixed effects estimations. The specification in Equation (2) follows the majority of the rent sharing literature based on linked data; for e.g. see Martins (2009) or Card *et al.* (2014). Detailed time-variant worker and firm characteristics are used as control variables:

$$\begin{aligned} w_{it} = {} & \pi/n_{j(i,t)t}\gamma + \text{Experience}_{it}\omega + \text{Experience}^2_{it}\psi + \text{Education}_{it}\chi \\ & + \text{White collar}_{it}\,\phi + \text{ Log unemployment}_{it}\,\upsilon + \text{Lag log total assets}_{j(i,t)t}\tau \\ & + \text{Lag equity ratio}_{j(i,t)t}\sigma + \text{Lag debt equity ratio}_{j(i,t)t}\rho \\ & + \text{Lag relative indebtedness}_{j(i,t)t}\xi + \varepsilon_{it}. \end{aligned} \tag{6}$$

The most notable differences from the literature are the following: first, tenure is not included in the specification because of the high quality of work history data. The data of number of months worked per year are available from 1975 onwards, implying that in the spell estimation, experience and tenure are (almost) perfectly correlated. Second, instead of log number of workers, the log total assets is used as measure of firm size[23]. The reason for this is that the number of workers is already considered for the main regressor of interest, firm profitability. Third, more firm controls than typical in the literature are used since access to the financial statements panel allows for controlling the important capital and financial figures that are likely to affect wages. Especially, the equity ratio, which also works as a time-variant proxy for the capital intensity of firms, controls for assortative matching. A certain level of exogeneity can be obtained by using the first lag of these variables. Finally, note that the local unemployment rate is measured for over 70 different regions in Finland, matching the workers' respective places of residence. This not only represents high-quality regional control, but also captures the business cycle effect on wages lagged by one to two periods (Blanchflower and Oswald, 1996).

The set of control variables remains unchanged when estimated by the basic as well as the augmented strategy in Section 4.2. Results from basic individual and firm fixed effects are shown in Appendix 2 and results from subsample IV fixed effects in Appendix 4. In order to directly control for both time-invariant individual- and firm-level heterogeneity, results from spell fixed effects are reported in Table III. This accounts for unobserved worker differences as well as the potentially systematic sorting of workers across firms. Robust standard errors clustered at the firm level are calculated.

We find clear evidence on profit sharing in firms with positive, increasing, and positive and increasing profits; see columns 2, 6 and 7. The coefficient is largest in the latter category. Wages increase by 1.6 percent if the per-worker profits increase by 100,000 euros. This is intuitive as the most profitable firms are part of that category. The mean wage-profitability elasticity in these categories ranges from 0.004 to 0.006[24].

Negative and insignificant results in columns 3 and 4 suggest that no downward adjustment of wages takes place in case firms realize negative profits. This indicates that wages do not

Table III.
Effect of profits on wages: results from spell fixed effects estimation

	(1) All data	(2) Positive	(3) Negative	(4) Negative decreasing	(5) Decreasing	(6) Increasing	(7) Positive increasing
π/n	0.01*** (0.002)	0.011*** (0.002)	−0.015 (0.013)	−0.021 (0.019)	0.012*** (0.004)	0.014*** (0.003)	0.016*** (0.003)
n	4,758,840	4,141,291	616,862	454,990	2,433,800	2,324,975	2,162,600
R^2	0.591	0.594	0.499	0.521	0.605	0.615	0.615
Mean π/n	0.254	0.318	−0.176	−0.168	0.185	0.326	0.366
Elasticity	0.003	0.004	0.003	0.004	0.002	0.005	0.006

Notes: The columns give the per-worker operating profits. The first column contains all data; the second, only positive profits; the third, only negative profits; and so on. Worker controls are experience and its squared, level of education, and a white-collar dummy. The firm controls are the first lag of log total assets as measure of firm size, equity ratio, debt equity ratio, and relative indebtedness. Regional control is the log local unemployment rate. The dependent variable is the log hourly wage. π/n is the per-worker operating profit divided by 100,000. Robust standard errors clustered at the firm level are in parentheses. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

move with profits if it leads to wage cuts; this implies wage rigidity. In column 5, firms with decreasing profits show a positive (and significant) effect, although it is smaller than in firms with increasing profits. The respective mean elasticity (0.002) is less than half the size of the elasticity in firms with increasing profitability. Thus, downward wage adjustments appear to be more sluggish than upward adjustments. As shown in Table AII, results from individual and firm fixed effects are similar. In fact, firm fixed effects estimation leads to a negative and significant coefficient for firms with decreasing profits per worker. This indicates, even more so than the above results, that deterioration of profitability does not lead to wage cuts.

To conclude, the results on profit sharing are robust to model estimations using different fixed effects methods. Thus, profit sharing cannot be explained by individual- or firm-level heterogeneity and might be a typical feature of the Finnish labor market. Evidence on wage rigidity is somewhat more mixed[25]. However, when the profit category is considered, there is no downward adjustment at all, or the adjustment is smaller than upward adjustments. Since the endogeneity of firm profitability (within- and between-category endogeneity) is not accounted for, the results need to be interpreted with caution. The accounting relationship between wages and profits suggests that profit sharing is underestimated, especially in firms with good profitability.

4.2 Augmented strategy: interaction IV fixed effects

This section examines the profit sharing based on IV fixed effects estimation of the interaction specification presented in Section 3.3. Profit endogeneity is entirely accounted for. The estimation is based on the set of control variables depicted in Equation (6): experience and its squared, level of education, and a white-collar dummy are worker controls. The first lag of log total assets, equity ratio, debt equity ratio and relative indebtedness are firm controls. Regional control is the log local unemployment rate.

Estimation of Equation (3) by IV spell fixed effects represents the most preferred identification strategy. It controls for the endogeneity of profits within and between the profit categories, the time-invariant individual- and firm-level heterogeneity as well as the time-variant worker and firm characteristics used as controls. Moreover, this allows for the calculation of robust standard errors clustered at the firm level[26]. The results for the first stage are presented in columns 1–3 in Table AVIII, Appendix 6.

Following Bound *et al.* (1995), the table reports the partial R^2 and the Sanderson–Windmeijer F-statistic (SWF) for each endogenous regressor separately. Because there is more than one instrumented variable, the standard first-stage F-statistic is not sufficient. For the SWF tests for under- and weak identification of each endogenous regressor individually, see Sanderson and Windmeijer (2016). In Table AVIII, both measures indicate high instrument quality. The partial

R^2 measures the variation in the endogenous regressor explained by the instruments. It varies between 0.04 and 0.23, which is quite substantial. Following Staiger and Stock (1997) and Cameron and Trivedi (2005), who suggest a threshold value of 10 for the F-statistic to indicate a weak instrument, no such problem occurs when the SWF varies between 11.23 and 768.9. Significant results for the profit category dummy indicate considerable endogeneity between the different categories of profitability (self-selection). This confirms the preference of the augmented strategy of Equation (3) over the mere IV estimation of Equation (2) for different subsamples. In comparison to the first stage results of the individual fixed effect estimation (see columns 4–6 in Table AVIII), clustering the standard errors at the firm level leads to substantially larger standard errors. This renders several coefficients insignificant.

Table IV presents the second-stage results. More precisely, it contains the estimates for firms with positive and negative profits, firms with increasing and decreasing profits and firms with positive and increasing and negative or decreasing profits, respectively. The coefficient in the first row (i.e. γ_1 from Equation (3)) indicates statistically significant profit sharing for firms with positive, increasing, and positive and increasing profits. A rise in per-worker profits by 100,000 leads to an increase in hourly wages by between 13.8 and 18.2 percent. This amounts to an almost 9- to 15-fold increase in estimates compared to Table III. The respective mean wage-profitability elasticities (of γ_1) reported in the table range from 0.06 to 0.08, indicating an increase by a factor of 10 to almost 20[27]. First, the wages and profits accounting relationship leads to a severe underestimation of profit sharing, and, second, the profitability of a firm is decisive for the extent of profit sharing.

The increase in profit sharing due to instrumentation is at the upper end of what is typically found in the literature that either falls short of controlling for the self-selection of firms (between-category endogeneity) or estimates the mean profit sharing effect over all the profitability categories. For instance, Card *et al.* (2014) find a modest 1.5-fold increase due to instrumentation, van Reenen (1996) report a doubling of the effect and Arai and Heyman (2009) report a 10-fold increase. It nevertheless has to be taken into account that, e.g., Card *et al.* (2014) use value added per worker as profitability measure while Arai and Heyman (2009) focus directly on per-worker profits. The estimated elasticities in the

	(1)	(2)	(3)
π/n	0.161** (0.073)	0.182** (0.08)	0.138*** (0.053)
$\pi/n \times D_1^*$	−0.454** (0.177)		
D_1^*	0.033 (0.05)		
$\pi/n \times D_2^*$		−0.162** (0.071)	
D_2^*		0.158*** (0.059)	
$\pi/n \times D_3^*$			−0.128*** (0.049)
D_3^*			0.142*** (0.043)
N	234,297	234,297	234,297
R^2	0.552	0.476	0.502
Hansen's J $\chi^2(1)$	0.723	1.120	1.443
$\chi^2(1)$ p-value	0.395	0.290	0.230
Mean π/n	0.428	0.433	0.442
Mean $\pi/n \times D_k^*$	−0.227	0.290	0.282
Elasticity of γ_1	0.069	0.079	0.061
Elasticity of $\gamma_1+\gamma_2$	0.067	0.006	0.003
H_0: $\gamma_1+\gamma_2=0$ $\chi^2(1)$	6.133	0.449	0.158
$\chi^2(1)$ p-value	0.0133	0.503	0.691

Notes: See Table AVIII. The endogenous variable is log hourly wages as defined in Section 3.1 and Appendix 1. π/n measures per-worker profits in 100,000 Euros. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table IV. Effect of profits on wages: interaction IV spell fixed effects – second stage literature with a direct focus on per-worker profits range between 0 and 0.06 placing the above estimates at the upper end (for e.g. see Margolis and Salvanes, 2001 (0.01–0.03); Arai, 2003 (0.01–0.02); see Card *et al.*, 2018 for an overview). Arai and Heyman (2009) and Martins (2009), who estimate the profit sharing of firms with increasing profitability separately, report elasticities ranging from 0.02 to 0.06. Rusinek and Rycx (2013) report an elasticity of 0.02 to 0.11 for firms with positive profits after instrumentation of firm profitability. However, like Arai and Heyman (2009) and Martins (2009), they do not account for self-selection and, moreover, do not control for unobserved worker and firm heterogeneity.

The impact of per-worker profits on wages for firms with negative, decreasing and negative or decreasing profits are given by the sum of rows 1 and 2, rows 1 and 4, and rows 1 and 6 (or $\gamma_1+\gamma_2$), respectively. As the coefficients for all three interaction terms are throughout negative and significant, downward wage adjustment is throughout smaller to non-existent. According to the test statistics of the null hypothesis (H_0: $\gamma_1+\gamma_2=0$) reported in the last two rows of Table IV, the null in columns 2 and 3 cannot be rejected. There is no significant effect of per-worker profits on wages in firms with decreasing, and negative or decreasing profitability. In case of negative profits, the coefficient becomes even negative. The respective mean elasticities are more than ten times smaller compared to the corresponding favorable profitability category. There is clear evidence of missing downward wage adjustments with the per-worker profits.

Since Equation (3) is overidentified – there are three endogenous regressors and four instruments – we can check whether the instruments are uncorrelated with the residuals. Thus, the exogeneity and, hence, the validity of the instruments are tested (Hansen, 1982). The third and fourth rows in the lower half of Table IV contain Hansen's J statistic, which is asymptotically $\chi^2(1)$ distributed because the number of overidentifying restrictions is $4-3=1$, and its respective p-value. Because $p>0.05$ in all three columns, the null hypothesis that the residuals and instruments are uncorrelated is not rejected, and we can conclude that the overidentifying restriction is valid.

Although the set of instruments presented above allows for the consistent estimation of Equation (3) and captures the endogeneity of profits entirely, it raises the question of external validity. The number of firms in Finland engaged in oil trade (SITC division 33) is indeed limited, leading to a substantial drop in observations. Therefore, and for the sake of comparability with Arai and Heyman (2009) and Martins (2009), the IV fixed effects estimation results of the split subsamples are reported in 7.4, although this leaves self-selection unaddressed. Moreover, 7.5 elaborates more on external validity: a comparison of the pooled OLS estimates based on the whole sample and the one used above in the interaction IV estimations suggests sufficient reason to expect the results to hold beyond oil trading companies.

5. Robustness

In order to test the robustness of the results, the most preferred identification strategy (interaction IV spell fixed effects; Table IV) is modified in several ways. Special attention is given to the measure of pay and firm size. Although the hourly wages considered above represent a measure of pay that is already independent of the amount of time worked, specific data on overtime pay and shift surcharges are used. Firms subject to an increase in demand for their products are likely to adjust labor on the intensive margin first, that is increase overtime, instead of hiring new employees. The latter involves potentially expensive hiring costs, as well as firing costs if the demand drops again. Because of surcharges on overtime work and extra shifts, the hourly wage of employees will necessarily increase. Obviously, the surge in demand will simultaneously lead to an increase in profits, and ultimately to the correlation between the per-worker profits and wages. In general, firms might engage in profit sharing through different types of bonus payments and extra pay, which may affect the respective wage measures differently. This warrants robustness checks with regard to the different measures of the dependent variable.

The wage measures available in the data for this are the monthly wages minus overtime pay, and monthly wages minus night, weekend and shift surcharges[28]. Similarly, the natural log is used in the estimations, allowing for the coefficients to be read as semi-elasticities. The first-stage results of all the robustness checks are reported in Tables AIX and AX in Appendix 6; since they are similar to Table AIX, they are not discussed separately. Table V reports the second-stage results of the IV spell fixed effects estimations of Equation (3) with log monthly wages minus overtime pay as a dependent variable in columns 1 to 3. As expected, the coefficients are smaller than in Table IV. In fact, only the coefficient in the first column is statistically different from zero at the 10 percent level, indicating profit sharing in firms with positive profits. The standard errors remain roughly similar, indicating that overtime pay is partly responsible for the evidence on profit sharing. As regards downward adjustments of wages, columns 2 and 3 report zero downward wage adjustments, while the coefficient ($\gamma_1+\gamma_2$) in column 1 is even negative and significant, as in the main results.

As further robustness check, columns 4–6 in Table V report the second-stage results of IV spell fixed effects estimations of Equation (3) with the log monthly wages minus shift surcharges as dependent variable. In contrast to the correction for overtime pay, the results are similar to Table IV, and profit sharing is more pronounced in firms with positive, increasing and positive and increasing profits. Evidence on downward wage rigidity is found in all the three columns: the null hypothesis of $\gamma_1+\gamma_2=0$ cannot be rejected. When both robustness checks are taken together, evidence on profit sharing is somewhat mixed. It seems to be partly driven by overtime. The results on wage rigidity, however, remain virtually unchanged.

As a final robustness check, the first lag of log revenue is added as a second proxy for firm size; for e.g. see Martins (2009). Columns 7–9 in Table V report the second-stage results. In all columns, profit sharing is now even more pronounced than in the second robustness check (columns 4–6) and the main results in Table IV. Wages increase by almost 25 percent in firms with increasing per-worker profits, which amounts to a mean wage-profitability elasticity of almost 0.11 (see the seventh row in the lower half of the table). This clearly strengthens the main result of the paper that profit sharing is much stronger if firms can afford it.

Evidence of downward wage rigidity, as denoted by the sum of the coefficient in the first row and the interaction term, remains almost unchanged compared to Section 4.2. Especially, in columns 8 and 9, the mean wage-profitability elasticities are over 10 times smaller and the null hypothesis that there is no effect on wages cannot be rejected. Overall, it can be concluded that the results on profit sharing are quite robust toward different wage measures. The results on downward wage rigidity are very robust. Controlling for firm size also through revenue leads to even stronger results on profit sharing. The profitability situation of the firm determines the extent of profit sharing.

6. Conclusions

Virtually, the entire empirical literature on profit sharing studies the effect of the per-worker profits on wages in the average firm. This means that profit sharing is estimated irrespective of the underlying profitability. Thus, little is known about the extent of profit sharing in the different profitability situations. From a theoretical perspective, market frictions, labor turnover, risk sharing, incentive models, union bargaining and fair wages suggest a positive connection between firm profitability and wages. Profit sharing is much more likely to be pronounced if the firm can afford it, i.e. if profitability is high. In case of losses, however, predictions of the theories diverge. While the first four suggest downward wage adjustments along deteriorating profitability the latter two argue that workers might resist the firms' attempts to share those losses.

The main reason for the little empirical evidence on the wage-profit relationship under different profitability situations is profit endogeneity. While it is already complicated to account for profit endogeneity when estimating the (average) effect of profit sharing, it is

Table V.
Robustness: IV spell FE I – second stage

	Excluding overtime pay			Excluding shift surcharges			Revenue as control		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
π/n	0.128* (0.073)	0.1 (0.073)	0.066 (0.06)	0.17 ** (0.083)	0.187** (0.08)	0.15*** (0.054)	0.215* (0.123)	0.249** (0.115)	0.183*** (0.069)
$\pi/n \times D_1^*$	−0.478*** (0.143)			−0.379* (0.205)			−0.546** (0.271)		
D_1^*	−0.016 (0.054)			0.084 (0.057)			0.054 (0.084)		
$\pi/n \times D_2^*$		−0.095 (0.061)			−0.177*** (0.066)			−0.214** (0.097)	
D_2^*		0.113** (0.048)			0.174*** (0.066)			0.211** (0.092)	
$\pi/n \times D_3^*$			−0.068 (0.055)			−0.148*** (0.045)			−0.162*** (0.057)
D_3^*			0.099** (0.043)			0.161*** (0.053)			0.179*** (0.06)
n	234,359	234,359	234,359	234,332	234,332	234,332	234,297	234,297	234,297
R^2	0.582	0.549	0.559	0.536	0.455	0.478	0.525	0.399	0.456
Hansen's J $\chi^2(1)$	0.967	2.172	2.339	0.198	0.468	0.321	0.466	0.263	0.972
$\chi^2(1)$ p-value	0.325	0.141	0.126	0.656	0.494	0.571	0.495	0.608	0.324
Mean π/n	0.428	0.433	0.442	0.428	0.432	0.442	0.428	0.433	0.442
Mean $\pi/n \times D_k^*$	−0.227	0.291	0.282	−0.227	0.29	0.282	−0.227	0.29	0.282
Elasticity of γ1	0.055	0.043	0.029	0.073	0.081	0.066	0.092	0.108	0.081
Elasticity of γ1+γ2	0.08	0.001	−0.001	0.048	0.003	0.001	0.075	0.01	0.006
H_0: γ1+γ2 = 0 $\chi^2(1)$	17.18	0.0325	0.0103	2.613	0.0688	0.00436	4.070	0.605	0.378
$\chi^2(1)$ p-value	0.0000340	0.857	0.919	0.106	0.793	0.947	0.0436	0.437	0.539

Notes: See Table IV. Columns 1–3: the endogenous variable is the log monthly wages minus overtime pay. Columns 4–6: the endogenous variable is the log monthly wages minus shift surcharges. Columns 7–9: the endogenous variable is the log hourly wage. The first lag of log revenue is added as a second control for firm size. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

much more complex to estimate how the extent of profit sharing varies with the underlying profitability. Firms' decisions co-determine their results, for example, whether profits increase or decrease, and thus make the endogeneity problem twofold: the endogeneity within and between the profitability categories has to be accounted for.

This is the first study to fully resolve that problem. The effect of firms' profitability on wages is consistently estimated for the following profitability categories: positive, increasing, positive and increasing, negative, decreasing and negative or decreasing. A large linked employer–employee data set containing all the private sector employees and firms of the Finnish labor market from 2000 to 2012 is used. International trade data taken from Finnish Customs allow for the construction of several instruments in order to fully account for within- and between-category endogeneity. More precisely, consistent estimation can be achieved through an identification strategy, where three endogenous variables are instrumented by the following four instruments: two firm-level trade-weighted exchange rates – one on imports and the other on exports – and two world oil price interaction variables – one based on the average share of oil imports in total costs and the other based on the average share of oil exports in revenue. SWF are calculated to test for weak instruments and tests of overidentifying restrictions are performed to assess the validity of the instruments.

Study results show a large variation in the extent of profit sharing. Profit sharing strongly depends on the firms' underlying profitability. The mean wage-profitability elasticities range from 0.03 to 0.13, with the midpoint around 0.06–0.08 in firms that are profitable or show increasing profits. This is above the results reported for the average firm in the relevant literature based on linked data. On the contrary, for firms that are not profitable or show decreasing profits, profit sharing is practically non-existent. That is, there is no downward wage adjustment in case of diminishing profitability. These results can be interpreted as empirical evidence for the unionization and fair wage theory model assumptions suggesting a close connection between rent sharing and wage rigidity.

As such, however, they stand opposed to the predictions of labor market frictions, turnover, incentive and risk sharing theories. Workers benefit from good firm profitability but apparently remain unaffected by bad profitability. A potential key ingredient to that result is the broad understanding of profit sharing adopted in the paper which includes formal sharing schemes as well as informal profit sharing. While formal profit sharing schemes are often explicitly motivated by risk sharing and incentive arguments, informal profit sharing is influenced by many more factors as it can even extend to regular pay increases. The findings nevertheless underline the potential importance of underlying firm profitability on profit sharing. Further analysis, especially with an explicit focus on formal profit sharing and the wage-profit elasticity is warranted. As fair wage considerations impact on the degree of wage rigidity and rent sharing primarily through worker motivation and effort, their interaction with explicit profit sharing schemes is an interesting avenue for both, theoretical as well as empirical research.

Notes

1. Some recent papers using linked data relate rent sharing directly to wage dispersion. As such, profit sharing can be seen as a firm-level driver of labor market inequality (see e.g. Barth *et al.*, 2016; Card *et al.*, 2018).

2. For a more detailed overview over explicit profit sharing in Finland (see e.g. Jones *et al.,* 2012; Sweins *et al.*, 2009; Kauhanen and Piekkola, 2006), for a comparison to other European countries (see e.g. Lowitzsch *et al.,* 2014; Poutsma *et al.,* 2006; Pendleton *et al.,* 2002). Pehkonen *et al.* (2017) provide descriptive evidence on wages, firm characteristics and profit sharing scheme adoption in the Finnish labor market.

3. Such a broad understanding is common in the literature quantifying the wage-profit relationship (see e.g. Arai and Heyman, 2009; Martins, 2009; Card *et al.,* 2014). While this broad understanding

is also referred to as rent sharing, the focus in the rent sharing literature is not exclusively on profit but also on output, revenue (sales) or value added (Card *et al.*, 2018).

4. The change in per-worker profit is calculated on a year-to-year basis. This implies that there is no information available on whether profits increase or decrease in the year 2000 as well as for the years in which firms (re)enter the panel.
5. Working hours data are based on working contracts and collective agreements, not actual hours worked.
6. Please see Appendix 1 for a detailed description.
7. Please see Appendix 1 for more details.
8. This is important from the fair wage perspective, as employees choose a wage reference that they are entitled to (Kahneman *et al.*, 1986).
9. Officially, the product classification follows the Combined Nomenclature, which can be matched to the SITC based on EU Regulation No. 2015/1754, Annex I to EEC No. 2658/87.
10. The per-worker profit is divided by 10,000 for easy exposition.
11. For a short discussion of the estimation of Equation (2) by pooled ordinary least squares (POLS) (see Appendix 5); it allows for the estimation of time-invariant covariates.
12. A firm is identified as having increasing (decreasing) profits if its profits increase (decrease) from one year to the next. The first year is excluded because the change in profits from the previous year is unknown.
13. All categories of firm profitability are identified before de-meaning. Therefore fixed effects estimation controls for time-invariant heterogeneity, leaving the respective categories unchanged.
14. In principle, both papers estimate instrumental variable (IV) fixed-effects models, where the data are split according to profitability categories, as in Section 4.1.
15. At $k=3$, γ_1 reports the effect of positive and increasing profitability while $\gamma_1+\gamma_2$ reports the effect of negative or decreasing profitability. More precisely, this includes firms with negative and decreasing, negative and increasing, and positive and decreasing profitability. Thus, all firms in any profitability category are included in the estimation and self-selection; that is between-category endogeneity is fully addressed. In an earlier version of this paper, $\gamma_1+\gamma_2$ directly measured the effect of negative and decreasing profitability at the expense of consistency. I am grateful to Pekka Ilmakunnas for this valuable comment.
16. These countries include Australia, Brazil, Canada, Switzerland, China, Czech Republic, Denmark, Great Britain, Hong Kong, Croatia, Hungary, Indonesia, India, Japan, South Korea, Mexico, Norway, New Zealand, Poland, Romania, Russia, Sweden, Singapore, Turkey, Taiwan, and the USA. Several EU member countries that joined the Eurozone toward the end or after the time span covered in the data, or that did not join at all, were not included; e.g. Estonia, Latvia, Lithuania, and Bulgaria. Although some of the countries did not take part even in the ERM II schedule, the value of their currency varies 1:1 with the euro, which is why they were not considered.
17. sdw.ecb.europa.eu (accessed April 8, 2016).
18. For the sake of comparison, the IV fixed effects model results based on the subsamples from Section 3.2 are presented in Appendix 4. Instrumentation is based on the two instruments just discussed.
19. The data set that the author used covers Portugal for the years 1990–1996, that is, before the country joined the Eurozone in 1999.
20. The data are obtained from www.investing.com/commodities/crude-oil-historical-data (accessed April 7, 2016).
21. It is unlikely that the instruments had a direct effect on wage-setting considerations because inflation was quite stable and low over the time period covered by the data. According to Statistics Finland, the average inflation based on the Consumer Price Index was below 2 percent for the years 2000–2012.

22. As the second set of instruments is confined to firms engaged in oil trade, a potential threat to exogeneity poses the fact that firms in that sector are similar to each other. If the instruments affected similar firms similarly, they could in turn affect wages through workers' outside option (Carlsson *et al.*, 2016). However, in the present context the instruments work on the cost as well as earnings sides of the single firm. While a positive price shock is beneficial on the earnings side it is detrimental on the cost side. As firms differ in their imports and exports, and costs and revenue, firms are affected differently by changes in the world oil price. As a consequence the instrument should not affect on wages through workers' outside option. Furthermore, local unemployment, which is an important ingredient in the worker's outside option, is used as a control. I am grateful to Oskar Nordström Skans for commenting on that potential problem.
23. As a robustness check, the log total sales are also included as a second measure (See Section 5).
24. The mean elasticity in the log-level regression is the product of the coefficient and mean of the regressor reported in the table.
25. For a more detailed discussion on wage rigidity in the Finnish context (see Obstbaum and Vanhala, 2016; Böckerman *et al.*, 2007, 2010).
26. Please see Appendix 3 for results from IV individual fixed effects estimation.
27. As mentioned above, the mean wage-profitability elasticities are given by the product of the coefficient and mean of the regressor, which are also reported in the table.
28. See also Appendix 1.
29. Hours worked are regular (contract) hours plus overtime.

References

Abowd, J.M., Kramarz, F. and Margolis, D.N. (1999), "High wage workers and high wage firms", *Econometrica*, Vol. 67 No. 2, pp. 251-333.

Abowd, J.M. and Lemieux, T. (1993), "The effects of product market competition on collective bargaining agreements: the case of foreign competition in Canada", *The Quarterly Journal of Economics*, Vol. 108 No. 4, pp. 983-1014.

Agell, J. and Bennmarker, H. (2003), "Endogenous wage rigidity", Working Paper No. 1081, CESifo, Munich.

Agell, J. and Bennmarker, H. (2007), "Wage incentives and wage rigidity: a representative view from within", *Labour Economics*, Vol. 14 No. 3, pp. 347-369.

Arai, M. (2003), "Wages, profits, and capital intensity: evidence from matched worker-firm data", *Journal of Labor Economics*, Vol. 21 No. 3, pp. 593-618.

Arai, M. and Heyman, F. (2009), "Microdata evidence on rent-sharing", *Applied Economics*, Vol. 41 No. 23, pp. 2965-2976.

Azfar, O. and Danninger, S. (2001), "Profit-sharing, employment stability, and wage growth", *Industrial and Labor Relations Review*, Vol. 54 No. 3, pp. 619-630.

Barth, E., Bryson, A., Davis, J.C. and Freeman, R.B. (2016), "It's where you work: increases in the dispersion of earnings accross establishments and individuals in the United States", *Journal of Labor Economics*, Vol. 34 No. S2, pp. S67-S97.

Bellmann, L. and Möller, I. (2010), "Profit sharing and employment stability", *Schmalenbach Business Review*, Vol. 62 No. 1, pp. 73-92.

Bewley, T.F. (1999), *Why Wages Don't Fall During a Recession*, Havard University Press, Cambridge.

Blanchflower, D.G. and Oswald, A.J. (1996), *The Wage Curve*, MIT Press, Cambridge, MA.

Blanchflower, D.G., Oswald, A.J. and Sanfey, P. (1996), "Wages, profits, and rentsharing", *The Quarterly Journal of Economics*, Vol. 111 No. 1, pp. 227-251.

Böckerman, P., Laaksonen, S. and Vainiomäki, J. (2007), "Who bears the burden of wage cuts? Evidence from Finland during the 1990s", *International Journal of Manpower*, Vol. 28 No. 2, pp. 100-121.

Böckerman, P., Laaksonen, S. and Vainiomäki, J. (2010), "Micro and macro level wage rigidity: lessons from Finland", *Finnish Economic*, Vol. 23 No. 1, pp. 27-42.

Bound, J., Jaeger, D.A. and Baker, R.M. (1995), "Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak", *Journal of the American Statistical Association*, Vol. 90 No. 430, pp. 443-450.

Brown, G.D.A., Gardner, J., Oswald, A.J. and Qian, J. (2008), "Does wage rank affect employees' well-being?", *Industrial Relations*, Vol. 47 No. 3, pp. 355-389.

Cameron, A.C. and Trivedi, P.K. (2005), *Microeconometrics Methods and Applications*, Cambridge University Press, New York, NY.

Card, D., Cardoso, A.R., Heining, J. and Kline, P. (2018), "Firms and labor market inequality: evidence and some theory", *Journal of Labor Economics*, Vol. 36 No. S1, pp. S13-S70.

Card, D., Devicienti, F. and Maida, A. (2014), "Rent-sharing, holdup, and wages: evidence from matched panel data", *The Review of Economic Studies*, Vol. 81 No. 1, pp. 84-111.

Carlsson, M., Messina, J. and Skans, O.N. (2016), "Wage adjustment and productivity shocks", *The Economic Journal*, Vol. 126 No. 595, pp. 1739-1773.

Clark, A. and Oswald, A.J. (1996), "Satisfaction and comparison income", *Public Economics*, Vol. 61 No. 3, pp. 359-381.

Danthine, J.-P. and Kurmann, A. (2007), "The macroeconomic consequences of reciprocity in labor relations", *Scandinavian Journal of Economics*, Vol. 109 No. 4, pp. 857-881.

Danthine, J.-P. and Kurmann, A. (2010), "The business cycle implications of reciprocity in labor relations", *Journal of Monetary Economics*, Vol. 57 No. 7, pp. 837-850.

Dickens, W.T. and Katz, L.F. (1987), "Inter-industry wage differences and industry characteristics", in Lang, K. and Leonard, J. (Eds), *Unemployment and the Structure of Labor Markets*, Basil Blackwell, New York, NY, pp. 48-89.

Egger, H., Egger, P. and Kreickemeier, U. (2013), "Trade, wages, and profits", *European Economic Review*, Vol. 64, pp. 332-350.

Estevao, M. and Tevlin, S. (2003), "Do firms share their success with workers? The response of wages to product market conditions", *Economica*, Vol. 70 No. 280, pp. 597-617.

Eurofound (2012), "Fifth European working conditions survey", Publications Office of the European Union.

Guertzgen, N. (2009), "Rent-sharing and collective bargaining coverage: evidence from linked employer-employee data", *Scandinavian Journal of Economics*, Vol. 111 No. 2, pp. 323-349.

Hamilton, B.H., Nickerson, J.A. and Owan, H. (2003), "Team incentives and worker heterogeneity: an empirical analysis of the impact of teams on productivity and participation", *Journal of Political Economy*, Vol. 111 No. 3, pp. 465-497.

Hansen, L.P. (1982), "Large sample properties of generalized method of moments estimators", *Econometrica*, Vol. 50 No. 4, pp. 1029-1054.

Hashmi, A.R. (2013), "Competition and innovation: the inverted-u relationship revisited", *The Review of Economics and Statistics*, Vol. 95 No. 5, pp. 1653-1668.

Heckman, J.J. (1979), "Sample selection bias as a specification error", *Econometrica*, Vol. 47 No. 1, pp. 153-161.

Hildreth, A.K.G. and Oswald, A.J. (1997), "Rent-sharing and wages: evidence from company and establishment panels", *Journal of Labor Economics*, Vol. 15 No. 2, pp. 318-337.

Jones, D.C., Kalmi, P., Kato, T. and Mäkinen, M. (2012), "Financial participation in Finland: incidence and determinants", *The International Journal of Human Resource Management*, Vol. 23 No. 8, pp. 1570-1589.

Jones, D.C., Kalmi, P., Kato, T. and Mäkinen, M. (2017), "Complementarities between employee involvement and financial participation: do institutional context, differing measures, and empirical methods matter?", *Industrial and Labor Relations Review*, Vol. 70 No. 2, pp. 395-418.

Jones, D.C. and Kato, T. (1995), "Japan: financial participation in the context of human resources and heightened competitiveness", in Vaughan-Whitehead, D. (Ed.), *Workers' Financial Participation: East-West Experiences*, ILO, pp. 125-140.

Kahneman, D., Knetsch, J.L. and Thaler, R.H. (1986), "Fairness as a constraint on profit seeking - entitlements in the market", *The American Economic Review*, Vol. 76 No. 4, pp. 728-741.

Kato, T. (2016), "Productivity, wages and unions in Japan", Technical Report No. 73, International Labour Office (ILO), Geneva.

Kato, T. and Kauhanen, A. (2018), "Performance pay and enterprise productivity: the details matter", *Journal of Participation and Employee Ownership*, Vol. 1 No. 1, pp. 61-73.

Kauhanen, A. and Napari, S. (2012), "Performance measurement and incentive plans", *Industrial Relations: A Journal of Economy and Society*, Vol. 51 No. 3, pp. 645-669.

Kauhanen, A. and Piekkola, H. (2006), "What makes performance-related pay schemes work? Finnish evidence", *Journal of Management and Governance*, Vol. 10 No. 2, pp. 149-177.

Kochan, T.A., Katz, H.C. and McKersie, R.B. (1993), *The Transformation of American Industrial Relations*, ILR Press, Ithaca.

Koskela, E. and Schöb, R. (2009), "A note on internal and external reference in efficiency wage models", *Journal of Economics*, Vol. 96, pp. 79-86.

Kramarz, F. (2003), "Wages and international trade", Technical Report No. 3936, CEPR discussion paper, London.

Kruse, D.L. (1993), *Profit Sharing: Does it Make a Difference?*, Upjohn Institute for Employment Research, Kalamazoo.

Kruse, D.L. (1996), "Why do firms adopt profit-sharing and employee ownership plans?", *British Journal of Industrial Relations*, Vol. 34 No. 4, pp. 515-538.

Layard, R., Nickell, S. and Jackman, R. (1991), *Unemployment: Macroeconomic Performance and the Labour Market*, Oxford University Press, Oxford.

Long, R.J. and Fang, T. (2012), "Do employees profit from profit sharing? Evidence from Canadian panel data", *International Labor Relations Review*, Vol. 65 No. 4, pp. 899-927.

Lowitzsch, J., Hashi, I., Hashani, A., Schneider, S., Salathé, L. and Lemmens, D. (2014), "The promotion of employee ownership and participation", technical report, Inter-University Centre, Brussels.

McLaughlin, K.J. (1994), "Rent sharing in an equilibrium model of matching and turnover", *Journal of Labor Economics*, Vol. 12 No. 4, pp. 499-523.

Margolis, D.N. and Salvanes, K.G. (2001), "Do firms really share rents with their workers?", Technical Report No. 330, IZA, Bonn.

Martins, P.S. (2009), "Rent sharing before and after the wage bill", *Applied Economics*, Vol. 41 No. 17, pp. 2133-2151.

Obstbaum, M. and Vanhala, J. (2016), "Paikallinen sopiminen", *Kansantaloudellinen aikakauskirja*, Vol. 112 No. 2, pp. 129-153.

Pehkonen, J., Pehkonen, S., Strifler, M. and Maliranta, M. (2017), "Profit sharing and the firm-size wage premium", *Labour*, Vol. 31 No. 2, pp. 153-173.

Pendleton, A., Poutsma, E., Brewster, C. and van Ommeren, J. (2002), "Employee share ownership and profit-sharing in the European Union: incidence, company characteristics, and union representation", *Transfer: European Review of Labour and Research*, Vol. 8, pp. 47-62.

Piekkola, H. (2005), "Profit sharing in Finland: earnings and productivity effects", *International Journal of Manpower*, Vol. 26 Nos 7/8, pp. 619-635.

Poutsma, E., Kalmi, P. and Pendleton, A. (2006), "The relationship between financial participation and other forms of employee participation: new survey evidence from Europe", *Economic and Industrial Democracy*, Vol. 27 No. 4, pp. 637-667.

Rusinek, M. and Rycx, F. (2013), "Rent-sharing under different bargaining regimes: evidence from linked employer-employee data", *British Journal of Industrial Relations*, Vol. 51 No. 1, pp. 25-58.

Sanderson, E. and Windmeijer, F. (2016), "A weak instrument f-test in linear iv models with multiple endogenous variables", *Journal of Econometrics*, Vol. 190 No. 2, pp. 212-221.

Staiger, D. and Stock, J.H. (1997), "Instrumental variable regression with weak instruments", *Econometrica*, Vol. 65 No. 3, pp. 557-586.

Statistics Finland (2017), "Quarterly national accounts, economic growth (gdp)", available at: findikaattori.fi/en/3 (accessed March 7, 2018).

Strifler, M. (2018), "Do internal references lead to wage rigidity?", *International Review of Economics*, Vol. 65 No. 1, pp. 15-49.

Strifler, M. and Beissinger, T. (2016), "Fairness considerations in labor union wage setting – a theoretical analysis", *Scottish Journal of Political Economy*, Vol. 63 No. 3, pp. 303-330.

Sweins, C., Kalmi, P. and Hulkko-Nyman, K. (2009), "Personnel knowledge of the pay system, pay satisfaction and pay effectiveness: evidence from Finnish personnel funds", *The International Journal of Human Resource Management*, Vol. 20 No. 2, pp. 457-477.

van Reenen, J. (1996), "The creation and capture of rents: wages and innovation in a panel of U.K. companies", *The Quarterly Journal of Economics*, Vol. 111 No. 1, pp. 195-226.

Weitzman, M.L. (1984), *The Share Economy*, Harvard University Press, Cambridge.

Weitzman, M.L. (1987), "Steady-state unemployment under profit sharing", *The Economic Journal*, Vol. 97 No. 385, pp. 86-105.

Weitzman, M.L. and Kruse, D.L. (1990), "Profit sharing and productivity", in Blinder, A.S. (Ed.), *Paying for Productivity: A Look at the Evidence*, The Brookings Institution, Washington, DC.

Appendix 1. Variable and data description

Variable	Mean	SD	*n*
Log hourly wage	2.782	0.404	5,499,903
Log monthly wage – overtime	7.875	0.403	5,499,818
Log monthly wage – shift	7.862	0.413	5,499,839
Experience	12.284	6.159	5,499,875
Tenure	4.267	3.27	5,494,615
Education	2.438	0.496	5,499,903
Female	0.339	0.473	5,499,903
Swedish	0.04	0.196	5,499,903
White collar	0.669	0.471	5,499,903
Log unemployment	2.307	0.324	5,499,903
Per-worker profits (π/n)	0.282	1.257	5,499,903
Log assets	18.265	2.586	5,496,674
Equity ratio	0.432	0.219	5,496,674
Debt-equity ratio	1.32	47.869	5,496,372
Relative indebtedness	6.852	2,151.887	5,496,677

Notes: Experience and tenure are measured in years, with three levels of education based on ISCED 1997 classification. Swedish is the dummy referring to mother tongue, with Finnish as default. Profits per full-time worker are measured on yearly basis divided by 10,000. *n* refers to number of worker-firm-year observations. With very few exceptions, the individual-, firm- and spell-level figures are very similar

Table AI.
Descriptive statistics

Wage measures are from the wage structure and tax statistics

- Log hourly wages: baseline earnings measure used throughout the paper.

The baseline wage measure is total earnings based on total hours worked. This includes earnings from regular hours, extra work as well as overtime work. Furthermore, the following items are included: task and skill-specific supplements; supplements based on location and workplace conditions; performance and achievement-based pay components; shift supplements; fringe benefits; compensation for being on call or urgent work; other irregularly paid supplements; pay for working hours not worked. For monthly salary recipients, earnings per hour are obtained by division through hours worked[29]:

- Log monthly wages minus overtime pay: used as robustness check.

Total monthly earnings (including all supplements as above) minus pay for overtime and extra work.

- Log monthly wages minus shift surcharges: used as robustness check.

Total monthly earnings (including all supplements as above) minus shift surcharges such as e.g. night, evening, weekend and holiday shifts.

Profit measure is from the balance sheet panel

Operating profits = operating margin – other operating income. Operating margin is the firm's operating result excluding financial items, taxes and depreciation.

Profits per worker (π/n)

$$\pi/n \equiv \frac{\text{Operating profits}}{\text{Number of full}-\text{time equivalent employees}} \times 1 \times 10^{-5}.$$

Worker characteristics

Gender, age, and mother tongue are from the population register. Mother tongue has three categories (Finnish, Swedish, others).

Experience and its square: years of employment based on the employment register. This data go back to 1975, implying that there is precise information for a large part of employees.

Tenure and its square: years of employment at the firm based on the employment register.

Field of education: ten categories based on ISCED 1997 classification (General programmes; Education; Humanities and Arts; Social Sciences; Business and Law; Natural Sciences; Engineering; Manufacturing and Construction; Agriculture; Health and Welfare; Services; Others).

Level of education: Three levels of education based on ISCED 1997 classification (Basic education; Secondary degree; Tertiary degree).

Form of payment: two categories (monthly = 1; hourly = 0). Blue-collar and white-collar affiliation is based on the payment form dummy.

Firm characteristics

Log total assets: main control for firm size.

Equity ratio, debt-equity ratio and relative indebtedness from balance sheet panel. Controls for capital intensity and firm's financial health.

Log revenue: second control for firm size used as robustness check.

Legal form: 14 categories. Not-for-profit organizations are excluded from the data.

Firm ownership: four categories (Private domestic, State, Municipality, Foreign).

Industry affiliation: Level 1 NACE classification with 21 categories. Out of those, five are excluded from the analysis based on missing profit orientation; for example public administration and defense or activities of extraterritorial organizations.

Regional characteristics

Local labor market tightness: unemployment rate in the area of residence of employee, 70 areas in total.

Appendix 2. Basic strategy: results from individual and firm fixed effects

Table AII contains estimation results based on individual and firm fixed-effect methods. While the first accounts for time-invariant individual-level heterogeneity, the second controls for firm-level heterogeneity. As discussed in the main text, results are similar to the spell estimation.

Appendix 3. Augmented strategy: results from IV individual fixed effects

The estimation of Equation (3) by IV individual fixed effects controls for the profit endogeneity within and between the profit categories, the time-invariant individual-level heterogeneity, and,

	(1) All data	(2) Positive	(3) Negative	(4) Negative decreasing	(5) Decreasing	(6) Increasing	(7) Positive increasing
Individual fixed effects							
π/n	0.01***	0.013***	−0.02***	−0.017***	0.012***	0.013***	0.016***
	(0.00)	(0.00)	(0.001)	(0.002)	(0.00)	(0.00)	(0.00)
n	4,758,840	4,141,291	616,862	454,990	2,433,800	2,324,975	2,162,600
R^2	0.630	0.632	0.555	0.573	0.635	0.648	0.644
Mean π/n	0.254	0.318	−0.176	−0.168	0.185	0.326	0.366
Elasticity	0.003	0.004	0.003	0.003	0.002	0.004	0.006
Firm fixed effects							
π/n	−0.013	0.008	−0.088***	−0.118***	−0.033***	0.016**	0.025***
	(0.008)	(0.011)	(0.028)	(0.038)	(0.012)	(0.007)	(0.008)
n	4,758,840	4,141,291	616,862	454,990	2,433,800	2,324,975	2,162,600
R^2	0.242	0.243	0.211	0.212	0.236	0.243	0.245
Mean π/n	0.254	0.318	−0.176	−0.168	0.185	0.326	0.366
Elasticity	−0.004	0.003	0.015	0.02	−0.006	0.005	0.009

Notes: See Table III. Robust standard errors clustered at the individual (individual FE) and firm (firm FE) levels are in parentheses. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Table AII. Effect of profits on wages: results from fixed effects estimation

	(1)	(2)	(3)
π/n	0.308*** (0.046)	0.084*** (0.026)	0.272*** (0.039)
$\pi/n \times D_1^*$	0.889** (0.346)		
D_1^*	0.493*** (0.122)		
$\pi/n \times D_2^*$		−0.095*** (0.018)	
D_2^*		0.125*** (0.007)	
$\pi/n \times D_3^*$			−0.214*** (0.026)
D_3^*			0.175*** (0.011)
N	235,077	235,077	235,077
R^2	0.191	0.512	0.455
Hansen's J $\chi^2(1)$	1.492	50.35	6.655
$\chi^2(1)$ p-value	0.222	1.29e-12	0.00989
Mean π/n	0.428	0.433	0.442
Mean $\pi/n \times D_k^*$	−0.227	0.290	0.282
Elasticity of γ_1	0.132	0.036	0.12
Elasticity of $\gamma_1 + \gamma_2$	−0.272	−0.003	0.016
H_0: $\gamma_1 + \gamma_2 = 0$ $\chi^2(1)$	9.429	1.633	18.45
$\chi^2(1)$ p-value	0.00214	0.201	0.0000175

Notes: See Table AVIII. The endogenous variable is log hourly wages. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Table AIII. Effect of profits on wages: interaction IV individual fixed effects – second stage obviously, the time-variant worker and firm characteristics used as controls. Robust standard errors clustered at the individual level are calculated. Columns 4–6 of Table AVIII in Appendix 6, report the first-stage results for all the three endogenous regressors. Similar to the interaction IV spell fixed effects estimation presented in Section 4.2 the first stage results indicate high instrument quality. Table AIII contains the second stage results.

There is significant profit sharing for firms with positive, increasing and positive and increasing profits. A rise in per-worker profits by 100,000 leads to an increase in hourly wages by between 8 and 31 percent. This amounts to a 7- to over 20-fold increase in estimates compared to Table V. The respective mean elasticities reported in the table range between 0.036 and 0.13, implying a 9- to 30-fold increase. Evidence on wage rigidity can be found in columns 2 and 3. The mean elasticities are 7 (decreasing vs increasing) and 11 (negative or decreasing vs positive and increasing) times smaller, implying a much more sluggish wage reaction. As regards firms with negative profits, there appears to be downward wage adjustment.

In the second column, the null hypothesis that the sum of coefficients ($\gamma_1 + \gamma_2$) is significantly different form zero, cannot be rejected. Firms with decreasing profits show no significant effect on wages. According to Hansen's J statistic the null hypothesis that the residuals and instruments are uncorrelated is not rejected in the first column, and we can conclude that the overidentifying restriction is valid. In columns 2 and 3 the null hypothesis is rejected at the 1 percent level, indicating that at least one instrument is not valid.

Appendix 4. Results from subsample IV fixed effects

The estimation of Equation (2) using IV fixed effects neglects the sorting of firms according to profitability categories (between-category endogeneity), but has the advantage of considerably larger sample size compared to that of Section 4.2. Firm-level trade-weighted exchange rates for imports and exports (Instruments 1 and 2) are used to instrument the per-worker profits. This implies that almost any firm trading with a country outside the Eurozone is included from the data. The same set of the main text's control variables is used.

The upper half of Table AIV reports the first-stage results of IV individual fixed effects estimation, while the upper half of Table AV reports the second-stage results. The first stage reveals the significance of the instruments. However, compared to Section 4.2, the partial R^2 is much smaller, ranging from 0.0004 to 0.015. The F-statistic nevertheless ranges from 96 to 2,497.1; this indicates the quality of the instruments.

The second-stage results indicate profit sharing for firms with increasing and positive and increasing profits. The coefficient is 8 to 15 times larger compared to that in columns 6 and 7 in Table AII, confirming accounting bias. This increase is comparable to that in Arai and Heyman (2009) and Martins (2009), and to a certain extent, to the one reported in the main text. Compared to Table AIII, the coefficients are somewhat larger, especially in the increasing profit category. There is also clear evidence of wage rigidity for firms with negative, decreasing, and negative and decreasing profitability (see columns 3–5). The results even suggest that wages increase with diminishing profitability. Rows 5 and 6 of the upper half of Table AV give the test statistics of overidentifying restrictions. The number of overidentifying restrictions is $2-1=1$. The p-value of Hansen's J is large in columns 1, 2, and 5, implying that the null hypothesis is not rejected and the overidentifying restriction is valid. However, in columns 3, 4, 6, and 7, the null is rejected, indicating that one of the instruments is not valid, possibly because the categories themselves are endogenous. Note, however, that the number of observations in some columns is more than half of the entire data. This suggests that the similar results found in this appendix and the main text extend to the whole sample.

The first-stage estimates based on the within-spell differences are reported in the lower half of Table AIV. Although the partial R^2 is in a range similar to the individual fixed effects estimation, the SWF statistic clearly indicates a weak instruments problem. Therefore, only few coefficients are significant in the second stage, as shown in the lower half of Table AV. The sign and size of the coefficients are very close to the individual fixed effects estimates. However, the standard errors are much larger because of clustering at the firm level. Another problem inherent in the estimation is the neglect of the endogeneity of profit categories, which could contribute to this result. For example, the sign of the coefficient in column 2 of Table AV, which is negative, disagrees with the above results, which is hard to rationalize.

Table AIV. First stage to Table AV

	(1) All data	(2) Positive	(3) Negative	(4) Negative decreasing	(5) Decreasing	(6) Increasing	(7) Positive increasing
Individual fixed effects							
Instrument[1]	−0.163*** (0.003)	−0.136*** (0.003)	0.046*** (0.006)	0.005 (0.007)	−0.048*** (0.002)	0.044*** (0.003)	0.011*** (0.003)
Instrument[2]	−0.05*** (0.003)	−0.042*** (0.002)	−0.069 (0.004)	−0.175*** (0.006)	−0.088*** (0.003)	0.033*** (0.004)	0.041*** (0.003)
Partial R^2	0.00457	0.00461	0.00272	0.0150	0.00236	0.000609	0.000426
F-statistic	2,497.1	2,011.6	126.7	499.0	795.0	200.6	96.04
Spell fixed effects							
Instrument[1]	−0.51 (0.316)	−0.486 (0.306)	0.14 (0.154)	0.083 (0.202)	−0.244* (0.138)	−0.063 (0.107)	−0.124 (0.104)
Instrument[2]	−0.002 (0.275)	0.056 (0.182)	−0.197 (0.175)	−0.353 (0.245)	−0.148 (0.376)	0.165 (0.175)	0.188 (0.189)
Partial R^2	0.0182	0.0215	0.00874	0.0297	0.00954	0.00157	0.00225
F-statistic	6.870	2.544	0.843	1.055	3.310	0.525	0.972

Notes: Specification as given in Equation (2). The set of control variables is identical to that in Section 4 (see Table II). Robust standard errors clustered at the individual (individual FE) and firm (spell FE) levels are in parentheses. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Table AV. Effect of profit on wages: Subsample IV fixed effects – second stage

	(1) All data	(2) Positive	(3) Negative	(4) Negative decreasing	(5) Decreasing	(6) Increasing	(7) Positive increasing
Individual fixed effects							
π/n	−0.041*** (0.005)	−0.028*** (0.007)	−0.179*** (0.043)	−0.330*** (0.021)	−0.065*** (0.011)	0.186*** (0.024)	0.132*** (0.033)
n	2,649,319	2,316,763	236,010	153,650	1,260,723	1,199,368	1,123,831
R^2	0.616	0.621	0.516	0.426	0.615	0.542	0.594
Hansen's J $\chi^2(1)$	0.475	0.0206	214.5	110.7	0.268	11.00	24.51
$\chi^2(1)$ p-value	0.491	0.886	1.41e-48	6.81e-26	0.605	0.001	7.38e-7
Mean π/n	0.309	0.377	−0.193	−0.204	0.219	0.404	0.437
Elasticity	−0.013	−0.01	0.035	0.068	−0.014	0.075	0.058
Spell fixed effects							
π/n	−0.051** (0.025)	−0.049* (0.028)	−0.196 (0.187)	−0.288** (0.141)	−0.105 (0.097)	0.182 (0.195)	0.072 (0.092)
n	2,576,878	2,250,308	227,347	145,435	1,204,196	1,138,384	1,067,434
R^2	0.601	0.605	0.468	0.418	0.576	0.541	0.619
Hansen's J $\chi^2(1)$	1.524	1.995	3.462	0.888	0.217	3.565	5.205
$\chi^2(1)$ p-value	0.217	0.158	0.0628	0.346	0.642	0.0590	0.0225
Mean π/n	0.309	0.377	−0.193	−0.204	0.219	0.404	0.437
Elasticity	−0.016	−0.018	0.038	0.059	−0.023	0.074	0.032

Notes: See Table II. Robust standard errors clustered at the individual (individual FE) and firm (spell FE) levels are in parentheses. $^*p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Appendix 5. Results from pooled OLS

By estimating the model from Equation (2) on the entire data using pooled OLS, we obtain the estimates of the time-invariant observable covariates. The firm-level characteristics in $y_{j(i,t)t}$ include: firm size in terms of the lag of log total assets, the lag of equity ratio, debt-equity ratio, and relative indebtedness. The set of individual-level characteristics in x_{it} include the level of education (ISCED 1997 classification), labor market experience and tenure as well as their quadratic. Both are measured in years and calculated using the employment register data dating back to 1975. Furthermore, blue-collar status and the log unemployment rate in the region of residence are included. The time-invariant worker variables in α_i are gender, mother tongue, and field of education (ISCED 1997 classification). The time-invariant firm variables in ϕ_j are an import/export dummy, industry affiliation (NACE classification level 1 with 21 categories), firm ownership and legal form dummies. Standard errors account for heteroscedasticity and are clustered at the firm level.

Table AVI presents the profit sharing coefficients under different specifications. Without any controls, as given in the first column, an increase in the per-worker operating profits by 100,000 leads to a wage increase by approximately 11 percent. Adding worker and firm controls and dummies in columns 2–4 leads to a steady decrease in the coefficient, while adding time dummies in column 5 leads to a slight increase. In the most complete specification, the coefficient is roughly one-third of that in the first column, with a wage increase of 3.2 percent. This lies in the range estimated by the literature using linked data. Given that profits are used directly in the estimation, a negative coefficient could result from accounting bias.

The impact of worker and firm controls are similar to that in the empirical literature using matched panel data. Experience and tenure have a positive impact on wages; the impact of experience is much larger. Wages increase by more than 20 percent from completing secondary tertiary education. Being female reduces wages by 18 percent; white-collar workers earn up to 10 percent more than blue-collar workers. An increase in local unemployment rate by 1 percent leads to a wage decrease of around 16 percent. The firm size wage elasticity is 1,8 percent, where firm size is measured as the lag of log total assets. A lagged equity ratio has a negative impact on wages, while a lagged debt-equity ratio as well as lagged relative indebtedness has a small positive impact.

	(1)	(2)	(3)	(4)	(5)
π/n	0.107*** (0.015)	0.065*** (0.01)	0.036*** (0.013)	0.024*** (0.009)	0.032*** (0.007)
Experience		0.04*** (0.001)	0.04*** (0.001)	0.04*** (0.001)	0.037*** (0.001)
Tenure		0.004** (0.002)	−0.002 (0.002)	−0.002 (0.002)	0.009*** (0.001)
Education		0.248*** (0.007)	0.24 (0.007)	0.206*** (0.007)	0.198*** (0.007)
Female		−0.184*** (0.004)	−0.184*** (0.005)	−0.18*** (0.004)	−0.179*** (0.003)
White collar		0.064*** (0.014)	0.066*** (0.016)	0.09*** (0.015)	0.091*** (0.015)
Local unemployment		−0.181*** (0.008)	−0.169*** (0.007)	−0.165*** (0.006)	−0.146*** (0.007)
Lag log total assets			0.018*** (0.003)	0.019*** (0.002)	0.019*** (0.002)
Lag equity ratio			−0.054** (0.024)	−0.063*** (0.015)	−0.039*** (0.014)
Lag debt equity ratio			0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
Lag relative indebtedness			0.001*** (0.00)	0.00** (0.00)	0.00*** (0.00)
Worker dummies	No	Yes	Yes	Yes	Yes
Firm dummies	No	No	No	Yes	Yes
Time dummies	No	No	No	No	Yes
n	5,285,176	5,280,670	4,755,516	4,755,516	4,755,516
R^2	0.0197	0.401	0.411	0.443	0.492
Mean π/n	0.250	0.251	0.254	0.254	0.254
Elasticity	0.027	0.016	0.009	0.006	0.008

Notes: Worker dummies: 10 fields of education based on ISCED 1997 classification. Mother tongue based on three categories (Finnish, Swedish, others). Experience and tenure squared are included in the specifications shown in columns 2 to 5. Firm dummies: Legal form based on 14 categories; firm ownership based on four categories; industry affiliation based on level-1 NACE classification with 21 categories. The dependent variable is log hourly wage. π/n is the per-worker operating profit divided by 10,000. Robust standard errors at the firm level are in parentheses. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$

Table AVI. Effect of profits on wages: results from pooled cross-section

Pooled OLS: IV sample

Given the large drop in observations in Section 4.2, the main concern relates to external validity. The workers and firms in the sample used for IV estimations are likely to be different from the average worker and firm in several aspects, especially from the constriction on firms engaged in oil trade (SITC division 33). However, estimating Equation (2) with pooled OLS for that sample can, compared to Table AVI, give some idea about external validity. Table AVII contains the same specifications discussed above and constraints the sample to the workers and firms used in the IV estimations in Section 4.2.

A comparison of the effect of profitability on wages between Tables AXI–AXII shows no clear-cut difference between the data. In columns 1–3, the effect is more pronounced in the IV sample. The effect is not significant in columns 4 and 5; also, it is substantially smaller in column 5. As regards worker and firm controls, the results are very similar in large parts, with the largest difference with the white-collar dummy and the firm's relative indebtedness. The effect of being a white-collar worker is much smaller and often not significant in the IV sample. This might be due to the higher education and specific skills the blue-collar worker in the oil refinement and transportation sectors possesses. Another rather small but surprising difference is with regard to female workers. In Table AVII, the negative effect of female dummy is 2 percentage points smaller than that in Table AVI. In general, one can conclude that no major relevant differences seem to appear between the data, especially with regard to effect of profits on wages. Along with the results from 7.4, this allows us to conclude that the effects found in the main text are likely to hold in not only the oil trade sector, but in general.

Appendix 6. First stage results

This appendix gives the first-stage results from the IV estimations of Equation (3) described in Sections 4.2–5 and in Apendix 3.

	(1)	(2)	(3)	(4)	(5)
π/n	0.129*** (0.039)	0.077*** (0.02)	0.069*** (0.021)	0.031 (0.03)	0.012 (0.019)
Experience		0.035*** (0.003)	0.036*** (0.003)	0.035*** (0.003)	0.035*** (0.002)
Tenure		0.013** (0.005)	0.008 (0.006)	0.011** (0.006)	0.019*** (0.004)
Education		0.242*** (0.015)	0.232*** (0.017)	0.216*** (0.013)	0.215*** (0.012)
Female		−0.162*** (0.018)	−0.159*** (0.018)	−0.163*** (0.018)	−0.163*** (0.016)
White collar		0.017 (0.023)	0.024 (0.025)	0.044* (0.024)	0.033 (0.024)
Local unemployment		−0.112*** (0.021)	−0.101*** (0.021)	−0.119*** (0.022)	−0.076*** (0.024)
Lag of log total assets			0.011** (0.005)	0.016* (0.009)	0.009 (0.006)
Lag equity ratio			−0.033 (0.035)	−0.044 (0.043)	−0.061 (0.038)
Lag debt equity ratio			0.001 (0.011)	0.002 (0.012)	−0.014* (0.008)
Lag relative indebtedness			−0.116** (0.052)	−0.228* (0.119)	0.002 (0.074)
Worker dummies	No	Yes	Yes	Yes	Yes
Firm dummies	No	No	No	Yes	Yes
Time dummies	No	No	No	No	Yes
n	281,563	281,378	257,439	257,439	257,439
R^2	0.0252	0.370	0.363	0.369	0.417
Mean π/n	0.359	0.359	0.367	0.367	0.367
Elasticity	0.046	0.028	0.025	0.011	0.004

Notes: As in Table AVI, but with the sample constricted to observations used for IV estimations in Section 4.2. $^*p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table AVII. Effect of profits on wages: results from pooled cross section—IV sample

Table AVIII. First stage to Table III (spell) and 6 (individual fixed effects)

	Spell fixed effects			Individual fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
	π/n	π/n	π/n	π/n	π/n	π/n
Instrument^1	−0.704 (0.45)	−0.704 (0.45)	−0.704 (0.45)	−0.722*** (0.011)	−0.722*** (0.011)	−0.722*** (0.011)
Instrument^2	−0.102 (0.451)	−0.102 (0.451)	−0.102 (0.451)	−0.082*** (0.011)	−0.082*** (0.011)	−0.082*** (0.011)
Instrument^3	3.329** (1.314)	3.329** (1.314)	3.329** (1.314)	0.547*** (0.183)	0.547*** (0.183)	0.547*** (0.183)
Instrument^4	−29.42*** (1.705)	−29.42*** (1.705)	−29.42*** (1.705)	2.905*** (0.365)	2.905*** (0.365)	2.905*** (0.365)
Partial R^2	0.117	0.117	0.117	0.0785	0.0785	0.0785
SWF	20.40	22.10	36.67	19.72	182.8	99.84
	$\pi/n \times D_1^*$	$\pi/n \times D_2^*$	$\pi/n \times D_3^*$	$\pi/n \times D_1^*$	$\pi/n \times D_2^*$	$\pi/n \times D_3^*$
Instrument^1	−0.106 (0.099)	−1.371** (0.564)	−1.386** (0.559)	−0.115*** (0.003)	−1.385*** (0.013)	−1.401*** (0.013)
Instrument^2	−0.263* (0.153)	0.330 (0.326)	0.324 (0.322)	−0.239*** (0.004)	0.333*** (0.011)	0.327*** (0.011)
Instrument^3	0.478 (0.353)	8.967*** (1.304)	8.947 *** (1.290)	−0.456 *** (0.068)	5.008*** (0.284)	4.943*** (0.290)
Instrument^4	−11.49*** (0.363)	−19.47*** (1.459)	−18.72*** (1.430)	0.503*** (0.135)	2.703*** (0.279)	3.457*** (0.274)
Partial R^2	0.236	0.180	0.185	0.145	0.165	0.173
SWF	70.86	15.02	23.92	24.32	207.4	103.9
	D_1^*	D_2^*	D_3^*	D_1^*	D_2^*	D_3^*
Instrument^1	0.547 (0.410)	−0.884 (0.598)	−0.870 (0.604)	0.562*** (0.009)	−0.889*** (0.02)	−0.873*** (0.02)
Instrument^2	0.781* (0.431)	1.307** (0.597)	1.324 ** (0.592)	0.732*** (0.011)	1.223*** (0.022)	1.238*** (0.022)
Instrument^3	−0.975* (0.592)	5.971** (2.356)	6.024** (2.376)	0.317*** (0.098)	4.685*** (0.372)	4.851*** (0.357)
Instrument^4	13.42*** (1.276)	17.22*** (3.499)	15.19*** (3.432)	−2.027*** (0.177)	3.201*** (0.156)	1.435*** (0.141)
Partial R^2	0.162	0.0419	0.0415	0.152	0.0348	0.0335
SWF	768.9	11.23	19.25	20.35	385.6	151.1

Notes: The specification is as given in Equation (3). The set of control variables is identical to that in the previous section; see Table II. The robust standard errors clustered at the firm (spell FE) and individual (individual FE) levels are in parentheses. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table AIX. First stage to columns 1-3, 4-6 in Table V

	Excluding overtime pay			Excluding shift surcharges		
	(1)	(2)	(3)	(4)	(5)	(6)
	π/n	π/n	π/n	π/n	π/n	π/n
Instrument[1]	−0.703 (0.449)	−0.703 (0.449)	−0.703 (0.449)	−0.703 (0.450)	−0.703 (0.450)	−0.703 (0.450)
Instrument[2]	−0.103 (0.451)	−0.103 (0.451)	−0.103 (0.451)	−0.103 (0.452)	−0.103 (0.452)	−0.103 (0.452)
Instrument[3]	3.328** (1.314)	3.328** (1.314)	3.328 ** (1.314)	3.328** (1.315)	3.328** (1.315)	3.328** (1.315)
Instrument[4]	−29.41*** (1.705)	−29.41*** (1.705)	−29.41 *** (1.705)	−29.41*** (1.703)	−29.41*** (1.703)	−29.41*** (1.703)
Partial R^2	0.117	0.117	0.117	0.117	0.117	0.117
SWF	20.40	22.04	36.57	20.25	22.10	36.59
	$\pi/n \times D_1^*$	$\pi/n \times D_2^*$	$\pi/n \times D_3^*$	$\pi/n \times D_1^*$	$\pi/n \times D_2^*$	$\pi/n \times D_3^*$
Instrument[1]	−0.106 (0.0993)	−1.371** (0.564)	−1.386** (0.559)	−0.105 (0.0994)	−1.368** (0.563)	−1.384** (0.558)
Instrument[2]	−0.263* (0.153)	0.331 (0.326)	0.324 (0.322)	−0.263* (0.153)	0.328 (0.325)	0.322 (0.322)
Instrument[3]	0.477 (0.353)	8.967*** (1.304)	8.947*** (1.29)	0.476 (0.353)	9.011*** (1.303)	8.991*** (1.289)
Instrument[4]	−11.49*** (0.364)	−19.47*** (1.46)	−18.72*** (1.431)	−11.48*** (0.363)	−19.51*** (1.455)	−18.76*** (1.426)
Partial R^2	0.236	0.180	0.185	0.236	0.180	0.185
SWF	71.03	14.98	23.86	70.67	15.00	23.85
	D_1^*	D_2^*	D_3^*	D_1^*	D_2^*	D_3^*
Instrument[1]	0.546 (0.41)	−0.886 (0.597)	−0.872 (0.603)	0.545 (0.41)	−0.882 (0.596)	−0.868 (0.602)
Instrument[2]	0.781* (0.431)	1.308** (0.597)	1.325** (0.592)	0.782* (0.431)	1.304** (0.596)	1.321** (0.591)
Instrument[3]	−0.971 (0.592)	5.972** (2.354)	6.027** (2.374)	−0.968 (0.591)	6.022** (2.36)	6.075** (2.38)
Instrument[4]	13.41*** (1.277)	17.22*** (3.499)	15.19*** (3.431)	13.42*** (1.273)	17.15*** (3.491)	15.14*** (3.424)
Partial R^2	0.162	0.0420	0.0416	0.162	0.0418	0.0415
SWF	768.7	11.20	19.20	769.7	11.23	19.24

Notes: The specification is as given in Equation (3). The set of control variables is identical to that in the previous section; see Table II. The robust standard errors clustered at the firm level are in parentheses. Columns 1–3: the dependent variable in the second stage is the log monthly wage minus overtime pay. Columns 4–6: the dependent variable in the second stage is the log monthly wage minus shift surcharges. $^*p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table AX.
First stage to columns 7-9 (revenue as control) in Table V

	(1)	(2)	(3)
	π/n	π/n	π/n
Instrument[1]	−0.663 (0.427)	−0.663 (0.427)	−0.663 (0.427)
Instrument[2]	−0.223 (0.374)	−0.223 (0.374)	−0.223 (0.374)
Instrument[3]	2.37* (1.304)	2.37* (1.304)	2.37* (1.304)
Instrument[4]	−28.41*** (1.531)	−28.41*** (1.531)	−28.41*** (1.531)
Partial R^2	0.128	0.128	0.128
SWF	13.58	17.08	37.00
	$\pi/n \times D_1^*$	$\pi/n \times D_2^*$	$\pi/n \times D_3^*$
Instrument[1]	−0.109 (0.103)	−1.323** (0.517)	−1.338*** (0.511)
Instrument[2]	−0.253 (0.16)	0.189 (0.284)	0.18 (0.283)
Instrument[3]	0.553 (0.352)	7.851*** (1.269)	7.807*** (1.252)
Instrument[4]	−11.57*** (0.366)	−18.3*** (1.649)	−17.53*** (1.619)
Partial R^2	0.232	0.189	0.195
SWF	33.59	11.92	24.58
	D_1^*	D_2^*	D_3^*
Instrument[1]	0.557 (0.424)	−0.816 (0.547)	−0.809 (0.556)
Instrument[2]	0.749 (0.465)	1.102* (0.593)	1.142** (0.579)
Instrument[3]	−1.226* (0.695)	4.352* (2.269)	4.584** (2.321)
Instrument[4]	13.68*** (1.458)	18.91*** (3.453)	16.7*** (3.402)
Partial R^2	0.157	0.0333	0.0333
SWF	451.7	7.496	16.12

Notes: The specification is as given in Equation (3). The set of control variables is the same as that in Section 4.2 plus the first lag of log revenue. The cluster-robust standard errors at the firm level are in parentheses. The dependent variable in the second stage is the log hourly wages. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Corresponding author
Matthias Strifler can be contacted at: matthias.strifler@jyu.fi