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Does Firm Size Affect Worker Earnings? Case of Iranian Manufacturing Enterprises

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Abstract: *Empirical literature on the link between firm size and wage effect indicates the positive effect of firm size on its workers' earnings. The present study analyses firm characteristics and wage linkage in Iranian manufacturing enterprises over the period from 2004-2013. The findings indicate that the effect of education, skill, and gender on worker earnings in large enterprises is stronger than that in small and medium enterprises (SMEs). In addition, in the Iranian manufacturing sector, larger exporting enterprises are more productive and capital intensive and tend to pay more wages and non-wage benefits to their employees.*

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1. Introduction

Many empirical and theoretical studies have reported substantial wage differentials between small and large enterprises. It is well-documented why large enterprises are willing to pay higher wages and non-wage benefits than their small counterparts by controlling different aspects of wage determinants such as workers' skill, working conditions, gender discrimination, and firm characteristics.

Larger firms are willing to employ more qualified workers because of the higher level of capital-labour complementarity (see Brown and Medoff, 1989; Kruse, 1992) because more capital-labour intensity enhances productivity directly. Moreover, it allows larger employers to pay higher wages and premiums to their employees (Yasar & Paul, 2008). Regarding

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the international trade theories, some studies have identified a connection between the wages, export, and firm size (see Bernard, 1995; Bernard and Wagner, 1997; Bernard and Jensen, 1997). These studies indicate that, because of more capital intensity and higher productivity, larger enterprises are more likely to enter the foreign markets. Therefore, the workers in larger enterprises can benefit from the gains of exporting in the form of higher wages or non-wage benefits.

Among the studies addressing the firm size-wage effects, many of them employ human capital theory to explain the wage differentials between small and large enterprises. Regardless of the ambiguity in defining and measuring the labour quality, this theory argues that because of hiring more skilled and productive labour, larger enterprises pay higher wages to their employees. As noted by Dunne and Schmitz (1992), larger enterprises are more likely to use more complex equipment and technologies. As a result, if there is a complementarity between the degree of equipment complexity and labour skills, the larger enterprises seemingly hire more skilled labour and pay higher wages. Finally, some studies analysed gender wage differentials by focusing on the worker and firm characteristics as well as the rewarding system of the differentials.

Despite a growing body of empirical studies on the absence or existence of firm size-wage effects, the analysis of such a relationship has not been investigated for the case of Iran. To fill this gap, this paper contributes to the empirical literature on the firm size-wage effects by identifying the determinants of the labour earnings across Iranian manufacturing enterprises. Analysing the causes of wage inequality in Iran is important in some aspects. First of all, the labour market characteristics in Iran are different from those in other developed or developing countries. Since the 1980s and due to public policies in fertility rate growth, the rate of population growth increased sharply and reached 4.4%, which was one of the most rapid population growth rates at that time (Crane, Lal, & Martini, 2008). The excess labour supply caused subsequent labour market adjustment and reduced real wages. Furthermore, evidence shows that the uneven effects of economic shocks increased the wage disparities across the sectors and territories.

To deal with the challenge of unemployment and its consequences, the Iranian administration respected the potential of businesses to create new jobs for the youth through national and regional economic policies. For instance, in the Iranian Sixth Development Programme (2016-2021), to reduce the unemployment rate from 12.6% (current rate) to 8.6% (target rate), exemptions were provided for businesses to employ college/university graduates in their enterprises. Increasing the business competitiveness, export, and productivity through the higher contribution of the college/university graduated workforce to production is among the main targets of the recent national economic strategies that would likely lead to a decrease in the youth unemployment crisis in the Iranian economy.

This paper investigates whether there are any differences in labour earning determinations between SMEs and large enterprises. For this purpose, we compared the elasticities of real earnings, wages, and fringe benefits to the worker and firm characteristics in the manufacturing sector of Iran. Analysing the labour earning determinations is an important feature of the Iranian labour market. On the one hand, earning determinants are closely related to firms' worker demand and individuals' worker supply decisions. On the other hand, regarding their relationship with firms' profitability, productivity, and efficiency, they are key determinants of economic growth and overall employee performance.

The empirical analysis presented in this work is different from previous studies in two ways: 1) To the best of our knowledge, this work is the first attempt to investigate the impact of worker and firm characteristics on real total earnings, wages, and fringe benefits for the case of Iran. To do so, we use the four-digit SIC (International Standard Classification-REV.3) dataset based on the Statistical Centre of Iran (SCI) survey of manufacturing enterprises with ten and more employees. The SCI survey provides detailed information, reported by the business owners on both the worker characteristics (e.g., education, skill, gender, gross annual wages, and fringe benefits) and the firms' characteristics (e.g., region, type of activity, export, sale, value-added, and physical capital). Therefore, the SCI dataset allows us to explore key determinants of labour earning, including the worker and firm characteristics in manufacturing enterprises. 2) In this work, we present evidence for two different types of enterprises (small and medium, and large) to analyse the existence or absence of earning effects across the subgroups of manufacturing enterprises. Moreover, for more detailed and comprehensive results, the equation is estimated separately for total earnings, wages, and fringe benefits as dependent variables for each type of subgroups.

The remainder of this paper is organised as follows. Section 2 presents the theoretical background and current evidence. Section 3 describes the models, methodology, and dataset. Section 4 discusses the empirical results. Section 5 concludes the paper with a summary and policy implications

2. Theoretical Justification

2.1 Firm Characteristics and Earning

The topic of firm size-wage effect has generated a growing body of studies over the past three decades. In this section, we review the results of some research works that investigate the relationship between firm size and wage effect in different countries and samples. The relationship between firm size and wage effect was initially mentioned by Moore (1911) and discussed by subsequent studies (Brown and Medoff, 1989; Idson and Oi, 1999; Troske, 1999). According to the current literature, large firms tend to pay more than their small counterparts.

In their leading paper, Brown and Medoff (1989) posed questions about why large firms pay their workers more than small ones, followed by giving six reasons for the positive nexus between firm size and workers' wage: 1) large employers hire workers with higher quality; 2) offer inferior working conditions; 3) pay higher wages to thwart unionisation; 4) have more capability to pay higher wages; 5) face fewer pools of applicants relative to vacancies, and 6) are less able to monitor their workers. In the case of the U.S, they also find that ceteris paribus working for a large firm provides a wage premium of between 1.5% and 3.8%.

The relationship between firm size and wage effect within Italian firms was investigated by Brunello and Colussi (1998). They find that the wage differentials between small and large firms are not significantly different from zero, and any wage premium is due to differences in the observed characteristics and selection effects. Using a large sample from the U.S. employer-employee database, Troske (1999) examined seven possible explanations for the firm size-wage premium in the 1990s. The results show that the matching of more skilled workers together in larger plants accounts for approximately 20% of both establishment and firm size-wage premium, while the capital-skill complementarity hypothesis accounts for approximately 45% of the firm size-wage premium. In all cases, there remains a considerable and significant firm size-wage premium.

In another study on U.S. manufacturing firms, Bayard and Troske (1999) used a continuous measure of the firm to analyse the firm size-wage effect by including supply-side variables directly in their wage regression. Their findings show the comparable, significant, and positive nexus between firm size and wage premium across industries. Their findings are consistent with the theory of Idson and Oi (1999) and indicate that productivity differences between employees in small and large industries account for half of the firm size-wage premium in manufacturing and service industries. Idson (2000) analysed the effects of the labour market on the firm size in Russia over the period 1994-1998. He investigated the relationship between firm size and the characteristics of labour, earning levels, job training, turnover, and tenure. His findings show that employer size effects in Russia have characteristics similar to other countries such as the U.S.

For the case of Colorado, Paez (2003) analysed the effect of firm size on wages in the year 2001. Similar to previous studies. However, this study concludes that the effect of firm size still exists and it is not explained by institutional vacancy or human capital characteristics. Even when controlling the effects of these characteristics, larger firms offer average wages that were 3.30% higher than SMEs.

Lallemand, Plasman, and Rycx (2007) examined the extent and determinants of firm size-wage effect in five European countries using a harmonised matched employer-employee dataset in 1995. They found a significant wage premium for large establishment workers. Further results show that the extent of this premium fluctuates substantially across countries and seems to be correlated with the degree of corporatism negatively.

Bottazzi and Grazzi (2009) focused on the effect of firms' scale of activity and productivity on the labour costs for Italian manufacturing enterprises (with more than 20 employees) based on Italian Statistical Office databank (ISTAT) from 1989-1997. The main question of this study is how the workforce composition affects the total costs for wages. The results reveal that once productivity differences among enterprises are accounted for, size still retains a positive impact on the costs of labour.

Barth and Dale-Olsen (2011) tested the hypothesis that each enterprise faces an upward-sloping supply curve for the worker, suggesting that the number of any particular worker should matter for his or her level of payment. Using linked employer-employee data from Norwegian enterprises, they add the log of skill group size to the standard log wage equation. The results reveal that the traditional firm size-wage effect on wage dwindles away, once the control for the educational type, as the observed individual within the establishment, is added to the equation. After controlling both individual and establishment-specific heterogeneity, a dwindling employer size-wage effect and a significant group size effect remain.

Using longitudinal data, Scoppa (2014) estimated the relationship between wages and size of the firms in Italy from 1985-2002. The findings show that larger firms pay significantly higher wages to their employees, depending on workers' abilities and size effects.

In a more recent study, Fackler, Schank, and Schnabel (2015) answered the question that "does the tenure increase plants size-wage differential?" Their results indicate that the main part of the plant size-wage premium is because of workers wage growth differentials in plants of different size. This result is in line with the hypothesis that larger plants invest more in human capital and that larger plants employ not only more skilled workers but also produce a larger number of skilled workers over time.

Using Turkish micro-level data, Balkan and Tumen (2016) developed a two-stage wage-posting game with segmented and imperfect markets and analysed the firm size-wage gap between the formal and informal sectors. They found that relative to small firms, large firms typically post higher wages for both formal and informal jobs. Furthermore, differences in size are less in formal jobs rather than informal jobs.

In a recent paper, Cosic (2018) analysed the evolution of wage distribution for the case of the American firms from 1992-2012 and reported that the firm size is a key variable in shaping the wage distribution in this country. Furthermore, wage inequality in small firms is more than large ones because of the more observed inequality in labour force characteristics.

Using the MultiProd dataset, which is based on the full population of OECD firms, Berlingieri, Calligaris, and Criscuolo (2018) investigated the links between size, productivity, and wage premium. They showed that increasing the firms' size leads to more productivity and wages premium in OECD manufacturing sector. Meanwhile, the evidence for the service sector is on the opposite side.

One important reason is related to the capital-skill complementarity hypothesis proposed by Lucas (1978). This hypothesis assumes that large employers hire workers with higher quality and more skill. Using this hypothesis, Hmermesh (1980) explained that larger firms that tend to be more capital intensive can achieve workers with higher quality. Therefore, higher levels of physical capital and human capital, which are complementary to each other in the production process, resulting in economies of scale and access to capital market credits (Lallemand et al., 2007). This hypothesis suggests that larger firms allocate fixed costs of their investment in more production and employees[1]. Moreover, studies indicate that larger firms are usually able and willing to undertake innovative activities, and hence, they require workers of higher quality to carry out such activities (Chuang & Hsu, 2004)[2].

In their study, Brown, Hamilton, and Medoff (1990) concluded that a lower relative price for capital could explain the higher relative demands for both capital and skilled labour. Larger firms usually have access to higher quality equipment and more advanced technologies[3.] Then, their workers can work with advanced equipment that does not reflect the differences in their quality. The factor abundance and diversity of production activities can also enhance the opportunity for large employers to appoint workers to tasks in which they have a comparative advantage (Ehrenberg & Smith, 2016). Hence, access to more complex equipment and technology can generate wage differentials, even between firms in the same industry and workers with similar demographic characteristics[4.]

2.2 The Control Variables: Workers Characteristics and Earnings

2.2.1 Human Capital and Earnings

In the field of labour economics, the literature has focused on the returns to education and skills (known as human capital in general) in theoretical and empirical aspects. As Mincer (1974) argues in his theorem, workers invest in their education and skills to maximise the present value of their lifetime earnings. Following Mincer's theory, many studies support that higher-qualified workers are more productive through the provision of knowledge, ability, and problem-solving (Perna, 2003). This qualifies them for higher wages and premiums, better employment contracts, less probability of unemployment, and access more prestigious job situations rather than their less-qualified counterparts (Card, 1999). Therefore, regarding the key role of education and skills on workers' income, any policies related to workers' quality have the potential to decrease or increase income inequality (Ashenfelter & Rouse, 2000).

2.2.2 Gender and Earnings

Despite the lack of theories currently available to deal with gender wage differences inside firms (Heinze & Wolf, 2010), some theoretical studies have evaluated the relationship between male and female wage gap with the characteristics of workers and firms (see Becker, 2010 and Hamermesh, 1999). According to the discrimination model, employers tend to hire fewer female workers than males. However, this view is not supported in strong competitive markets, and it is argued that firms may not be able to afford discrimination and, therefore, behave in an egalitarian fashion (Heinze & Wolf, 2010).

2.2.3 Other Determinants of Earnings

In addition to the studies conducted on the role of workers' characteristics in earning, other studies investigated the effect of firms' export and productivity on worker earnings. For instance, in the US, exports are the leading reason for the demand for skilled labour and raise in wage inequality (Bernard & Jensen, 1997). Since exporting firms are usually larger with more capital-labour intensity and higher productivity, they pay a higher wage to their employees. This finding is in line with Acemoglu (2003) and Ekholm and Midelfart (2005), which indicate that firm decisions to enter foreign markets may modify the available technologies and lead to skill-biased technological change. Thus, exporter firms which are more productive than their non-exporting counterparts tend to be relative skill intensive and usually pay higher wages to their employees rather than firms selling only to the domestic market. Accordingly, because exporting firms face much more fierce competition in the international markets than non-exporting ones, those firms that enter the export market and succeed in maintaining their position within the market are supposed to outperform their purely domestic counterparts. Under the proposed scenario that exporters exhibit superior performance over non-exporters, it is expected that larger and exporting firms pay higher wages than small and non-exporting ones (Tsou, Liu, & Huang, 2006).

3. Models, Methodology and Data

Three models are estimated in our study. The first is the basic earning equation. In this step, we used total earnings (i.e., the sum of wages and non-wage benefits) as the dependent variable and estimate the model based on our total sample (enterprises with ten and more employees). Also, to analyse the size effect on worker earnings, the natural logarithm of total employment is used as a proxy for firm size in the model.[5]Therefore, the earning model can be written as follows:

$$E_{i,t} = \alpha_1 . D_{EXP_{i,t}} + \alpha_2 . \sum WC_{i,t} + \sum_{z=3}^{4} \alpha_z GC_{i,t} + \sum_{k=5}^{7} \alpha_k . EC_{i,t} + u_{i,j,t} \quad (1)$$

$$i = 1,2,\dots,134; t = 2004, 2005, \dots, 2013.$$

In the second and third models, relative wage and fringe benefit are assumed to be dependent on the characteristics of both workers and enterprises. As discussed in section (2.1), larger enterprises are more likely to pay higher wages and non-wage benefits to their employees compared to their small counterparts. However, worker and enterprise characteristics may vary across the firms with different size, thus, these differences must be controlled for. To investigate this question, our empirical strategy is developed based on the estimation of the following wage and fringe benefit equations:

$$W_{i,j,t} = \beta_1 . D_{EXP_{i,j,t}} + \beta_2 . \sum WC_{i,j,t} + \sum_{z=3}^{4} \beta_z GC_{i,j,t} + \sum_{k=5}^{6} \beta_k . EC_{i,j,t} + \varepsilon_{i,j,t} \quad (2)$$

$$i = 1,2,\dots,134; t = 2004, 2005, \dots, 2013; j = small\ and\ medium, large.$$

$$FB_{i,j,t} = \gamma_1 . D_{EXP_{i,j,t}} + \gamma_2 . \sum WC_{i,j,t} + \sum_{z=3}^{4} \gamma_z GC_{i,j,t} + \sum_{k=5}^{6} \gamma_k . EC_{i,j,t} + \epsilon_{i,j,t} \quad (3)$$

$$i = 1,2,\dots,134; t = 2004, 2005, \dots, 2013; j = small\ and\ medium, large.$$

where E, W, and FB are the real average earnings, wages and fringe benefits of workers, respectively, D_EXP is export dummy, WC is a vector of worker characteristics, GC is a vector of gender conditions, EC is a vector of characteristics of enterprises, and u, ε, and ϵ are error terms. Unlike many of the previous studies that used dummies for mentioned variables (which is static in nature), we use the actual size of these variables to make our analysis dynamic and capture the role of independent variables much more effective in our empirical model.

In Equations (1), (2), and (3), we refer to the theory of nominal wage adjustment that was presented by Kahneman and Tversky (2013). This theory implies that workers evaluate nominal wage changes relative to a reference wage, depends on their rational wage expectations from the recent past. Furthermore, there is a large literature that indicates workers evaluate their wages relative to a reference point in the form of an implicit wage norm (Jaques, 2013) or past earning (see Clark, 1999; Grund and Sliwka, 2007; Kawaguchi and Ohtake, 2007).[6] Thus, the empirical models to be estimated are as follows:

$$E_{i,t} = \alpha_1 . E_{i,t-1} + \alpha_2 . D_{EXP_{i,t}} + \alpha_3 . \sum WC_{i,t} + \sum_{z=4}^{5} \alpha_z GC_{i,t} + \sum_{k=6}^{8} \alpha_k . EC_{i,t} + u_{i,j,t} \tag{4}$$

where $i = 1,2, \ldots, 134; t = 2004, 2005, \ldots, 2013$

$$W_{i,j,t} = \beta_1 . W_{i,j,t-1} + \beta_2 . D_{EXP_{i,j,t}} + \beta_3 . \sum WC_{i,j,t} + \sum_{z=4}^{5} \beta_z GC_{i,j,t} + \sum_{k=6}^{7} \beta_k . EC_{i,j,t} + \varepsilon_{i,j,t} \tag{5}$$

where $i = 1,2, \ldots, 134; t = 2004, 2005, \ldots, 2013; j = small\ and\ medium, large$

$$FB_{i,j,t} = \gamma_1 . BF_{i,j,t-1} + \gamma_2 . D_{EXP_{i,j,t}} + \gamma_3 . \sum WC_{i,j,t} + \sum_{z=4}^{5} \gamma_z GC_{i,j,t} + \sum_{k=6}^{7} \gamma_k . EC_{i,j,t} + \epsilon_{i,j,t} \tag{6}$$

where $i = 1,2, \ldots, 134; t = 2004, 2005, \ldots, 2013; j = small\ and\ medium, large.$

However, the need for including the lagged dependent variable in models (4), (5), and (6) implies an obvious challenge of endogeneity that leads to a biased estimation of such impact. Thus, to tackle this challenge, we used the GMM estimator as a natural solution for first-order dynamic panel data models developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). In this work, we prefer the GMM-SYS estimator since it involves some advantages in the context of our data. First of all, this method is particularly suitable for short panel data, such as those used in this study. Secondly, it is appropriate with a highly persistent dependent variable such as wage[7]. Finally, it can deal with the potential endogeneity arising from the inclusion of the lagged dependent variable and other potentially endogenous variables.

In the present paper, we used data at the four-digit aggregation level of ISIC classification from 2004 to 2013. The main source of data is the Statistical Centre of Iran (SCI) that collects annual information about manufacturing enterprises in Iran. The SCI database provides rich information for enterprises such as export, sale, geographic location, total assets, and employment. Furthermore, it reports detailed information about the workforce through education, skill, and gender. Thus, using this data, we can analyse the role of worker characteristics on wages and premiums. The description of the data is as follows: In the first equation, we considered *total earning* as a dependent variable that is measured by real average earnings of workers who employed in the total sample (enterprises with ten and more employees). In the second equation, we used *wage* as a dependent variable that is measured by the real average wage of workers who employed in SMEs and large enterprises. In the third equation, we used of *fringe benefit* in the left side of the model that refers to other real average payments to workers (e.g., rewards, over time, the cost of food and clothing, transportation cost, child allowance, and other related issues) divided into SMEs and large enterprises. To get the real value, the nominal amounts of earning, wage, and fringe benefit are deflated by the Consumer Price Index (CPI).

On the part of independent variables, we used *education* as the share of workers in SMEs and large enterprises with college or university degree (i.e., bachelors, masters, and PhD). The next explanatory variable is the *skill* measured by the share of skilled workers, technicians, and engineers in SMEs and large enterprises. According to the SCI definition, skilled workers are a type of workers who have technical knowledge and experience to do technical tasks. Also, technicians are those who have acquired enough experience and skill via training courses, and engineers are those with college/university degrees who work in production lines. Therefore, the sum of skilled labour, technicians, and engineers to the total labour force is defined as the skill variable.

Moreover, to analyse the effect of worker characteristics on their earning, an interaction variable between education and skill is considered in the model as *education×skill*. In *gender condition*, the share of male and female workers in SMEs and large enterprises is considered as independent variables and the effect of gender on total earnings, wage, and fringe benefits are analysed.

In *enterprise characteristics*, we used of following variables in the models. In the first model, we used the growth form of total employment as a proxy for the *size* variable. In fact, in this model, the size variable included as an explanatory variable to analyse the impact of firms' size on total earnings in our whole sample investigation. The next explanatory variable is *capital intensity* (C/L) that refers to the ratio of firms' real fixed capital including machinery, durable equipment, vehicles, buildings, land, and software (in million Rials) to their labour force and is included testing the capital-skill complementarity hypothesis. We applied the Producer Price Index (PPI) to convert the nominal fixed capital amount to real value. The third variable is *export dummy* that is equal to 1 if the export of industry *i* at the period *t* is positive, and 0 if otherwise. Finally, we used the *Total Factor of Productivity* (TFP) and measured this variable according to the Kendrick index. The Kendrick measure of TFP is an arithmetic measure that is expressed by $TFPK_t = \frac{V_t}{\alpha L_t + \beta K_t}$, where V_t is an index of output and L_t and K_t are indices of capital and labour in year *t*, respectively (Narayan, 2003).

Table 1 presents the summary statistics for the variables employed in the paper based on the size of the enterprises; i.e., small and medium (10-49 employees) and large (50 and more employees). As the results show, large enterprises pay, on average, a much higher wage than SMEs. This finding is the same for the workers' benefit fringe. Concerning the capital-labour ratio, large enterprises are on average more capital intensive than small and medium ones. Furthermore, comparing the employment structure reveals that large enterprises tend to employ both more qualified workers in terms of education and skill.

Table 1: Descriptive Statistics

	Mean	**Maximum**	**Minimum**	**Std. Dev.**	**Skewness**
			Large		
Wage	49.01	1148.21	4.10	60.26	6.21
Benefit fringe	30.64	778.56	0.39	42.98	6.66
Education	0.23	0.9	0.01	0.11	1.29
Skill	0.76	1.88	0.18	0.24	2.01
Male	0.87	1.00	0.16	0.14	-2.38
Female	0.13	0.84	0.00	0.14	2.38
Capital intensity	36.64	2321.14	0.01	116.26	12.04
TFP	1.68	42.03	0.04	2.78	6.64
			Small and Medium		
Wage	38.44	350.0	2.65	39.61	1.81
Benefit fringe	13.21	227.83	0.41	15.78	3.80
Education	0.20	0.91	0.01	0.10	1.53
Skill	0.74	0.93	0.00	0.09	-2.03
Male	0.87	1.00	0.00	0.11	-1.93
Female	0.13	0.70	0.00	0.11	1.68
Capital intensity	19.55	1891.46	0.00	80.32	17.11
TFP	0.00	3.06	-3.12	0.88	0.30

Note: All variables used in their natural form.

4. Empirical Results

4.1 Unit Root Test

In this section, we start by reporting the results of panel unit root tests to examine the stationary of model variables (Table 2). The basic panel unit root test regression can be written as follows:

$$y_{i,t} = \rho_i y_{i,t-1} + X_{i,t}\delta_i + \varepsilon_{i,t} \quad (7)$$

where i= 1,2,…,N is the cross-section units or series observed over periods t= 1,2,…,T; X_{it} is the exogenous variables in the model, including any fixed effects or individual trend; ρ_i is the autoregressive coefficient, and the error ε_{it} is assumed to be mutually independent of individual disturbance. In this section, we apply the Levin, Lin, and Chu (2002) test to examine the stationary situation of model variables. The null hypothesis of this test is that each series in the panel contains a unit root test, while the alternative hypothesis allows for some of the individual time series to have unit roots. The results of the panel unit root test in Table 2 suggest that there is a mixture of I(0) and I(1) variables and none I(2).

4.2 General Results

In this section, we begin our analysis by discussing general results related to estimating the equation (4) for all manufacturing enterprises. In this part, the dependent variable is the logarithm of the average earnings in each year.

The evidence presented in Table (3) shows that the total earnings turn out to be highly auto-correlated, while the path-dependency of the dependent variable being kept in all manufacturing enterprises. This result is consistent with the theory of nominal wage adjustment (Kahneman & Tversky, 2013). The overall results also show a similar pattern regardless of whether education, skill, or interaction between them are used as indicators of worker characteristics. Worker earnings in the year *t* are significantly increased by an increase in the share of education in the same period. This result is consistent for all measures of human capital in the models and supports findings of Troske (1999) and Dai and Xu (2017) about the positive impact of education and skill on worker earnings.

The result of the effect of gender conditions on total earnings is in line with our prediction (Model 4). In other words, although both the share of male and female workers put a positive and significant effect on the earnings, nevertheless, the magnitude of the coefficient for male workers is greater than female ones. It shows that in Iranian manufacturing enterprises, an increase in the share of male workers has more effect on average earnings than an increase in the share of female ones.

Table 2: Results of the unit root test

	Level			First difference		
	none	**intercept**	**intercept & trend**	**none**	**intercept**	**intercept & trend**
ln(wage)	21.22	26.31	34.29	-24.62***	-6.82***	-21.13***
ln(education)	-15.98***	26.23	18.52	-33.83***	-17.95***	-28.33***
ln(skill)	-9.24***	50.65	61.07	-13.73***	36.79	12.80
ln(education) ×*ln*(skill)	-11.27***	45.31	49.00	-20.17***	6.54	-11.48***
ln(male)	-13.72***	9.80	30.76	-19.00***	13.33	2.33
ln(female)	-13.99***	12.56	14.44	-27.49***	1.38	-13.30***
ln(capital intensity)	17.91	9.19	-4.49***	-12.87***	-9.76***	-12.82***
ln(size)	-9.25***	16.47	21.95	-12.07***	3.15	-7.61***
ln(TFP)	-9.64***	5.75	-13.45***	-18.75***	-17.75***	-40.14***
Large						
ln(wage)	17.85	31.68	52.09	-8.33***	5.33	-9.52***
ln(fringe benefit)	22.23	30.71	21.57	-15.56***	-9.30***	-10.02***
ln(education)	-12.63***	31.15	32.26	-17.80***	-7.73***	-13.96***
ln(skill)	-7.61***	65.19	70.30	-11.20***	41.66	23.85
ln(education) ×*ln*(skill)	-9.18***	46.88	69.41	-8.58***	18.39	6.35
ln(male)	-7.13***	72.83	38.40	-9.06***	-20.63***	-1.18
ln(female)	-11.63***	24.27	21.13	-19.27***	-12.90***	-20.96***
ln(capital intensity)	16.61	12.21	0.92	-12.98***	-5.16***	-13.62***
ln(TFP)	-8.75***	6.50	-12.17***	-18.98***	-16.74***	-22.26***
SMEs						
ln(wage)	29.34	19.46	-6.72***	5.42	-10.42***	-16.00***
ln(fringe benefit)	24.39	12.35	-12.79***	-0.77	-15.50***	-19.23***
ln(education)	-22.14***	-9.32***	-17.05***	-21.45***	-24.81***	-33.09***
ln(skill)	7.60	-9.35***	-14.90***	-30.59***	-20.89***	-63.23***
ln(education) ×*ln*(skill)	-20.98***	-25.51***	-29.61***	-34.44***	-49.02***	-62.28***
ln(male)	3.09	-16.60***	-22.11***	-28.46***	-24.75***	-26.39***
ln(female)	-12.11***	-17.98***	-26.35***	-28.44***	-33.57***	-28.22***
ln(capital intensity)	9.50	0.30	-14.39***	-19.05***	-18.10***	-16.71***
ln(TFP)	13.73	16.29	-0.71	-11.59***	-3.75***	-23.24***

Table 2: (Continued)

Notes: Null hypothesis denotes unit root (assumes common unit root process). ***, ** and * show significant at 1%, 5%, and 10% level, respectively.

The obtained results reveal that the export dummy variable is positively and significantly related to the worker earnings, and the positive sign indicates that firms' exporting activities are able to pay more to their workers. As Melitz (2003) argues, entering the foreign markets offers more profit opportunities and makes firm able to cover trade sunk costs. By entering foreign markets, firms may benefit from knowledge spillover from their international counterparts. This learning by exporting reduces the marginal cost of production and enhances firms' efficiency (Aw & Batra, 1995), which leads to paying more wages and premiums to the employees. This result supports the findings of previous studies such as Isgut (2001), Hansson, xe, and Lundin (2004), Schank, Schnabel, and Wagner (2007), and Were and Kayizzi-Mugerwa (2009) which emphasise the role of exporting on the worker earnings.

The coefficients of size are positive and statistically significant in all models except for model (1), showing that larger enterprises will pay more to their employees rather than smaller ones. As demonstrated in previous studies, in larger firms, the production processes are more dependent on the output of work teams. Larger firms, then, need more steady workers to reduce the costs of monitoring and duty shrink. Therefore, after employing the required workers, large firms tend to pay more wages and premiums to reduce the probability of quitting because of the screening investment in their workers (Ehrenberg & Smith, 2016). This result confirms the findings of Gerlach and Hübler (1998) and Fu and Wu (2013) about the role of size on worker earnings in Germany and China firms, respectively.

The log of capital intensity (capital-labour ratio) is positively related to earnings, which supports the capital-skill complementarity hypothesis. It is well established that larger enterprises are more capital intensive and require employing more skilled workers for dealing with complex equipment. Therefore, the capital-labour complementarity intends larger firms to pay more to their workers. This result is in line with the studies of Doms, Dunne, and Troske (1997), Leiponen (2005), and Grund and Sliwka (2007) who reported that increasing the capital-labour complementarity enhances productivity, suggesting more skilled workers and higher wages. The coefficient of total factor productivity is also positive and statistically significant at 1% level. It means that larger firms are more productive, hire more skilled workers and offer higher earnings to them. This result is in line with Yasar and Paul (2008) for the case of Turkish manufactures. Finally, diagnostic tests such as Hansen test and first and second- order serial correlation indicate that the models fit well and there are not over-restrictions or first and second- order serial correlation in the models.

Table 3: General model estimation (dependent variable: *total earnings*)

Variables	Model (1)	Model (2)	Model (3)	Model (4)
ln(earnings)$_{i,t-1}$	0.582***	0.713***	0.676***	0.751***
	[0.017]	[0.015]	[0.014]	[0.013]
ln(education)$_{i,t}$	0.637***			
	[0.039]			
ln(skill)$_{i,t}$		0.554***		
		[0.014]		
ln(education)$_{i,t}$ ×*ln*(skill)$_{i,t}$			0.381***	
			[0.012]	
ln(male)$_{i,t}$				0.909***
				[0.026]
ln(female)$_{i,t}$				0.115***
				[0.018]
D_exporting	2.252***	0.506***	0.767***	0.232***
	[0.247]	[0.151]	[0.194]	[0.140]
ln(capital intensity)$_{i,t}$	0.214***	0.181***	0.163***	0.153***
	[0.009]	[0.007]	[0.007]	[0.006]
ln(size)$_{i,t}$	-0.009	0.063***	0.119***	0.118***
	[0.027]	[0.016]	[0.023]	[0.017]
ln(TFP)$_{i,t}$	0.313***	0.266***	0.239***	0.223***
	[0.013]	[0.011]	[0.009]	[0.009]
Diagnostic tests				
AR(1)	(0.000)	(0.000)	(0.000)	(0.000)
AR(2)	(0.934)	(0.774)	(0.770)	(0.589)
Hansen test	0.911	0.860	0.873	0.822
Instrument	49	49	49	50
Observation	1188	1188	1188	1182

Table 3: (Continued)

Notes: ***, ** and * show significant at 1%, 5% and 10% level respectively. Standard errors are in brackets. The calculations were carried on using the software STATA15.

4.3 Robustness Check

In the prior section, we used the average earnings as the dependent variable. It is evidenced that Iranian manufacturing enterprises pay wage and non-wage benefits such as rewards, overtime, medical care insurance, cost of food and clothing, old-age pension funds, transportation cost, child allowance, and other related issues to their employees. Hence, in the remainder of this section, we analyse the effects of worker and enterprise characteristics on average wage and fringe benefit in Tables (4) and (5). Our empirical strategy is based on the estimation of standard wage and fringe benefit equations previously tested in similar studies. In addition, besides using the different measurements of the dependent variable and to get detailed and more comprehensive results, we also consider two different categories of enterprises, namely, SMEs and large enterprises according to their size of the activity.

The empirical investigation was done in various steps and estimated in different scenarios. Tables (4) and (5) show the main findings obtained from estimating Equations (5) and (6) in four different steps. The results are generally consistent with the theoretical predictions. As a starting point, Models (1) and (5) present the results from estimations when the education and enterprise characteristics variables are included and, when $\gamma_4 = \gamma_5 = \beta_4 = \beta_5 = 0$. The estimated coefficients have the expected sign and are statistically significant at 1% level for both wage and fringe benefit equations. The results strongly indicate that in large enterprises, the effect of educated workers on wage and fringe benefit is higher than SMEs (0.715 to 0.083 in wage and 0.722 to 0.216 in fringe benefit equations). These findings are consistent with the labour quality hypothesis that indicates that larger firms usually hire workers with higher quality or education because of capital-labour complementarity, economies of scale, financial advantages, and other related issues. Moreover, based on the efficiency wage model, larger firms have to reimburse higher monitoring costs, which may reduce shirking problems, since they intend to attract skilled workers and pay wages above the market clearing level to them. Finally, utilising more advanced technology in larger firms promotes greater complementarity between workers and a higher return on human capital (García-Pozo, Sánchez-Ollero, & Benavides-Chicón, 2012).

In the second step, the equations were estimated using the skill variable (Models 2 and 6) as the second measurement of workers' characteristic. As can be seen, our estimation gives mixed results for SMEs and large enterprises. Based on these results, workers' skill in large enterprises has positive and significant effects on average wage and fringe benefit (0.585 in wage and 0.576 in fringe benefit equation), while in the case of SMEs, the results show the negative effect of skill on dependent variables (-0.397 in wage and -0.841 in fringe benefit equation). In the third step, we included the interaction between education and skill as an independent variable in the wage and benefit fringe models. As can be seen, all coefficients are positive and significant at 99% level of confidence with a range from 0.062 to 0.359. Our estimations suggest that the interaction between education and skill in large enterprises has a higher effect on wage rather than SMEs (0.353 to 0.062, respectively) and this finding is the same for the result observed in the fringe benefit model (0.359 to 0.163, respectively).

Another possible explanation for the firm size-wage effect is related to different gender conditions. Thus, to investigate the effect of gender conditions on workers' wage and fringe benefit, in the fourth step, we included the share of male and female workers in the equations. As Table 4 and 5 show, Models 4 and 8 report the results from Equations (5) and (6) by setting $\gamma_3 = \beta_3 = 0$. In this step, we considered gender conditions and enterprise characteristics as explanatory variables that, except for female workers in fringe benefit equation, all coefficients are positive and significant at 99% level of confidence with a range from 0.028 to 0.916. Our results suggest that the share of male workers in both SMEs and large enterprises have a higher impact on wage rather than the share of female ones (0.604 to 0.028 in SMEs and 0.731 to 0.113 in large enterprises, respectively). In other words, estimations highlight the important role of male workers on the wage rather than female workers. However, since the coefficients of the female variable in Models 4 and 8 in Table 5 are insignificant, we just focused on significant coefficients.

Table 4: Model estimation (dependent variable: *wage*)

	SMEs				**Large**			
Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**
$ln(\text{wage})_{i,t-1}$	0.914***	0.916***	0.916***	0.941***	0.593***	0.806***	0.758***	0.822***
	[0.009]	[0.009]	[0.008]	[0.008]	[0.018]	[0.017]	[0.016]	[0.015]
$ln(\text{education})_{i,t}$	0.083***				0.715***			
	[0.018]				[0.026]			
$ln(\text{skill})_{i,t}$		-0.397***				0.585***		
		[0.039]				[0.015]		
$ln(\text{education})_{i,t} \times ln(\text{skill})_{i,t}$			0.062***				0.353***	
			[0.020]				[0.009]	
$ln(\text{male})_{i,t}$				0.604***				0.731***
				[0.145]				[0.028]
$ln(\text{female})_{i,t}$				0.028***				0.113***
				[0.020]				[0.024]
D_exporting	**0.744** ***	**0.353*****	**0.691*****	**0.656*****	**2.074*****	**0.715*****	**1.405*****	**0.847*****
	[0.071]	[0.030]	[0.078]	[0.106]	[0.173]	[0.075]	[0.114]	[0.095]
$ln(\text{capital intensity})_{i,t}$	0.082***	0.085***	0.084***	0.079***	0.198***	0.137***	0.127***	0.131***
	[0.005]	[0.005]	[0.005]	[0.004]	[0.010]	[0.009]	[0.009]	[0.009]
$ln(\text{TFP})_{i,t}$	0.044***	0.045***	0.044***	0.041***	0.315***	0.224***	0.218***	0.209***
	[0.003]	[0.003]	[0.003]	[0.002]	[0.019]	[0.014]	[0.016]	[0.014]
Diagnostic tests								
AR(1)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AR(2)	(0.604)	(0.513)	(0.636)	(0.352)	(0.275)	(0.939)	(0.402)	(0.948)
Hansen test	0.850	0.839	0.995	0.724	0.798	0.852	0.731	0.813
Instrument	47	47	47	48	47	47	47	48
Observation	1140	1139	1139	1128	1098	1098	1098	1092

Notes: ***, ** and * show significant at 1%, 5% and 10% level respectively. Standard errors are in brackets. The calculations were carried on using the software STATA15

Table 5: Model estimation (dependent variable: *fringe benefit*)

	SMEs				Large			
Variables	**Model (1)**	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**	**Model (8)**
ln(fringe benefit)$_{i,t-1}$	0.869***	0.882***	0.869***	0.906***	0.471***	0.674***	0.651***	0.744***
	[0.014]	[0.015]	[0.016]	[0.015]	[0.022]	[0.025]	[0.023]	[0.023]
ln(education)$_{i,t}$	0.216***				0.722***			
	[0.041]				[0.036]			
ln(skill)$_{i,t}$		-0.841***				0.576***		
		[0.178]				[0.024]		
ln(education)$_{i,t}$ ×*ln*(skill)$_{i,t}$			0.163***				0.359***	
			[0.046]				[0.0145]	
ln(male)$_{i,t}$				0.719***				0.916***
				[0.229]				[0.039]
ln(female)$_{i,t}$				0.041				0.001
				[0.039]				[0.034]
D_exporting	0.748***	-0.080	0.662***	0.438***	2.843***	1.093***	1.789*	0.842***
	[0.129]	[0.073]	[0.155]	[0.158]	[0.144]	[0.082]	[0.099]	[0.129]
ln(capital intensity)$_{i,t}$	0.089***	0.092***	0.095***	0.094***	0.213***	0.164***	0.145***	0.136***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.015]	[0.014]	[0.015]	[0.015]
ln(TFP)$_{i,t}$	0.056***	0.059***	0.057***	0.053***	0.320***	0.256***	0.225***	0.183***
	[0.005]	[0.006]	[0.005]	[0.005]	[0.021]	[0.020]	[0.020]	[0.019]
Diagnostic tests								
AR(1)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AR(2)	(0.288)	(0.235)	(0.235)	(0.322)	(0.806)	(0.747)	(0.705)	(0.621)
Hansen test	0.566	0.742	0.756	0.443	0.654	0.631	0.636	0.648
Instrument	47	47	47	48	47	47	47	48
Observation	1140	1139	1139	1128	1098	1098	1098	1092

Notes: ***, ** and * show significant at 1%, 5% and 10% level respectively. Standard errors are in brackets. The calculations were carried on using the software STATA15.

Returning to the estimates of the wage and fringe benefit models, we focus on the results of enterprises' characteristic variables. In Tables 4 and 5, the log of the capital-labour ratio is positively and significantly associated with wage and fringe benefit in both firm subgroups, while the positive effect of capital intensity in large enterprises is more than the same effect in SMEs. This finding supports the capital-labour complementarity hypothesis for both groups of Iranian manufacturing enterprises with a stronger effect in large enterprises. According to Troske (1999), larger firms are more likely to employ more complicated capital equipment, and if there is a complementarity between the skill of capital and the skill of workers, large employers are also more likely to employ more skilled and highly paid workers. Similar results were found for the case of TFP reveal that total factor productivity positively and significantly (99%) affected relative wage and fringe benefit in both groups of the enterprises. However, regarding the magnitude of the coefficients, the elasticity of the TFP turns out to be larger in large enterprises compared to the SMEs. This finding indicates that larger enterprises are more productive (Lucas, 1978; Melitz, 2003) and pay higher wage and non-wage benefits to their employees which supports the view of Burdett and Mortensen (1998).

Finally, the estimated coefficients β_2 and γ_2 also measure the export-wage and export-fringe benefit relationships for the SMEs and large enterprises respectively. As shown in Tables 4 and 5, the estimated results suggest that the export dummy has a positive and significant effect on both enterprise subgroups. However, for the case of large enterprises, the positive effect is found to be more pronounced than SMEs. Thus, the overall results of this section notify to this stylised fact that larger exporting enterprises are more productive, skilled, and capital intensive and tend to pay more wages and non-wage benefits to their employees in the Iranian manufacturing sector.

5. Summary and Conclusion

It has been widely recorded that there is a positive relationship between firm size and worker earnings. However, this fact has not been verified by all sectors or countries. In this paper, we examined the firm size-wage effect hypothesis in the Iranian manufacturing enterprises at the four-digit aggregation level of ISIC classification over the period 2004-2013. The two-step GMM-SYS technique was applied to estimate total earnings, wage, and fringe benefit equations. In addition to the new facts presented in our analysis, this paper adds some contributions to the current literature. First and most importantly, this study concerns Iran and, to the best of our knowledge, it is the first attempt to addresses the firm size-wage relation for this country, which faces the harsh effects of economic recession and labour supply surplus during the last decade. Furthermore, to extend the analysis, we distinguished enterprises into small and medium, and large, and analysed the effect of earning determinants across each subgroup. Finally, the equation was estimated for total earning and its major components (wages and fringe benefits) for each type of enterprise.

The result indicates that larger enterprises with more productivity and capital intensity pay higher wages and fringe benefits to their employees, even when controlling for education, skill, and gender variables. The second part revealed that differences in skill structure, capital intensity, productivity, and exporting lead to wage and fringe benefit differences between enterprises. Although we found that the share of education, the interaction between education and skill, male workers, capital intensity, TFP and exporting have positive and significant impacts on relative wages and fringe benefits in both of the subgroups, these effects are more pronounced in large enterprises than SMEs.

In terms of policy implications, we recommend that business owners pay more attention to growth-driven factors such as capital intensity and total factor productivity in their policymaking. On a broader scale, government export stimulation policies should provide tools to assist local enterprises in promoting their export-oriented activities and access to foreign markets, especially after lifting economic sanctions on Iran. Strong relationships with international business partners, using foreign assistance, and increasing the capacity of FDI absorption are additional tools to improve the manufacturers' trade potential. For sustainable export orientation, the government should also limit its control over the price of manufacturing production. Furthermore, the government should facilitate access to credit for the manufacturing enterprises and direct them toward banking loans at preferential rates. For the case of SMEs specifically, government assistance programmes should help overcome the restrictions that are related to starting export activities. The government can also introduce programmes to help enterprises seek business opportunities abroad. It can help business owners enhance their international mindset and orientation of activities.

As the results show, size is an important factor for stimulating the enterprises to pay a higher wage and fringe benefit to their employees. Therefore, the government should take some policy tools to encourage SMEs to increase their size. Improving the quality of the business environment, integration to international markets, and facilitating the access to required credit, technologies, skills, and raw materials are effective tools to help SMEs scale-up.

Furthermore, successful education and training policies that increase the skill ratio may also act as an indirect incentive to workers' earning in both subgroups. As the Management and Planning Organisation reports recently, during the Sixth Development Programme, a major share (about 80%) of the labour supply will associate to the higher education graduates (Ashrafzadeh & Alaedini, 2018). Therefore, the manufacturing sector should absorb a large cohort of new graduates in the country. This will also have a positive impact on the skill intensity of manufacturing enterprises.

This paper has provided the first empirical analysis of the firm size-wage effect in Iranian manufacturing enterprises. Although it provides impressive results, the effect of firm size on worker earnings in other sectors such as service, wholesale and trade are not analysed. These could be important avenues for future studies of the Iranian economy.

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Notes

1. For more discussion, see Kremer and Maskin (1995) and Troske (1999).
2. For more discussion, see Oi (1983); Tan and Batra (1997).
3. For example, see Pull (2003); Mazumdar and Mazaheri (2002).
4. For further details, see Pedace (2010).
5. Logarithm of total employment as a main index of firm size is the most common variable in previous studies.
6. For further reading see Ahrens, Pirschel, and Snower (2015).
7. Andersson and Koster (2010) indicate that the GMM-SYS estimator has higher efficiency and less finite sample bias compared to the GMM-Diff estimator in the presence of persistence.

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