Does Wage Inequality Affect Labor Productivity? 
Some Evidence from Manufacturing Industries of Taiwan and South Korea

Jeng Liu*

We investigate the effects of wage inequality on labor productivity in manufacturing industries. Two particular types of wage inequality are considered: relative deprivation and efficiency wages. Using Taiwanese data from 1979 to 1996 and Korean data from 1993 to 1996, our results indicate that relative deprivation has a highly negative effect on industrial productivity while the effect of efficiency wages is not statistically significant. Although many studies by labor economists have focused on efficiency wages, our findings underscore the importance of relative deprivation. The results also generally consistent with the view that, in order to maintain high productivity, manufacturing firms must be concerned with the social legitimacy of their wage distributions.

Keywords: wage inequality, labor productivity, relative deprivation, efficiency wages

1. Introduction

The objective of this research is to estimate the net effects of two types of wage inequality, namely, relative deprivation and efficiency wages, on labor productivity. Specifically, testing the hypotheses of relative deprivation and efficiency wages theories is the main concern of this paper. Although we believe that relative deprivation is multifaceted and could be defined in different ways, with our data we are able to operationalize it as the degree to which a worker’s human capital credentials are rewarded less than is average in the labor market as a whole. Conversely, efficiency wages refer to the degree to which a worker’s human capital are rewarded greater than is average in the labor market. Thus, we define relative deprivation and efficiency wages as being mutually exclusive events for any particular worker because no individual can be both underpaid and overpaid relative to the market average based on his or her human capital credentials.

* Corresponding author. Department of Sociology, Tung-hai University, Tai-chung, 407, Taiwan. Tel: 04-2359-0121 ext 2987; Fax: 04-2359-3780; e-mail: JLIU@MAIL.THU.EDU.TW

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We measure relative deprivation and efficiency wages at the individual level. To our knowledge, however, objective measures of productivity at the individual level are exceedingly rare. We therefore aggregate the individual scores on relative deprivation and efficiency wages to the level of the industrial codes for which reasonably reliable and valid data on productivity are available. We then estimate regression models where industry is the unit of analysis. In particular, we investigate whether the degree of aggregate relative deprivation and the degree of aggregate efficiency wages in the jth industry affect its productivity after controlling for other factors.

In doing so, our concern is not to criticize conventional economic models, but to investigate how aspects of wage structure affect industrial productivity. Despite a relatively large economic literature on productivity, the effects of wage structure have been neglected. Although income inequality is a fairly common topic among economists and sociologists, they have not systematically linked it to the empirical study of productivity which has been relatively ignored by researchers. Thus, in the following, we hope to help fill a research gap in the economic and sociological literatures by investigating the effects of wage inequality on productivity.

2. Theoretical Background and Literature Review

2.1 The Traditional Economic Approach

According to the standard neoclassical view, economy is generally represented as a large set of competitive markets in which the typical firm operates as a price-taker. The labor market is one of these competitive markets, and it allocates a particular factor of production (i.e., labor) where the wage refers to the price for another unit of labor of a given quality. Firms that attempt to pay below the wage set by the market will be unable to attract and retain qualified workers. Firms that attempt to pay above the wage set by the market will be unable to meet their costs and will be driven out of business.

Previous work on our research topic is somewhat limited because it is not naturally suggested by traditional economic theory. Given the assumption of a perfectly competitive economy, the wage structure is caused by productivity (rather than vice versa). The productive abilities and human capital possessed by individuals are viewed as being objective characteristics whose utilization or elicitation are generally unproblematic. The distribution of wages is said to primarily reflect the distribution of marginal revenue products (which in turn mainly derives from the distributions of
workers’ abilities and their investments in human capital). In sum, the assumption of a perfectly competitive economy is inconsistent with the idea of treating wage inequality as an independent variable in a model of productivity. It is therefore not surprising that economic studies of productivity, though numerous, have not investigated the effect of wage inequality as an independent variable.

2.2 Institutional Perspectives on Labor Markets

We adopt an institutional approach to the study of labor market outcomes. Although this approach has not yielded any dominant model, the basic institutional perspective begins with the assumption that employment relationships are often too complex to be fully understood in terms of the competitive market model. Such complexities that reduce the capacity of employers to readily equate wages with workers’ marginal productivities include: the existence of firm specific skills; the important of on-the-job training; the role of senior workers in training junior workers; the existence of interdependencies between workers in the production process; the facilitation of worker acceptance and utilization of new technologies; the uncertainties and imperfect information that are inherently involved when assessing worker quality and measuring their individual productive contributions; and the general potential for costly malfeasance among workers (Akerlof [1]; Doeringer and Piore [10]; Granovetter [19]; Sorensen and Kalleberg [42]; Thurow [44]; Williamson [46]). These complexities give rise to various incentive systems and internal labor market structures (Sorensen [41]).

In adopting the institutional approach, we assume that incentive system and internal labor market structures have net effects on wages after controlling for workers’ human capital credentials (Sorensen [41]). A distribution of wages will therefore be observed for workers with a given set of human capital credentials (e.g., Groshen [22], [23]). Although we assume that, ceteris paribus, the typical worker will prefer a high wage to a lower one, job rationing and labor market queuing will result in workers who vary in their success at obtaining higher-paying jobs despite having similar human capital credentials (Dickens and Lang [9]; Sakamoto and Chen [36]; Sakamoto and Powers [37]). In the traditional neoclassical economic approach, relative deprivation and efficiency wages cannot exist: firms that attempt to pay below the market price for human capital will be unable to obtain a sufficient number of qualified workers, and firms that attempt to pay above the market price for human capital will go bankrupt. In the institutional approach that we adopt, however, relative deprivation and
efficiency wages occur because labor market structures operate to generate a
distribution of wages for workers who are the same in terms of human capital
credentials.

2.3 Efficiency Wages

During the last two decades, labor economists have developed a
literature on efficiency wages (for review, see Akerlof and Yellen [2];
Sorensen [41]; and Weiss [45]). In our opinion, efficiency wage models
may be classified as an institutional approach and are often consistent with
the work of labor market sociologists. The affinity derives from a
fundamental assumption that is a characteristic of the efficiency wage
literature, namely, worker quality or productivity is not completely observed
by employers. As a result of this rejection of a perfectly competitive labor
market, efficiency wage models generate results which are often similar to
the conclusions that are frequently reached by sociologists: job training, labor
market queuing, internal labor markets, and structural unemployment.

Furthermore, as noted by Akerlof and Yellen [2], “Under these
circumstances [where worker quality or productivity is not completely
known], the payment of a wage in excess of market-clearing may be an
effective way for firms to provide workers with the incentive to work rather
than shirk.” That is, the typical assumption in the efficiency wage
literature—that productivity is not clearly measured or defined for at least
some types of workers—results in the conclusion that some workers often
receive higher wages. The latter refers to a wage that is in excess of what is
average in the market for a worker given his or her human capital credentials.
This higher wage—which is also known as the efficiency wage—is often paid
by employers in order to ensure that their workers are working hard (or that
they are, on average, of higher quality on unobserved aspects of human
capital).

The rationale for this assumption is often motivational: workers being
paid efficiency wages will work with greater effort because they have more to
lose by being dismissed from their job due to inadequate performance (which
in the efficiency wage literature is known as “shirking”). These models
typically include some monitoring parameter which refers to the probability
that “shirking” workers are dismissed. Firm productivity would not be
increased if workers had nothing to lose from inadequate job performance;
that is, if they enjoyed no efficiency wage or if their employment were
absolutely guaranteed.

Akerlof and Yellen [2] and Weiss [45] provide reviews of the types and

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variations of efficiency wage models. Given our purposes, however, we only wish to note that the unifying assumption in these studies—that productivity will be greater when workers are paid a wage that is higher than what is expected given their human capital investments—remains, to our knowledge, largely untested against empirical data. Although the efficiency wage literature is by now fairly expansive, its fundamental premise has not been sufficiently investigated due to the relative lack of data on productivity. Our objective is not to argue against efficiency wage models but rather to fill an important gap by empirically testing one of their key assumptions.

One study that does use a type of efficiency wage model to empirically investigate productivity is Rebitzer [34]. He uses U.S. data on productivity growth in manufacturing industries from 1960 to 1980, and estimates the net effect of the unemployment rate (although the effects of wage inequality are not investigated). His results suggest that the increasing in the unemployment rate has a net positive effect on productivity growth. Rebitzer [34] interprets this effect as deriving from the increased incentive that workers have—during periods of higher unemployment—to keep their jobs because alternative work opportunities are dismissed. Rebitzer [34] also finds that this effect of unemployment is smaller in certain manufacturing industries where job security seems to be greater due to stronger internal labor markets which he refers to as “long-term employment relations” (Rebitzer [34], p.627). Although these results suggest the utility of the efficiency wage approach, Rebitzer [34] does not actually operationalize efficiency wages per se and test the assumption that they increase productivity.

2.4 Relative Deprivation

Efficiency wages refer to the payment of a wage that is greater than expected. By relative deprivation, we generally refer to the converse: the payment of a wage that is less than expected. The efficiency wage assumption—that productivity increases when workers are paid more than what is expected given their human capital—is widely referred to in labor economics, but the issue of whether relative deprivation in wages affects productivity has not attracted the same sort of attention among economists. To our knowledge, Akerlof and Yellen [2] is the only economic study that systematically considers this issue, and their analysis is analytical rather than empirical. As stated Akerlof and Yellen ([2], p.225) “According to the fair wage-effort hypothesis, workers proportionately withdraw effort as their actual wage falls short of their fair wage.”

In regard to empirical research, one related economic study does
investigate the effect of a “worker attitude index” on productivity in the U.S. automobile industry over a twenty year period (Norsworthy and Zabala [33]). Their analysis does not, however, attempt to measure worker attitudes or wage inequality directly. Instead, their index “is based only on the behavioral manifestations of attitude” (Norsworthy and Zabala [33], p.992) and includes annual unauthorized strikes, voluntary separations, total number of grievances filed, and number of unresolved grievances. Not surprisingly, the authors find that these variables affect productivity (Norsworthy and Zabala [33], p.997). Although their study is not concerned with estimating the effects of relative deprivation in wages on productivity, their empirical results may at least be interpreted as being consistent with the general view that industrial productivity is affected by the extent to which workers believe that an acceptable degree of fairness exists in the workplace.

Some psychologists and social psychologists have conducted various sorts of experiments to investigate the relation between various work behaviors and the degree to which a worker is underpaid or overpaid relative to some expected wage. Several of these studies are briefly reviewed by Akerlof [1], Akerlof and Yellen [3], and Cappelli and Chauvin [7]. In general, the results do not provide strong support for the efficiency wage assumption. In these particular experimental studies, workers do not seem to consistently increase their efforts when they are overpaid because it is relatively easy for such workers to psychologically adjust their evaluation of the value of their labor to fit their higher wages; in short, rather than consistently working harder and being more productive, workers often find it easier to alter their conception of what their expected wage should be.

The experimental results regarding the effect of underpayment on work effort, however, tend to support the hypothesis of reduced productivity among workers who experience relative deprivation in wages. Indeed, according to Akerlof and Yellen ([3], p.257), “[psychologists] consider it obvious that agents who feel under rewarded will supply corresponding fewer inputs.” Also, as noted by Akerlof ([1], p.82), “as might be expected, the evidence appears strongest of the withdrawal of services by workers who are led to believe they are underpaid.” It is also worth noting that this hypothesis “accords with common sense. It appears frequently in literature; it is considered obvious by personnel textbooks; and it explains commonly observed taboos regarding discussion of wages and salaries” (Akerlof and Yellen [3], p.256).

2.5 Wage Inequality and Productivity

A few studies consider summary measures of within-firm or
within-sector wage inequality and thereby relate to these issues to some extent. Freeman and Medoff [13] investigate wage inequality and productivity among union and nonunion workers in the United States. They find that, relative to the nonunion sector, the distribution of wages is less dispersed in the union sector. Freeman and Medoff ([13], p.79) argue that this result derives from unions as “political institutions whose policies reflect the preferences of average workers.” The authors furthermore note that (Freeman and Medoff [13], pp.79-80):

Unions are likely to favor single-rate policies because they replace managerial discretion and power at the workplace with more objective decision rules. Because the value of a worker’s contribution to a firm is extremely difficult to measure and different supervisors may read the same facts in different ways, the union will seek to protect their membership from the uncertainty of arbitrary supervisory decisions by pressing for a one-rate-per-job pay policy. Third, unions are likely to seek to equalize wages among workers doing similar tasks for reasons of worker solidarity and organizational unity.

In short, Freeman and Medoff [13] find less dispersion in the intra-firm distribution of wages in unionized firms, and the authors attribute this reduction in inequality largely to the preferences of unionized workers and their ideas about fairness.

Freeman and Medoff ([13], p.169) also conclude that “most studies of productivity find that unionized establishments are more productive than otherwise comparable nonunion establishments.” Furthermore, the authors believe that a substantial portion of this productivity growth derives from improved “industrial relations climate” and “more rational, professional management” (Freeman and Medoff [13], p.163) which is linked to lower quit rates, reduced training costs, and lower rates of grievances filed. Although the authors do not explicitly relate this improved productivity to reduced wage inequality per se, the link between reduced relative deprivation and improved labor relations (i.e., worker motivation, cooperation, and discipline) seems plausible especially given the other social scientific studies on this topic referred to above.

The link between reduced inequality in wages and workforce productivity is also often encountered in discussions of Japanese industrial labor relations. For example, in his essay “Motivation and Productivity,” Takeuchi [43] argues that productivity involves much collective efforts on the part of a firm’s workforce, and a large degree of wage dispersion should
therefore be avoided as it creates jealousies and ill feelings that are akin to relative deprivation. Reduced intra-firm wage inequality is thereby said to promote and improve workers’ cooperative efforts, the training of junior workers by senior workers, the facilitation of on-the-job training, and greater flexibility in job assignment—all of which are often said to be well developed characteristics of large Japanese firms (e.g., Shimada [39]).

As for American analyses, Frank ([12], p.549) similarly argues that “egalitarian internal wage structure arises because of ‘equality consistence’….Many firms, for example, follow strict pay formulas based on education, experience, and length of tenure with the firm, even when there are apparently very wide differences in productivity among individual workers who are alike with respect to the characteristics specified in the pay formula.” Frank [12] argues that this occurs because higher-paid workers receive not only higher wages but also what he refers to as the higher social “status” that is associated with being at the top of the pay hierarchy. In other words, Frank [12] argues that being at the top of the pay hierarchy constitutes a reward of itself (i.e., status) and lesser-paid workers will feel that those at top of the pay hierarchy are overpaid if the latter’s monetary wages reflect their actual productivities too closely. The majority of a firm’s workers will reduce their cooperative work efforts for the firm when the monetary wages of the most productive workers in the firm are not discounted for the added bonus of the “status” that they also necessarily receive. Frank’s [12] study therefore hypothesizes that firms with high levels of wage inequality will tend to have lower productivity.

3. Operationalizing Relative Deprivation and Efficiency Wages

3.1 Measuring Relative Deprivation

We operationalize relative deprivation in a theoretical informed way using available Taiwanese and Korean data. We do not claim that this is the only type of relative deprivation that an individual may experience. Indeed, we agree Merton [32] who argues that an individual may have multiple reference groups of varying importance. However, even though the wage inequality within a firm is more intuitive but it can be addressed only with appropriate data which is not generally available. In the following we only assume that our measure represents one important type of relative deprivation that a worker may experience.

We begin with the assumption that people in industrial societies commonly believe that workers with more education tend to be more
qualified for substantively complex jobs, and more deserving of higher wages (Alves and Rossi [5]; Jasso and Rossi [26]; Grandjean and Bean [18]; Kluegel and Smith [28]). Workers who have low wages but good educational attainment will thus feel that their wages are unjustly low. As noted by Kluegel and Smith ([28], p.45), “Americans to attach special significance to education a route to economic advancement. By a substantial margin our respondents see getting more education as the most effective means to economic advancement.” We therefore contend one useful definition of relative deprivation that is the degree to which a worker’s wage is less than average given the worker’s human capital credentials and demographic characteristics. The main assumption underlying this definition of relative deprivation is that workers will tend to feel underpaid if their wages are less than that which is expected in terms of the total effects of human capital variables and demographic traits.

To operationalize this definition of relative deprivation, the first step is to estimate the following regression for the entire labor market:

$$\log W_i = a + \sum b_k X_{ki} + \varepsilon_i$$  \hspace{1cm} (1)

where the dependent variable is the log of the ith individual’s wage, and the independent variables include education, age, marital status, and gender (including terms of non-linearities and interactions). The least-squares estimation of equation (1) than provides us with the predicted value of each worker’s log-wage which then can be converted back into dollar units by taking the anti-log:

$$\exp(a + \sum b_k X_{ki}) = W_i^e$$  \hspace{1cm} (2)

where $W_i^e$ refers to the expected wage for the ith worker given his or her human capital and demographic characteristics. We define relative deprivation for the ith worker as being zero (i.e., $RD_i = 0$) when his or her observed wage is greater than or equal to his or her expected wage (i.e., $W_i \geq W_i^e$). However, if $W_i < W_i^e$, then

$$RD_i = \frac{W_i^e - W_i}{W_i^e}$$  \hspace{1cm} (3)

Thus, a positive value on $RD_i$ indicates the percentage shortfall between a worker’s wage and the expected or average wage in the labor market given his or her human capital and demographic characteristics.
3.2 Measuring Efficiency Wages

We define the ith worker’s efficiency wage as being zero (i.e., $E_{Wi} = 0$) if $W_i \leq W_i^e$. In this case, the worker’s efficiency wage is not greater than what is expected in the market, on average, for someone with the same human capital and demographic characteristics. If, however, $W_i > W_i^e$ then the ith worker’s observed wage is greater than that which is expected in the market, and in this circumstance:

$$EW_i = \frac{W_i - W_i^e}{W_i^e}$$

(4)

so that the efficiency wage is equal to the ration of the wage premium to the expected wage for the ith worker. This definition stipulates that the larger a worker’s efficiency wage, the more the worker is being paid relative to the average in the market for someone with the same human capital and demographic characteristics.

3.3 Aggregation

We have defined the relative deprivation (i.e., $RD_i$) and efficiency wage (i.e., $EW_i$) as independent variables associated with each ith individual. For the purpose of assessing whether these variable affect productivity, however, we aggregate the individual scores by the industrial codes that are available in both of our Taiwanese and Korean data. Direct measures of productivity at the individual level generally do not exist, and we therefore investigate productivity at the level of manufacturing industries for which reasonably reliable measures of productivity are available. As reviewed above, we believe that relative deprivation and efficiency wages also operate at the level of firm. Furthermore, there are indeed firm-level factors such as firm’s strategy and competitive position which may influence the pay decision. We do agree that the firm-level measures of relative deprivation and efficiency wages would be very useful to have. However, we do not believe that one should a priori assume that within-firm relative deprivation is the only type which merits empirical investigation. Nevertheless, we are currently collecting data of this sort and the topic related to the effect of within-firm wage inequality on productivity can be analyzed in future research. 

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1 This research proposal has been approved by NSC and the author is the PI.
In addition, to indicate a scenario raised by some researchers interested in human resource management (e.g., Gordon), we will test an additional variable the percentage of each industry’s workforce that is managerial. The rationale for this variable derives from Gordon’s ([15], [16], [17]) argument that increasing administrative ratios result in greater earnings inequality in firms. His view suggests that the effects of relative deprivation and efficiency wages on productivity may be spurious to the extent that those independent variables are merely correlated with the proportion of the work force who are managers. Following this argument, taking the percentage managerial workers into account allows us to more clearly interpret the net effects of relative deprivation and efficiency wages as deriving from the degree of work effort exerted by workers rather than simply reflecting industrial variations in the degree to which workers are “monitored.” Because our data are measured at the industrial level, our results can be interpreted as an average across all firms in the manufacturing sector.

To indicate the aggregate levels of efficiency wages and relative deprivations at the industrial level, we sort workers industrial codes and then calculate Sen’s [38] index of deprivation for each jth industry based on the wages of the workers employed in each jth industry. After doing so, regression models are estimated to investigate the net effects of the levels of relative deprivation and efficiency wages on productivity in the jth industry.

3.4 Sen’s Index of Deprivation

Sen’s [38] index of deprivation was created for the purpose of measuring the extent of poverty or absolute economic deprivation in a society, but we borrow it for our purpose of measuring the extent of relative deprivation in an industry. From a methodological point of view, this index is appropriate because it is concerned with indicating the total amount of deprivation experienced by a group of persons whose incomes are less than some designated level. In Sen’s [38] original application, the designated level of interest is the poverty line whereas in our application the economic shortfall is with respect to the ith individual’s expected wage as was defined above. In either application, however, the basic concern is the same essential problem of measuring the extent of aggregate deprivation that is generated when the incomes of a group of persons are lower than some benchmark standard.

Given the concerns of our research, we specify Sen’s ([38], p.223) index as:

$$S_j = H_j \left[ I_j + (1 - I_j) G_j \right]$$

(5)
where $S_j$ refers to the aggregate level of a particular type of relative deprivation in the jth industry; $H_j$ refers to the proportion if individuals who experience any degree of deprivation in the jth industry; $I_j$ is the average degree of deprivation experienced by those who are deprived in the jth industry; and $G_j$ is the Gini index for the degree of inequality or the variability in deprivation among those who are deprived in the jth industry.

As an indicator of the aggregate level of deprivation, $H_j$ by itself is informative to some degree because it tells us how pervasive the deprived status is in the jth social unit. The limitation of this indicator, however, is that it is completely insensitive to the average degree of deprivation experienced by those who are deprived. Therefore, Sen’s index also includes $I_j$ which provides exactly the opposite information that is given by $H_j$. In Sen's index, $I_j$ indicates the average degree of deprivation (where the underpayment is expressed as a percentage of the expected wage) among those who are deprived in the jth social unit, but $I_j$ is completely insensitive to the proportion of persons in the jth social unit who are in the deprived status. Thus, by incorporating both $H_j$ and $I_j$, Sen’s index conveys more precise information about the aggregate level of deprivation experienced by some social group.

The last component of Sen’s index is $G_j$ which is the Gini coefficient of the variability of deprivation among those who are deprived in the jth social unit. The rationale for including $G_j$ into Sen’s index is the assumption of the declining marginal utility of money that we referred to earlier. For example, to the deprived by $10 an hour is more than twice the deprivation experienced by being deprived by $5 an hour. In other words, the greater the total degree of deprivation, then the more the deprivation, then the more the disutility that is incurred by each dollar of deprivation.

Sen’s index can be used to measure the degree of relative deprivation in each industry. Let $ARD_j$ refer to the aggregated, total amount of relative deprivation in the jth industry where the deviations used to calculate the index refer to shortfalls from the expected wage based on the wage regression with human capital and demographic variables as the independent variables in the model. Sen’s index can also be calculated for efficiency wages in each jth industry where the deviations used in to calculate the index refer to the positive residuals from the wage regression with human capital and demographic variables as the independent variables in the model. However, given the psychological studies mentioned above—in which the effects of overpayment are much less stimulating than are the effects of underpayment—we do not wish to assume that positive deviations necessarily result in disproportionately larger levels of increased productivity. For this
reason, we ignore variability in efficiency wages across individuals in the same industry. In doing so, we measure the aggregated efficiency wages by using a slightly modified version of the index (i.e., $AEW_j = H_j I_j$) in which the Gini component is dropped (which is equivalent to setting it equal to zero).

4. Data and Model Specification

4.1 Data

We have access to the 1979, 1982, 1985, 1989, 1992 and 1995 data files of the Taiwan Manpower Utilization Survey and the 1993 to 1996 data files of the Korean Occupational Wage Survey which we use in this paper. Given our research strategy, one important advantage of these surveys is that they have a fairly large sample size. For this reason, we have enough cases for each individual code to reliably estimate its mean age, mean years of schooling, mean efficiency wage, and Sen’s index for relative deprivation which are all then used as independent variables in our regression models. Another advantage of the surveys is that they use the same industrial codes for which high quality data on industrial productivity and capital expenditures are regularly published in both Taiwan (the Taiwan Industrial Production Statistics Yearly Report and the Report on Taiwan Factory Census) and South Korea (the Year Book of Labor Statistics and the Korea Statistical Year Book). That is, we may obtain an objective indicator of its productivity per employee hour that serves as the dependent variable in our regression models.

We restrict our study to manufacturing industries because productivity data are more likely to be valid and reliable for the manufacturing sector than for other sectors of the economy such as services where the output is sometimes not quantifiable. Restricting the analysis to one sector also reduces the residual influences of technological heterogeneity which might further complicate the study of wage structure and industrial productivity.

To predict the productivity of the $j$th industry in the $t$th year, we use independent variables that pertain to that the $j$th industry in the year previous to $t$. For example, the 1979 covariates for the $j$th industry are used to predict the productivity of the $j$th industry in 1980; the 1982 covariates for the $j$th industry are used to predict the productivity of the $j$th industry in 1983; and so forth. In this way, we avoid the possibility of simultaneity bias that might arise if productivity and wage inequality were both measures during exactly the same time period.
4.2 Statistical Model

A well-known and widely used model in economic analysis is the Cobb-Douglas production function:

\[ Q = A K^\alpha L^{1-\alpha} \]  

(6)

where \( A \) is a constant; \( \alpha \) is a positive fraction; and \( Q \) is the quantity produced during the given time period in which \( K \) units of capital are used and \( L \) units of labor are employed. In practice, a vector of human capital variables is also often added to the above equation so as to take into account the quality of the employed workers (e.g., Kendrick and Grossman [27]).

In our approach, we expand upon equation (6) by specifying the following generalized Cobb-Douglas function:

\[ Q = A K^\alpha L^\beta E^{\delta} \]  

(7)

where \( K \) is a vector of variables indicating capital usage with \( \alpha \) being the vector of associated coefficients; \( L \) is a vector of variables indicating the quantity and quality of labor employed with \( \beta \) being the vector of associated coefficients; and \( E \) is a variable that indicates the aggregate amount of effort exerted by the workers with its associated coefficients being \( \delta \).

We do not have any direct data on \( E \). Therefore, we cannot directly test any hypotheses about the relationship between effort and relative deprivation or efficiency wages. We can, however, indirectly investigate them by assessing whether their implications in the model are consistent with the available empirical data. In order to do so, we assume that \( E \) is a function of our indices for relative deprivation and efficiency wages (i.e., \( ARD_j \) and \( AEW_j \)) and we substitute that for \( E \) in equation (7). We then obtain:

\[ Q = A K^\alpha L^\beta (ARD)^{\delta_1} (AEW)^{\delta_2} \]  

(8)

In order to transform equation (8) into an additive linear model that can be estimated by least squares, we take the natural logarithm of both sides of the equation. After doing so, we get:

\[ \ln Q = \ln A + \alpha \ln K + \beta \ln L + \delta_1 \ln(ARD) + \delta_2 \ln(AEW) + \varepsilon \]  

(9)

If the estimate of \( \delta_1 \) is less than zero, then this finding would indicate that the aggregate level of relative deprivation has a negative effect on industrial
productivity net of other factors, and we could interpret this result as deriving from the reduction in the aggregate level of work effort in industries where the aggregate level of relative deprivation is greater. If the estimate of $\delta_2$ is greater than zero, then this finding would indicate that the aggregate level of efficiency wages has a positive effect on industrial productivity net of other factors, and we would interpret this result as deriving from the increase in the aggregate level of work effort in industries where the aggregate level of efficiency wages is greater.

Additionally, we can extend our equation (9) to estimate a fixed-effects regression of the labor productivity observed in the manufacturing industries across this time period. We use the least-squares dummy variable formulation of this model in which J-1 dummy variables are included to indicate the J units (Greene [1993]) which in our application refers to the specific industries. The rationale for this approach is that each industry may have unique aspects of technology that may influence its productivity but which are not fully indicated by the value of annual capital expenditures per worker. The fixed-effects specification also eliminates the problem of autocorrelated error terms across the years for each of the industries.

5. Empirical Results

5.1 Descriptive Statistics

Table 1 shows the summary of the variables used for our data analyses and Table 2 shows the descriptive statistics.

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2 As mentioned above, we restrict our analyses to manufacturing industries. Given both Taiwan and South Korea have industrial classification system to code specific industries by two-digit numbers, we therefore can estimate our regression based on these specific industries instead of the whole manufacturing industry sector. There are 20 industries and 26 industries in Taiwanese and Korean manufacturing sector.
Table 1. Descriptions of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<tbody>
<tr>
<td>HROUT</td>
<td>Hourly output</td>
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<tr>
<td>NK</td>
<td>Annual capital expenditures per work</td>
</tr>
<tr>
<td>MSCH</td>
<td>Mean years of schooling completed by workers</td>
</tr>
<tr>
<td>MEXP</td>
<td>Mean years of working experience</td>
</tr>
<tr>
<td>MNTR</td>
<td>Mean percentage of Managerial Workers</td>
</tr>
<tr>
<td>ARD</td>
<td>Sen index for aggregated relative deprivation</td>
</tr>
<tr>
<td>AEW</td>
<td>Modified Sen index for efficiency wages (head-count ration times average benefit)</td>
</tr>
<tr>
<td>CV</td>
<td>Coefficient of variation for employee wages</td>
</tr>
<tr>
<td>P0</td>
<td>A dummy variable for the 1993 Korean case</td>
</tr>
<tr>
<td>P1</td>
<td>A dummy variable for the 1994 Korean case but for 1980 and 1983 of the cases of Taiwan</td>
</tr>
<tr>
<td>P2</td>
<td>A dummy variable for the 1995 Korean case but for 1986 and 1990 of the cases of Taiwan</td>
</tr>
<tr>
<td>P3</td>
<td>A dummy variable for the 1996 Korean case but for 1993 and 1996 of the cases of Taiwan</td>
</tr>
</tbody>
</table>

Note: A LN prefix in later tables indicates that natural log transformation of the variable.

Because we have 6 years of Taiwanese data for 20 manufacturing industries and 4 years Korean data for 26 industries, the total sample size is 120 for the case of Taiwan and 104 for the case of South Korea. Across these observations, for Taiwan, the mean of output per employee hour is 453.439 New Taiwan dollars while 1,036,823.91 Won for South Korea. The mean of the log of this variable is 5.366 and 13.263 for Taiwan and South Korea, respectively. The mean of annual capital expenditures per Taiwanese worker is 13,218.45 New Taiwan dollars and 65,904,706.92 Won for Korean worker. For the case of Taiwan, the mean of mean schooling is 9.35 years and the mean of mean experience is 16.67 years; for the case of South Korea, they are 11.49 years and 17.75 years.
Table 2. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Taiwan Mean</th>
<th>Taiwan S.D.</th>
<th>South Korea Mean</th>
<th>South Korea S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HROUT</td>
<td>453.439</td>
<td>838.340</td>
<td>1036823.91</td>
<td>2114615.82</td>
</tr>
<tr>
<td>LNHROUT</td>
<td>5.366</td>
<td>1.019</td>
<td>13.263</td>
<td>0.848</td>
</tr>
<tr>
<td>NK</td>
<td>13218.450</td>
<td>19143.217</td>
<td>65904706.92</td>
<td>89791395.2</td>
</tr>
<tr>
<td>LNNK</td>
<td>8.914</td>
<td>1.017</td>
<td>17.633</td>
<td>0.78</td>
</tr>
<tr>
<td>LNMSCH</td>
<td>2.226</td>
<td>0.135</td>
<td>2.437</td>
<td>0.099</td>
</tr>
<tr>
<td>MEXP</td>
<td>16.673</td>
<td>3.653</td>
<td>17.748</td>
<td>5.114</td>
</tr>
<tr>
<td>LNMEXP</td>
<td>3.480</td>
<td>0.114</td>
<td>2.837</td>
<td>0.281</td>
</tr>
<tr>
<td>MNTR</td>
<td>8.701</td>
<td>2.570</td>
<td>9.686</td>
<td>2.796</td>
</tr>
<tr>
<td>LNMNTR</td>
<td>1.257</td>
<td>1.488</td>
<td>1.870</td>
<td>2.131</td>
</tr>
<tr>
<td>ARD</td>
<td>15.730</td>
<td>3.742</td>
<td>19.112</td>
<td>7.366</td>
</tr>
<tr>
<td>LNARD</td>
<td>2.719</td>
<td>0.295</td>
<td>2.944</td>
<td>0.517</td>
</tr>
<tr>
<td>AEW</td>
<td>22.216</td>
<td>6.198</td>
<td>17.601</td>
<td>12.099</td>
</tr>
<tr>
<td>LNAEW</td>
<td>3.067</td>
<td>0.254</td>
<td>2.868</td>
<td>0.242</td>
</tr>
<tr>
<td>CV</td>
<td>44.170</td>
<td>7.011</td>
<td>42.185</td>
<td>8.124</td>
</tr>
<tr>
<td>LNCV</td>
<td>3.777</td>
<td>0.148</td>
<td>3.742</td>
<td>0.195</td>
</tr>
</tbody>
</table>

The mean percentage of workers who are managers is 8.70% in Taiwan’s manufacturing industries and is 9.69% in Korean ones. Across these observations, we found that the highest value on this variable is 13.10%. Thus, in Taiwan’s and Korean manufacturing industries, most workers are not managerial. Further, based on other calculations for our data (available upon request from the author), we know that most of the employees in these industries for both Taiwan and South Korea are also blue-collar workers.

We have multiplied Sen’s indices for both relative deprivation and efficiency wages by 100 so that they have a theoretical range of 0 to 100. Across our observations, the mean of Sen’s index for relative deprivation is 15.73 in Taiwan and 19.11 in South Korea. And, the mean of the efficiency wage is 22.22 in Taiwan and 17.60 in Korea. For each of the 120 Taiwanese observations and the 104 Korean observations, we have also computed the coefficient of variation in wages (multiplied by 100). For this variable, the mean is 44.17 in Taiwan and 42.19 for the case of South Korea.
Table 3 shows the Pearson correlation coefficients for several of these variables. The dependent variable (i.e., the logged hourly output) has a correlation of -.78 with the logged Sen's index for relative deprivation for the case of Taiwan and -.68 for South Korea. These are highly negative correlation coefficients, and they indicate that there are strong bivariate relationships between industrial productivity and the degree of underpayment in wages for both Taiwan and South Korea. The correlation between the dependent variable and the logged efficiency wages is .73 and .57 for Taiwan and Korea. They show that there are strong positive bivariate relationships between industrial productivity and the degree of overpayment in wages. Furthermore, industries that pay wages that reflect higher than average returns to the characteristics of some of their workers are also less likely to pay wages that reflect lower than average returns to the characteristics for their other workers; that is, efficiency wages and relative deprivation have a highly negative correlation, namely, -.78 for Taiwan and -.88 for Korea. Multivariate analysis is therefore clearly needed to estimate the net effects of relative deprivation and efficiency wages on productivity.

Table 3. Pearson Correlation Coefficients

<table>
<thead>
<tr>
<th></th>
<th>a. Taiwan (N = 120)</th>
<th>b. South Korea (N = 104)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Log of Hourly Output</td>
<td>(1) Log of Hourly Output</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(2) Log of Relative Deprivation</td>
<td>-0.78</td>
<td>-0.68</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(3) Log of Efficiency Wage</td>
<td>0.73</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>(4) Log of Coefficient of Variation</td>
<td>-0.23</td>
<td>-0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

We should note that one might argue that the multicollinearity issue (i.e., there exists high correlation between relative deprivation and efficiency wages) may violate the robustness of our regression results. While we agree that, in general, multicollinearity can sometimes obscure the implications of a given set of research results, but multicollinearity per se does not violate any assumption of the mathematical regression model. In the regression models,
the formulas for parameter estimates and standard errors are still correct and the estimates are still BLUE (Wonnacott and Wonnacott [47], pp. 84-88). The problem for multicollinearity is that it makes the standard errors large and unstable but the only real solution to this problem is to get more data. In this research, we collect as many data as possible and intend to figure out the net effects of relative deprivation and efficiency wages on productivity. Therefore, we really need to include these two variables in our models. Further, we will apply other indexes (Belsley, Kuh, and Welch [6]) to check if our results are convincing which we will discuss in the last section of this paper.

5.2 Regression Results

Column 1 and column 4 (i.e., Model 1 for the case of Taiwan and of South Korea, respectively) in Table 4 show the results of our estimation of equation (9) with the dependent variable being the log of output per employee hour.\footnote{Regression models using aggregate data are often heteroscedastic (e.g., Greene 1993, pp.277-8). However, test statistics for the null hypothesis of homoscedasticity are not statistically significant using the Breuch-Pagan test in which we specified the error variance to be a function of the sample size of each $j$th industry.}

As expected, the log of mean experience and the log of the mean years of schooling both have large and highly significant effects. The effects of the log of annual capital expenditures per worker are negative while the effects of their square are positive for both Taiwan and South Korea. These results imply that the effect of annual capital expenditures is U-shaped. At lower levels additional annual capital expenditures actually reduce output per employee hour whereas at higher levels additional annual capital expenditures increase output per employee hour.

Also as hypothesized, the effects of the logged Sen’s index for relative deprivation are highly negative in Model 1 for both the cases of Taiwan and South Korea. These effects are also statistically significant at any conventional level. In Taiwan’s case, the coefficient of -.96 indicates that a 1\% increase in Sen’s index for relative deprivation reduces output per employee hour by .96\% net of the other variables in the regression (and it is .67\% in South Korea). These findings show that the productivity of a Taiwanese or Korean manufacturing industry is highly sensitive to its aggregate level of relative deprivation. The results are also consistent with the general view that workers reduce their productive efforts when they are paid less than average returns (i.e., those that prevail in the entire labor market) on their human capital and demographic characteristics.
Table 4. Results for the Regressions of LNOUT

<table>
<thead>
<tr>
<th></th>
<th>Taiwan (N = 120)</th>
<th></th>
<th>South Korea (N = 104)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 1</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.734*</td>
<td>10.763*</td>
<td>9.431*</td>
<td>47.600*</td>
</tr>
<tr>
<td>LNNK</td>
<td>-2.332*</td>
<td>-2.940*</td>
<td>-1.740*</td>
<td>-5.604*</td>
</tr>
<tr>
<td></td>
<td>(0.500)</td>
<td>(0.543)</td>
<td>(0.586)</td>
<td>(1.476)</td>
</tr>
<tr>
<td>LNNK2</td>
<td>0.137*</td>
<td>0.173*</td>
<td>0.099*</td>
<td>0.168*</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.030)</td>
<td>(0.033)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>LNMSCH</td>
<td>1.967*</td>
<td>2.716*</td>
<td>1.870*</td>
<td>3.431*</td>
</tr>
<tr>
<td></td>
<td>(0.395)</td>
<td>(0.418)</td>
<td>(0.433)</td>
<td>(0.852)</td>
</tr>
<tr>
<td>LNEXP</td>
<td>1.065*</td>
<td>1.275*</td>
<td>1.213*</td>
<td>0.852*</td>
</tr>
<tr>
<td></td>
<td>(0.151)</td>
<td>(0.183)</td>
<td>(0.285)</td>
<td>(0.327)</td>
</tr>
<tr>
<td>LNARD</td>
<td>-0.959*</td>
<td>-1.057*</td>
<td>-0.667*</td>
<td>-0.681*</td>
</tr>
<tr>
<td></td>
<td>(0.180)</td>
<td>(0.290)</td>
<td>(0.215)</td>
<td>(0.221)</td>
</tr>
<tr>
<td>LNAEW</td>
<td>-0.083</td>
<td>-0.081</td>
<td>-0.166</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(0.205)</td>
<td>(0.338)</td>
<td>(0.167)</td>
<td>(0.172)</td>
</tr>
<tr>
<td>LNCV</td>
<td>-0.332</td>
<td></td>
<td>-0.712*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.293)</td>
<td></td>
<td>(0.321)</td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>0.170</td>
<td>0.120</td>
<td>0.156</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.123)</td>
<td>(0.130)</td>
<td>(0.127)</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>0.107</td>
<td>0.025</td>
<td>0.153</td>
<td>0.314*</td>
</tr>
<tr>
<td></td>
<td>(0.094)</td>
<td>(0.103)</td>
<td>(0.111)</td>
<td>(0.129)</td>
</tr>
<tr>
<td>P3</td>
<td>0.099</td>
<td>-0.138</td>
<td>0.032</td>
<td>0.377*</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.113)</td>
<td>(0.117)</td>
<td>(0.130)</td>
</tr>
<tr>
<td>RSQ</td>
<td>0.858</td>
<td>0.822</td>
<td>0.902</td>
<td>0.760</td>
</tr>
</tbody>
</table>

Note:

1. Standard errors are shown in parentheses; star * indicates p < .05
2. Model 3 is a fixed-effect model. Due to space limitation, we do not report the parameter estimates and standard errors for the industrial dummy variables (19 for Taiwan and 25 for South Korea) in the each model. The complete information is available upon request to the author.
Contrary to expectations of the efficiency wages literature, the results shown in Table 4 indicate that efficiency wages do not have a net effect on industrial productivity. The coefficients for the log of the efficiency wages in Model 1 is -0.08 for Taiwan and -0.17 for South Korea. These effects are very small and not statistically significant. We therefore cannot conclude that these regression results are consistent with the research hypothesis that increases in the efficiency wage increase output per employee hour.

As mentioned above, we extend our equation (9) to estimate a fixed-effects regression to make certain that the unique aspects of technology for each industry can be controlled. The results are shown in column 3 and column 6 (i.e., Model 3) of Table 4. Basically, they indicate that the effects of the target independent variables on productivity are robust and consistent with those reported in Model 1: the effects of relative deprivation are highly negative for both the cases of Taiwan and South Korea (-1.057 and -0.681, respectively). And, the effects of efficiency wages on productivity are -0.081 for Taiwan and -0.007 for South Korea. These effects are still very small and not statistically significant at any conventional level.

Column 2 and column 5 (i.e., Model 2 for the case of Taiwan and of South Korea, respectively) in Table 4 show the results for the estimation of modified version of equation (9). In this specification, the Sen indices for relative deprivation and efficiency wages are dropped from the model, and the log of the coefficient of variation is included instead. The results in Model 2 shows that the net effect of the coefficient of variation is not statistically significant at any conventional level for the case of Taiwan but is significant for the case of South Korea.4

For exploratory purpose, we also estimated a regression model in which the log of the coefficient of variation in wages is the dependent variable and the independent variables include the log of Sen’s indices for relative deprivation and efficiency wages. The results for this model are reported in Table 5 and they show that both of these independent variables have sizable and significant effects (i.e., 0.46 and 0.32 for Taiwan and 0.31 and 0.14 for South Korea).

These findings indicate that wage inequality tends to be greater in both Taiwanese and Korean manufacturing industries that have higher levels of relative deprivation and efficiency wages. However, the coefficient of

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4 As introduced in the aggregation procedure (section 3.3), we did try to control the variable of percentage managerial workers. However, because the results indicate that the effect of the percentage managerial appears not statistically significant, we do not include this variable in our model.
determination (i.e., R-square) for the regression in Table 5 is only 0.31 for Taiwan and 0.24 for South Korea. This implies that only 31% of the variation between Taiwanese industries in wage inequality is explained by their aggregated levels of relative deprivation and efficiency wages (and, 24% for Korean industries).

Table 5. Regression Results of the Logged Coefficients of Variation of Wages

<table>
<thead>
<tr>
<th></th>
<th>Taiwan</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.661*</td>
<td>4.680*</td>
</tr>
<tr>
<td></td>
<td>(0.340)</td>
<td>(0.229)</td>
</tr>
<tr>
<td>Log of Sen's Index for Relative Deprivation</td>
<td>0.463*</td>
<td>0.310*</td>
</tr>
<tr>
<td></td>
<td>(0.070)</td>
<td>(0.068)</td>
</tr>
<tr>
<td>Log of Modified Sen's Index for Efficiency Wages</td>
<td>0.322*</td>
<td>0.144*</td>
</tr>
<tr>
<td></td>
<td>(0.064)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>R-square</td>
<td>0.313</td>
<td>0.241</td>
</tr>
</tbody>
</table>

* p < .05; standard errors are in parentheses.

In other words, most of wage inequality (i.e., 69% for Taiwan and 76% for South Korea) in manufacturing industries reflects factors other than relative deprivation and efficiency wages. Therefore, wage inequality (as measured by the coefficient of variation) should not be considered as being synonymous with the aggregate levels of relative deprivation and efficiency wages.

6. Discussions and Conclusions

In this research, we use data on wages and productivity in Taiwan and South Korea and the empirical result shows the similar pattern for both countries. Whether this can be seen as a fact that both countries are facing the same situation needs further investigation, we believe that it is reasonable to presume that Taiwanese and Korean workers are both sensitive to relative deprivation and efficiency wages. First of all, both Taiwan and South Korea have well-defined and relatively closed labor markets. Compared to a large heterogeneous country like the United States, information about wages is more likely to be widespread in Taiwan and South Korea. Secondly,
compared to the United States, we believe that Taiwan and South Korea have comparatively fewer ethnic distinctions and regional divisions that might potentially complicate the analysis of relative deprivation and efficiency wages. In addition, some survey evidence suggests that Asian workers value and desire a good wage at least as much as do American workers (Silverthorne [40]). Because of this, even though most of the studies reviewed in this study involve Americans, we believe that the basic processes of relative deprivation and efficiency wages that we have discussed are also applicable to both Taiwanese and Korean workers.

In this paper we have investigated the effects of relative deprivation and efficiency wages on labor productivity in Taiwan and South Korea. We defined relative deprivation as being paid a wage that is less than average for workers with comparable human capital and demographic characteristics, and we defined efficiency wages as being paid a wage that is greater than average for workers with comparable human capital and demographic characteristics. We then aggregated the individual-level scores to the level of two-digit industries for which measures of productivity are available. One may argue that the key idea of a worker’s feelings on relative deprivation and efficiency wages is based on how much her or his co-workers get. We believe that this fact is still consistent with our operationalization process. In our earlier discussion, we concur with Merton’s argument that emphasizes that there is more than one form of relative deprivation and efficiency wages. Furthermore, we believe that the workers are assumed to know wages outside of their firms. So, we do think that people respond to wages in other firms and we do not think that the firm is the only or even primary reference group for a worker. In this study, we treat the workers in the jth industry as an individual worker’s reference group to be compared with. And, the specific issues related to organizational power should be done in future research.

The regression results indicate that relative deprivation has a highly negative effect that is statistically significant at any conventional level but the effect of efficiency wages on productivity is not significant. From a theoretical point of view, we do not believe that labor market models of relative deprivation are fundamentally incompatible with efficiency wage models. Both approaches are generally consistent with an institutional view of the labor market in which workers’ productive efforts may be relevant variables for analysis. This theoretical compatibility is also consistent with our empirical results which find support for the effects of both relative deprivation and efficiency wages. In contrast to previous research relating to these effects, however, our findings underscores the importance of relative deprivation which has not received as much attention as have efficiency
Regarding the robustness of our empirical findings, the collinearity between relative deprivation and efficiency wages might cause suspicion. However, we do not think that multicollinearity is a serious problem for our analysis. Multicollinearity refers to the situation when two or more variables in a regression are jointly significant (in terms of F-test) but none of them are individually significant (in terms of their respective t-tests); in this situation, the researchers know that the variables cannot be fully dropped from the model but the t-tests do not clearly indicate which variable is significant (Goldberger [14], p.245). Therefore, this issue does not apply to our findings because the same result -- the effect of relative deprivation on productivity is negatively significant and that of efficiency wages is not; the effect of relative deprivation is still significant if we drop the variable of efficiency wages; the effect of efficiency wages is still not significant if we drop the variable of relative deprivation -- is consistently evident in our Models. Furthermore, the condition indexes for collinearity diagnostics of models reported in Table 4 do not fall outside the limit that Belsley et al. [6] advocate as the “comfort zone.”

Our other results suggest that wage inequality per se (as summarized by the coefficient of variation) is not as important as are relative deprivation and efficiency wages in affecting industrial productivity in both Taiwan and South Korea. This conclusion is consistent with the view that social legitimacy of the wage distribution--rather than its degree of dispersion per se--is a key motivational factor that influences the productive efforts of workers. When workers feel that they are underpaid relative to what is average for people with comparable human capital and demographic characteristics, they seem to reduce their work efforts. Thus, workers with more education and experience usually expect wages that are higher than those received by workers with less education and experience, and productivity may be lost if employers do not distribute wages in a way that is consistent with this expectation.

Our results thus suggest that employers may increase productivity by paying workers wages that are at least commensurate with their education and experience even though in doing so overall wage inequality may sometimes be increased. Paying higher wages so as to reduce relative deprivation or to increase efficiency wages certainly increase production costs, however, and to what extent doing so affects profits or economic efficiency would be an interesting topic for future research.
References


