Does Unionization Rate Matter for Labor Productivity Level: Panel Evidence

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Sendikalaşma Oranı İşgücü Verimliliği İçin Önemli midir?: Panel Kanıt

Özet

Bu çalışma on üç farklı işgücü verimlilik göstergesini kullanarak sendikalaşma oranının işgücü verimliliği üzerindeki etkisini incelemektedir. Analizlerde kullanılan veri seti dengesiz panel veri olup 2000-2013 yılları arası ve elli bir ülke içindir. Literatürde konu hakkında iki zıt ampirik bulguya rastlanmaktadır. Çalışmalardan bazıları sendikalaşma ile verimlilik arasında negatif ilişki tespit ediyor iken diğerleri pozitif ilişki bulmaktadır. Bundan ötürü sendikalaşmanın verimlilik üzerindeki etkisinin yönü belirsizdir. Çalışmanın ana bulgusu sendikalaşma oranı ile işgücü verimliliği arasında kuvvetli ve istatistiksel olarak anlamlı negatif bir ilişkinin olduğunu ortaya koymaktadır. Bundan dolayı daha yüksek sendikalaşma oranına sahip ülkelerin daha düşük işgücü verimlilik düzeyi ile karşı karşıya kaldığı sonucunu çıkarabiliriz.

Anahtar Kelimeler: Sendikalaşma Oranı, İşgücü Verimliliği, Panel Çalışma

Does Unionization Rate Matter for Labor Productivity Level: Panel Evidence

Abstract

This study investigates the effect of unionization rate on labor productivity by using thirteen distinct labor productivity indicators. The data used in the analyses is unbalanced data covers the periods between 2000 and 2013 for fifty one countries. There are two opposite empirical findings on the issue in the literature. While some of the studies find negative association between unionization and productivity, the others find positive association between unionization and productivity. Hence the impact of unionization on productivity is ambiguous. The main finding of the study reveals a strong and statistically significant negative association between unionization rate and labor productivity and this finding remains valid in all models. Hence we may conclude that countries with higher unionization rate face lower labor productivity level.

Keywords: *Unionization Rate, Labor Productivity, Panel Study*

1. Introduction

The effect of labor unionization on productivity level of a country is one of the main disputes in the unionization literature for a long time. Productivity level in a country is not just related to economic policies or strategies prevailing in that particular country. The idea that economic justifications and explanations are not merely sufficient to explain the changes in productivity level is also one of the important headlines of endogenous growth models emerged at the end of the 20th century. Therefore the

studies conducted by Filippetti and Peyrache (2013), Piero (2013) and Felix and Thum (2013) draw attention to the roles of socio-political environment on productivity. According to these studies, decisions taken by politicians, labor market and non-governmental organizations have great impacts on productivity accordingly on economic growth.

Unions' effect on productivity is an important issue for policymakers, unions and business world as much as for scientists in industrial relations and economics. Theoretical and empirical findings of the studies on the issue are not one-way but contradictory. While a part of the empirical studies on the relationship between unionization and productivity find positive association between them, some others find negative; nevertheless, it is impossible to assert that there is no interaction between them.

Theoretical advancements about the issue are related to negotiations for wage rise and working conditions; whereas, empirical studies are related to direct effect of unionization on productivity. Although rates of unionization and numbers of union membership differ by years and countries across the world, on the whole, the inclination for unionization in an economy is still a source of concern. This makes the productivity issue more important in the balancing counter effect in fiscal competition caused by high wage of unionized labor.

With reference to the description of the International Labor Organization (ILO), unions are the labor organizations established to defend the interest of labors. Hence the total number of labors affiliated to a union might be assessed as an indicator of union power. Besides, the unionization density is an indicator of the labor's degree of being organized. Unionization density reflects the rate of union members among the working labors, as a percentage of total number of labors (ILO, 2016).

In political and social context, unionization density is an indicator which needs to be assessed within the legislative and institutional framework. Nonetheless, this rate is not a significant indicator reflecting the power of unions in industry wide bargaining. In some countries like France, unionization rate might be relatively low. Nevertheless, collective labor agreements play a crucial role in the regulations bounden in the determination process of employment conditions and in the provision of high-level laborer participation. Likewise, in old Soviet Union countries, unionization rate might be relatively high; however, that reflects neither the power of unions nor the dimension of freedoms (Hayter and Stoevska, 2011: 2).

Accordingly, this kind of a definition and role assignment make unions even more competent in obtaining and preserving members and wage gains in the environment of less competitive economic climates and political structures more prone to political corruption. Industries with oligopolistic market structures in which it is hard to enter the market and obtain scale economies or regulated industries in which entry or

competition (in either domestic or international form) is restricted by the state constitutes instance for this case (Hircsh, 1997: 38). Hence, unionization may be affected by facts such as the open and competitive structure of the market, the advance in legal order and democracy; however, it may not act in parallel with these facts. There may be increase in density of unionization in order to gain and preserve economic and political interest like gaining political advantage or emergence of political corruption and its continuation. On one hand, this point of view makes the reason of unionization no longer economic; on the other hand, its results are more political irrelevant to productivity.

In addition to the political and economic factors affecting productivity level in an economy, unionization rate may also play a role in the explanation of productivity level. Therefore, in this study we analyze the relationship between unionization rate and labor productivity. In the analyses we use thirteen different productivity indicators in order to check the validity and robustness of our finding. Our data is unbalanced data and our sample covers the years between 2000 and 2013 and fifty one countries. As indicated in discussion above, the impact of unionization rate on productivity is ambiguous; thus, the effect of unionization rate on labor productivity may be either positive or negative. The detailed review and discussion about the studies supporting the negative and positive impact of unionization on productivity are argued in the following literature section. The primary finding of the empirical study indicates a strong and statistically significant negative association between unionization rate and labor productivity and this finding remains valid in all models. Hence we may claim that countries with higher unionization rate experience lower labor productivity level. Meanwhile, to the best of our knowledge, this is the first study in the literature examining the issue with so many countries (i.e. fifty one countries) and checking the validity of results with so many proxies (i.e. thirteen variables) of productivity.

The remaining parts of the article proceed as follows. The following section reviews the literature. Data and methodology are explained in section three. The findings are reported and discussed in fourth section. Finally the last section concludes.

2. Literature

It is clear that making wage rises without having positive increase in productivity in companies which possess flexible practices towards unionization in an industry would cause increase in company costs and decrease in competition superiority in comparison with the other companies in the industry. In this case, costs would be reflected to the consumer prices; however, in the long term, the sustainability of this case will gradually get harder. Entrance of non-union companies to the market and market extension will become comparatively easier and/or manufactured products would be traded in the world market. Briefly, to gain and sustain bargaining power and members for a union is challenging in an open and competitive economy in which

there is no positive progress about productivity which will balance the rise in wages (Hirsch, 1997: 38).

In the understanding of classical economics, unions are obstacles for the price (i.e. wage) taken place in labor market to be liquid and thereby for market to be free and balanced with its own dynamics. According to the understanding of standard economics, unions increase wages over the competitive level and administration responds this by increasing the density of the capital in the workplace. In this way, the productivity of the labor and hence the quality of labor force are improved. Actually, this kind of productivity effect of the unions is accepted as the most controversial field among existing issues (Freemen and Medoff, 1984). Furthermore, increase of average wage level provided by union rights in labor force will make a greater impact on macro-economic indicators like inflation, interest rates, and investments and, also at the same time, on factors providing national competitive advantage and on international trade (OECD, 1995 and 1997).

The literature about the adverse effect of unionization on productivity is also named as neo-classical view. For instance, Metcalf (1990) base the negative relation between unionization and productivity on four reasons. Firstly, unions can limit the executive decisions by collective bargaining which brings flexibility to executive decisions. Secondly, because of the fact that unions always inform laborers about advantages of legal regulations (e.g. by imposing rules related to seniority to the employer), this might weaken competition among employees. Thirdly, labor movements organized by unions may bring negative effect on the grounds that they would give rise to capacity limiting effect as a result of the uncertainty with regards to output levels and they would also cause the company fall into disrepute in the market. Fourthly, unions might decrease the enterprise power in capital equipment and research and development investments by decreasing the investments' rate of return. Lastly, existence of unions might cause problems in industrial relations by breaking the trust and dissolving the collaboration between administration and employees.

On the other hand, in the approach based on positive relation between unionization and productivity, studies of Freeman and Medoff (1979, 1983, and 1984) are important. This approach is known as Harvard school in the literature. According to this, unions, by decreasing labor force turnover, might lower the new-employment and job training costs which take a very serious place in labor costs. On the other side, unions follow the requirements of legal legislation on behalf of the employee by preventing arbitrary decrees of punishment and reward on labor force and thus, it becomes morale booster and source of motivation for the laborer. Additionally, unions can improve productivity of labor force by means of collective bargaining and also by opening the communication channels between employees and administration. Lastly, by virtue of the unions, employers become more aware and enterprising in the sector against high price and thereby, cost of labor force.

Beyond any doubt, unions have dramatically changed after the study of Freemen and Medof (1984) which considerably affected literature about the effect of unionization on the growth, profitability and productivity. After that, unions have been known as organizations which make wage-claims, dissuade the entrance of new technologies and capital investments (Pantuosco and Seyfried, 2008: 27; Asteriou and Monastiriotis, 2004: 30). Besides, if the analytical studies up to the present had found out that unionization and collective bargaining in the workplace increase productivity to the degree that bearing the cost brought by the systematic unionization and collective bargaining process, facilitation of the formation of union organizations in the workplaces and in the sector would be a strong argument for the policy makers (Hirsch, 1997: 42).

These two contradicting approaches about the effect of unionization on productivity also accept that existing association between unions and productivity cannot be generalized for all empirical studies. Two different directional disputes on unionization and productivity raise the importance of empirical studies about the issue more. Empirical analyses and findings are necessary to evaluate relative importance of views on unionization. However, at the beginning, it should be emphasized that the effect of unionization on productivity significantly differs across industry, time and countries. The importance of two different approaches on the issue is determined by legal and economic environment where unions and companies operate. Therefore, the fact that the political, social and economic factors which differentiate the effects of unionization on productivity is variable according to industry, time and country is an obstacle for taking any of the two different approaches about productivity effect as gospel (Hircsh, 1997: 39). Furthermore, new researches to be conducted might bring new sources related to the effect of unionization on productivity which have not been discussed by these two approaches. So then, empirical studies about the effect of unionization on productivity might cause results which may rapidly change with regards to the political and socio-economic conditions and structures, numbers and world conjuncture of the countries mentioned.

At the beginning, the unionization-productivity relation was examined at industries in various countries, especially at public sector, for many branches of industries like construction, cement, banking and coal. Many of these studies inspired by studies of Freeman and Medof (1979 and 1984) have used data of the USA and the UK and focused on productivity level of these two countries (Clark, 1980 and 1984; Addison and Hirsch, 1989; Denny, 1997; Chezum and Garen, 1998). While many of the studies originated from the USA associate unionization with high productivity, many of the studies in the UK and Australia reveal either there is no effect of unionization on productivity or there is a negative effect on it. While it seems as if there is a positive effect of unionization on productivity in France, this situation is more disputable in Germany and Japan (Doucouliagos and Laroche, 2016).

The main frame of literature expressed above requires the sorting of studies which analyze the effect of unionization on productivity into two groups.

2.1. Negative Effect

Hirsch and Link (1984) concluded that results gained in the report of Harvard scholars are not healthy and the outcomes cannot be generalized. According to the results obtained in the empirical studies done by the researchers, increase in the density of unionization decreases productivity both in terms of level and growth rate. Unionization will lead to lower productivity degrees not only because of the obtained gains as a result of the wage rise, but also because of the decrease in flexibility in the management, entrance of ineffective work rules to the work environment and wage restrictions based on individual productivity. While the findings obtained from Harvard scholars' studies reveal that unionization would create a higher productivity, analyses related to Research & Development costs, as opposed, assert that increase in the productivity in the industries with higher rates of unionization is lower.[1]

Based on the new evidences about union membership on company level, Hirsch (1991) analyses the effects of unionization on the profitability, investment behavior and productivity growth in 1970's in detail. According to Hirsch, studies in the literature do not support the positive productivity effect of unionization; findings of empirical studies on employment and profitability do not verify a consistent and large-in-scale productivity effect of unionization.

Hirsch thinks that the relation between unionization and productivity growth is not too clear. The overall studies on this field are focused on total factor productivity. Most of these studies use the industrial unionization rate as a control variant in their analyses. In these studies that have been held in data and econometric limitations, it is generally inferred that high unionization density decreases the productivity among companies and industries. On the other hand, it can also be expressed that there is no direct impact of unionization on productivity growth but indirectly growth-enhancing investments and R&D investments may affect productivity (Hirsch, 1991: 5).

Despite a number of researchers who have positive predictions on the effect of unionization on productivity, more common view in the literature is that unionization has negative impact on productivity and manufacturing. As unionization causes increase in the wages, theory supports the idea that employer acting with profit maximization motivation substitutes labor for capital and thus responds with the reduction of labor employment. (Ehrenberg and Smith, 2012: 480). DeFina (1983) and Lovell (et. al, 1988) can be given as examples of studies which assert that there is negative effect of unionization on productivity and output in the whole economy. Similarly, Nickell and Layard (1999) predicted negative effect of unionization on

[1] See Turnbull (1991) for another critique on Harvard view.

economic growth in their study carried out using panel data analysis for OECD countries.

According to Black and Lynch (2001), impact of unionization on productivity is highly connected to the quality of the relationship between employee and employer in each environment of collective bargaining. The study shows that even though unionized and nonunionized companies have similar practices in human sources formed with the participation of employer and employee together and having outcome-based payment form, unionized companies get higher productivity level than nonunionized one. Unless unionized companies perform such practices, they have gained lower productivity than nonunionized one.

According to Metcalf (2002), the existence of union in a workplace or a company increases wage level. If productivity is not increased concordantly, financial performance of the company gets worse. Metcalf who lays emphasis on the effect of unionization on financial performance, investment and productivity has analyzed the results of these effects in six countries (the USA, Canada, England, Germany, Japan and Australia) in his study. He found negative association between unionization and productivity for just Australia and England among the six countries.

Contracts signed by the unions in order to protect laborers may affect productivity negatively. Autor, Kerr and Kugler (2007) in their study examine this argument in the USA for the period between 1970 and 1999, and identified that productivity decreases as a result of that type of contracts. Findings of the study show that protective contracts may cause deterrent and restrictive practices against acquiring high productivity.

Studies in the literature about the effect of unionization on productivity show that high unionization density considerably prevents foreign direct capital investments. Radulescu and Robson (2008) found out that multi-national companies which aim to expand their foreign market area prefer the companies and countries having lower unionization density and weak bargaining power and allowing flexible wage settings. Therefore, unionization may indirectly deteriorate productivity level through deterring high-tech productive foreign direct investments.

Ehrenberg and Smith (2012) state that unionization negatively affects productivity by resisting technological innovations which may displace labor force. Bargaining of the laborers against research-development and technological innovations causes decline in productivity in the long term.

Doucouliagos and Laroche (2013, 2003) obtained negative empirical findings particularly between technological innovations and unionization in their studies. The study conducted by using meta-regression analysis provides a systematic review of the econometric evidence on the effects of unions on innovation and technology adoption. Twenty-nine studies were evaluated in the study and 3 (Austria, Australia and Canada)

out of these 29 studies were about the USA and the correlation coefficients vary between -0,81 and +0,29. The results show that the relation between productivity growth and unionization is negative particularly for the USA. While most of the 29 studies found significant negative relationship, some of the studies found insignificant relationship. Only two studies have found the positive relationship between unionization and productivity. In as much as the findings, unions restrain technological innovation in the countries.

If the unionization trend causes an increasingly rise in laborers' wages in the sectors, the higher wages will cause decrease in employment and an increase in the job cuts (even temporarily). In such a case, workers will shift to other sectors in which they will become less productive than in that they came. In this case, workers possessing skills of the company which they left will impossibly make themselves accepted in a different sector and position. According to Borjas (2013), rise in the wage levels will cause decrease in employment, occupational immobility and ineffective distribution of human resources, all which will create negative effect in productivity.

Unions have had played essential role in economic and political histories of Latin America. Economic and political development process of the unions in Latin America is not low dimensional. In the past, governments and unions have been in mutual interaction. Rios-Avila's study (2014) uses augmented Cobb-Douglas production function in order to analyze the impact of unions on productivity in manufacturing sector for six Latin America countries (Argentina, Bolivia, Chile, Mexico, Panama and Uruguay). The study shows that, except Argentina, unionization largely has positive effect on productivity; however this occurs at a small scale. This small effect is a productivity effect which can nearly bear the high cost brought by unionization. The study also reveals that union density has negative effect on productivity on a large scale in Argentina whereas there is no effect in Bolivia.

2.2. Positive Effect

Studies regarding unions as providing higher productivity adopt the opinion that unions are effective not only in resolution of the working condition conflicts but also about assuring reformatory investments aimed at workforce. Besides, by virtue of the power to be attained by unionization, raise in wages will be the motivation necessary for productivity increase of the workers. There is no doubt that the most important representatives of this opinion are Freeman and Medoff (1984) with their study called "What Do Unions Do?". As unions give opportunity to their workers to deliver their opinions and complaints about production process and working conditions, workers will be involved into the decision making process and thus create opportunity to solve the problems.

Clark (1979) made impact analysis concerning the effect of unionization on productivity about the USA cement industry, and concluded that the productivity of

unionized enterprises is 6-8% more than their counterparts which are not unionized. By using time series data he reached to another conclusion that the productivity in pre-unionization compared to the productivity in post- unionization in time series data supports similar percentages positive effect.

According to Dahl (1985) and Alesina and Rodrik (1994), providing an equal participation in decision making process in a more democratic setting will create an impact which will diminish the struggle between capitalist class and working class. This case will be a source of motivation for the workers to show a higher performance and to get better results in the production process.

Asteriou and Monastiriotis (2004) used panel data analysis in their study to inquire into the existence of relationship between unionization and productivity for 18 OECD countries and came to a conclusion that unionization affects productivity positively and also found out that it increased production per worker.

Morikawa (2008) conducted an empirical study on many Japan companies using the data acquired from these companies. The study empirically analyses the relationship between company's performance in the sense of profitability and productivity and presence of union. The study attains two results; the first, productivity is affected positively by unionization; and the second unionization has a negative impact on company profitability.

In the empirical study on Chinese economy by Lu, Tao and Wang (2010), even though they have found out that unions have positive impact on productivity, such an impact do not exist for the company's profitability. Findings obtained from the study shows that, unions in private enterprises in Chinese economy which switched from central economy to market economy support workers' interests without expelling traditional relationships inside employment structure, as the unions in other countries.

Muller (2012), who is a proponent of positive effect, argues that consistent human capital investment give rise to higher productivity. Muller analyzed the effect of worker representatives' such as work councils on productivity in 1267 small and medium-sized enterprises in Germany and inferred that these kinds of organizational structures – in favor of the workers – affected productivity more than known. Labor-force mobility may be reduced by the contracts which ensure consistency of work-place and advanced employment relations skills. Unions promote contracts which ensure permanence of their members in the workplace. Employers are more interested in employees who have the ability to advance special skills peculiar to the company than those who change their workplaces easily. This case is also reported in the studies of Auer, Berg and Coulibaly (2005) who concluded that the consistency of workplace leads to a higher productivity in 13 European Union member states between 1992 and 2002. According to the study, consistent contracts provide stronger employment relationships and higher wages. When workers make the company profit more as a

result of high productivity, the company may share its profitability with productive workers. Therefore, this will not only motivate workers, but also make them go on working in that particular workplace.

Against the idea of negative effect proponents who think that higher prices would decrease productivity because of its negative effect on the production costs, positive effect proponents think that this, though being a fact which increases unemployment, has a positive effect on the workers' motivation which leads to a higher productivity. Kumar, Webber and Perry (2012) found that 1% increase in wages provided 0,5-0,8% increase in productivity in manufacturing sector in Australia between 1965 and 2007. According to the researchers, increase in the purchasing power of the workers affect their performance in the workplace positively, and decreases their probability of leaving the job, provides the motivation for a higher productivity needed to avoid the risk of dismissal by the employer.

3. Data and Methodology

We investigated the impact of labor union on labor productivity by using 13 distinct productivity indicators. Our unbalanced data covers the periods between 2000 and 2013 for 51 countries.[2] Our sample is restricted to 51 countries owing to the unavailability of labor union data for the other countries.

By using unbalanced panel data, we estimate the following one-way multivariate fixed effect models (FEM);

$$PROD_{it} = \beta_{1i} + \beta_2 UNION_{it} + \beta_3 GROSCAP_{it} + \beta_4 ENROL_{it} + \beta_5 HW_{it} + \beta_6 HW^2{}_{it} + u_{it} \qquad (1)$$

and the following one-way multivariate random effect models (REM);

$$PROD_{it} = \beta_1 + \beta_2 UNION_{it} + \beta_3 GROSCAP_{it} + \beta_4 ENROL_{it} + \beta_5 HW_{it} + \beta_6 HW^2{}_{it} + (\varepsilon_i + u_{it}) \qquad (2)$$

where *it* subscript stands for the *i-th* country's observation value at time *t* for the particular variable. All variables (i.e., independent and dependent variables) are in logarithmic forms. β_{1i} represents country specific factors not considered in the regression, which may differ across countries but not within the country and is time invariant. ε_i is a stochastic term, which is constant through the time and characterizes

[2] The sample includes following countries: Argentina, Armenia, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Russia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, United Kingdom, United States, Uruguay.

the country specific factors not considered in the regression. u_{it} is error term of the regression.

Thirteen different productivity indicators are used to represent labor productivity (PROD) in the analyses. The main result of analyses may vary across the productivity indicators in the sense of the sign taken and significance level of the relevant coefficient; however, if the finding of analyses remains valid across those thirteen distinct productivity indicators then this will be indication of the robustness of the result. The list of thirteen productivity indicators, their definitions, and the data sources are given in Table 1 below.

Table 1: List of Productivity Indicators

Indicator Name	Definition	Source
CTFP	Total Factor Productivity Level at Current PPPs	Penn World Table
CWTFP	Welfare-relevant Total Factor Productivity Levels at Current PPPs	Penn World Table
LPRODA	Labor productivity per person employed in 1990 US$ (converted at Geary Khamis PPPs)	The Conference Board
LPRODB	Labor productivity per person employed in 2014 US$ (converted to 2014 price level with updated 2011 PPPs)	The Conference Board
LPRODC	Labor productivity per hour worked in 1990 US$ (converted at Geary Khamis PPPs)	The Conference Board
LPRODD	Labor productivity per hour worked in 2014 US$ (converted to 2014 price level with updated 2011 PPPs)	The Conference Board
PCVALAD	{Gross value added at factor cost (current US$)}/	WDI
	{Total Population}	WDI
PLMANVALAD	{Manufacturing, value added (current US$)}/	WDI
	{Employment in Manufacturing (thousand of persons)x1,000}	ILO
PLAGRVALAD	{Agriculture, value added (current US$)}/	WDI
	{(Employment in agriculture (% of total employment)/100)x	WDI
	(Persons employed (in thousands of persons)x1,000)}	The Conference Board

PLINDVALAD	{Industry, value added (current US$)}/ {(Employment in industry (% of total employment)/100)x (Persons employed (in thousands of persons)x1,000)}	WDI WDI The Conference Board
PLSERVALAD	{Services, etc., value added (current US$)}/ {(Employment in services (% of total employment)/100)x (Persons employed (in thousands of persons)x1,000)}	WDI WDI The Conference Board
PLVALAD	{Gross value added at factor cost (current US$)}/ { Persons employed (in thousands of persons)x1,000}	WDI The Conference Board
PEREMPGDP	GDP per person employed (constant 1990 PPP $)	WDI

CTFP and CWTFP are two indicators of total factor productivity level. LPRODA, LPRODB, LPRODC, and LPRODD are labor productivity indicators measured in either per person employed or per hour worked. PLVALAD is per labor value added and computed by ratio of gross value added at factor cost to persons employed. PCVALAD is per capita value added and computed by ratio of gross value added at factor cost to total population. PEREMPGDP is GDP in terms of per person employed. Also we computed four sectoral labor productivity indicators. PLMANVALAD is per labor value added in manufacturing sector and calculated by ratio of value added in manufacturing to employment in manufacturing. PLAGRVALAD is per labor value added in agricultural sector and computed by ratio of value added in agriculture to employment in agriculture. PLINDVALAD is per labor value added in industrial sector and calculated by ratio of value added in industry to employment in industry. PLSERVALAD is per labor value added in sector of services and calculated by ratio of value added in services to employment in services.

In Table 2 below we provide names, definitions, sources of independent variables used in regression models.

Table 2: List of Independent Variables

Variable Name	Definition	Source
UNION	Trade union density rate (%)	ILO
GROSCAP	Gross capital formation (% of GDP)	WDI
ENROL	School enrollment, tertiary (% gross)	WDI
HW	Annual hours worked per worker	The Conference Board

UNION stands for trade union density rate in terms of percentage. A trade union is defined as a workers' organization constituted for the purpose of furthering and defending the interests of workers. This trade union density rate conveys the number of union members who are employees as a percentage of the total number of employees. Because of the reasons evaluated in details in the literature section above, the sign of the coefficient of UNION is ambiguous. Thus it may take either positive or negative sign.

Besides our primary explanatory variable UNION, we included three other covariates playing important role in the explanation of productivity into the model. The selection of covariates is made in the light of previous studies existing in the literature and our main research question.

GROSCAP is gross capital formation (% of GDP) and a proxy for investment level in an economy. We anticipate a positive sign for coefficient of GROSCAP since investment in fixed capital improves both the labor productivity and total factor productivity.

ENROL is gross tertiary school enrolment in terms of percentage and represents the human capital level in an economy. Countries investing more on human capital and improving quality of human capital may experience higher productivity level. Therefore we expect to have a positive coefficient for ENROL variable.

HW is annual hours worked in terms of per worker in a country. In theory, an increase in the working hours increases the productivity level of a worker up to a certain threshold level; nonetheless, the productivity level of a worker decreases beyond this threshold level. In order to take this theoretical implication into account, we keep both HW variable and its squared form (HW^2) in the regression model. Hence, our prior expectations for the coefficients on HW and HW^2 are positive and negative respectively.

4. Estimation Results

Table 3 reports the estimation results. The table also reports the Hausman test statistics for choosing between FEM and REM models. At the 5% significance level, the Hausman test statistics results select FEM model for all models.

Table 3: Estimation Results

	Dependent Variables												
	LPRODA	*LPRODB*	*LPRODC*	*LPRODD*	*CTFP*	*CWTFP*	*PEREMPGDP*	*PCVALAD*	*PLVALAD*	*PLAGRVALAD*	*PLINDVALAD*	*PLMANVALAD*	*PLSERVALAD*
	Model1	*Model2*	*Model3*	*Model4*	*Model5*	*Model6*	*Model7*	*Model8*	*Model9*	*Model10*	*Model11*	*Model12*	*Model13*
C	**-166,1432**	**-165,5018**	**-167,2193**	**-160,7232**	**-143,8932**	**-124,5922**	**-141,8501**	**-97,6269**	**-96,7875**	**-285,5794**	**-159,0703**	**581,5091**	**-72,0723**
Std. Error	*20,8884*	*20,8886*	*22,7748*	*21,2179*	*31,5828*	*29,0860*	*19,8751*	*84,4953*	*81,9366*	*96,7973*	*92,5082*	*167,2791*	*80,5275*
Prob.	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,2485*	*0,2381*	*0,0034*	*0,0863*	*0,0006*	*0,3713*
UNION	**-0,2495**	**-0,2495**	**-0,2513**	**-0,2566**	**-0,0631**	**-0,0649**	**-0,2556**	**-0,9411**	**-0,8755**	**-0,8937**	**-0,7196**	**-0,5925**	**-0,7024**
Std. Error	*0,0175*	*0,0175*	*0,0191*	*0,0178*	*0,0255*	*0,0235*	*0,0174*	*0,0794*	*0,0770*	*0,0831*	*0,0794*	*0,0897*	*0,0691*
Prob.	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0136*	*0,0059*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*
GROSCAP	**0,0237**	**0,0237**	**0,0147**	**0,0300**	**0,1014**	**0,2940**	**0,0542**	**0,5443**	**0,3562**	**0,2285**	**0,3285**	**0,3862**	**0,3735**
Std. Error	*0,0175*	*0,0175*	*0,0191*	*0,0178*	*0,0248*	*0,0228*	*0,0169*	*0,0700*	*0,0679*	*0,0801*	*0,0766*	*0,1253*	*0,0667*
Prob.	*0,1761*	*0,1761*	*0,4397*	*0,0926*	*0,0001*	*0,0000*	*0,0014*	*0,0000*	*0,0000*	*0,0046*	*0,0000*	*0,0023*	*0,0000*
ENROL	**0,1631**	**0,1630**	**0,1695**	**0,1596**	**0,0197**	**0,0921**	**0,1907**	**0,9654**	**0,9144**	**0,9576**	**1,1194**	**1,1912**	**1,0625**
Std. Error	*0,0196*	*0,0196*	*0,0214*	*0,0199*	*0,0276*	*0,0254*	*0,0192*	*0,0790*	*0,0766*	*0,0914*	*0,0873*	*0,0996*	*0,0760*
Prob.	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,4766*	*0,0003*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*
HW	**47,2893**	**47,2886**	**46,5444**	**44,9969**	**37,0653**	**31,9142**	**40,5842**	**30,5854**	**30,4326**	**79,9887**	**47,0500**	**-149,5620**	**23,0735**
Std. Error	*5,5155*	*5,5155*	*6,0136*	*5,6024*	*8,3227*	*7,6648*	*5,2470*	*22,3240*	*21,6480*	*25,5918*	*24,4578*	*44,2136*	*21,2903*
Prob.	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,1714*	*0,1605*	*0,0019*	*0,0551*	*0,0008*	*0,2791*
HW^2	**-3,1635**	**-3,1634**	**-3,1782**	**-3,0757**	**-2,3911**	**-2,0644**	**-2,7051**	**-2,2133**	**-2,1832**	**-5,4413**	**-3,3119**	**9,7178**	**-1,6632**
Std. Error	*0,3641*	*0,3641*	*0,3970*	*0,3698*	*0,5482*	*0,5048*	*0,3463*	*1,4747*	*1,4301*	*1,6918*	*1,6168*	*2,9209*	*1,4074*
Prob.	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0000*	*0,0001*	*0,0000*	*0,1341*	*0,1276*	*0,0014*	*0,0411*	*0,0010*	*0,2380*
Hausman Stat.	*60,9842*	*83,1240*	*60,9051*	*90,3633*	*94,4092*	*93,6685*	*62,4087*	*81,5564*	*84,0347*	*88,0516*	*73,0253*	*74,3290*	*75,4654*
Selected Model	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*	*FE*
Num. Of Countries	*51*	*51*	*51*	*50*	*49*	*49*	*50*	*47*	*47*	*46*	*47*	*40*	*47*
Num. Of Obs.	*522*	*522*	*522*	*518*	*456*	*456*	*495*	*494*	*494*	*470*	*472*	*297*	*472*
R-square	*0,9870*	*0,9867*	*0,9890*	*0,9900*	*0,9475*	*0,9394*	*0,9889*	*0,9510*	*0,9446*	*0,9571*	*0,9478*	*0,9588*	*0,9541*

As shown by the results in Table 3, the estimated coefficient of UNION variable has negative sign and is statistically significant at 1% significance level in twelve models and statistically significant at 5% significance level in one model. The strongly significant explanatory power of UNION variable was not drained by the inclusion of the other additional explanatory variables. Therefore, this finding suggests a negative relation between the unionization rate and labor productivity in all models.

In respect to the other explanatory variables, the estimated coefficient of GROSCAP variable is positive parallel to our prior anticipation and statistically significant at 1% significance level in nine models and statistically significant at 10% significance level in one model and insignificant in the others. Thus, this finding in general supports the argument that an increase in the investment of fixed capital flourishes total factor productivity and particularly labor productivity.

The estimated coefficient of ENROL variable takes the expected positive sign and statistically significant at 1% significance level in twelve models while it is insignificant in one model. Therefore we can discuss that increasing/improving human capital may result in higher productivity level.

The estimated coefficients of HW and HW2 variables get the anticipated signs and are statistically significant at the 1% significance level in eight models and statistically significant at the 10% significance level in one model. Conversely, they are statistically insignificant in three models and statistically significant but get reverse signs in one model. Hence, this result for the most part supports the theory that increasing working hours augments the labor productivity level up to a certain threshold level and diminishes it after that.

Since our models are full-logarithmic models, the coefficients in front of the each variable reflect the elasticities. Labor productivity shows highest sensitivity against to the unionization in Model 8. In this model if unionization rate goes up by 1% then labor productivity goes down by 0.94 %. On the other hand, lowest sensitivity level is in Model 5.

Meantime, as seen from Table 3, all models have excessively high R2 values. This implies that the models conducted in the study are quite well constituted in terms of inclusion of important explanatory variables and correct mathematical form.

5. Conclusion

The existing studies in the literature do not have a consensus about the effect of unionization on labor productivity. Some of them conclude that higher unionization rate means lower labor productivity. Conversely, the others deduce that unionization has a positive impact on labor productivity. Hence findings are mixed. Also, most of the empirical studies are carried out for one or more firms/sectors in one or more countries or conducted with cross-section data in a cross-country analysis. Studies using panel data in the literature are rare and limited with a couple of countries.

In fact there are many factors playing important role in the explanation of the productivity level of labor in a country. Besides them, the rate of unionization among labors may affect the productivity level of labor in that country. In order to empirically examine this hypothesis, in this study we explore the impact of unionization rate on labor productivity by using thirteen distinct labor productivity indicators. The sample includes fifty one countries' unbalanced data for the periods between 2000 and 2013. The primary finding of the study implies a strong and statistically significant negative association between rate of unionization and labor productivity level. This result keeps its validity across all models; therefore it shows how robust the result is. Based on the finding, we may assert that countries with higher unionization rate encounter lower labor productivity level.

To the best of our knowledge, unlike the existing studies, this is the first study in the literature examining the issue with so many countries (i.e. fifty one countries) and checking the validity of results with so many proxies (i.e. thirteen variables) of productivity by using panel data.

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