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The Impact of Technology Diffusion through Trade on Employment and Wages in the Manufacturing Industry in Sri Lanka

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Abstract— *This paper examines the impact of technology diffusion through trade on employment and wages in the manufacturing industry in Sri Lanka. The study models the effects of technology on employment and wages in the manufacturing industry in a labour demand and a wages framework on an integrated panel dataset of trade, labour and manufacturing industries. The impact of technology on employment and wages in the manufacturing industry is examined following the predictions of the Neo-technology trade theories. On the labour demand model, technology is negative and statistically significant on manufacturing employment against theoretical expectations. On the wages model, technology is positive and statistically significant on manufacturing wages as expected, confirming the neo-technology predictions.*

Keywords— *Trade, Technology diffusion, Neo-technology trade theories, employment, wages.*

I. INTRODUCTION

At independence, Sri Lanka pursued an open economic model and the State remained confined to its functions before independence. With influence from the socialist bloc, in the late 1950's, it tilted towards a closed economic model. With this shift, the country embarked on a rigorous programme of import substitution and the State directly intervened in economic affairs by nationalising private ventures and opening up new public-sector enterprises. After a few years of experimenting with closed economic policies, the Government realised the futility of inward-oriented economic policies and their potency in delivering economic independence. Against this backdrop, Sri Lanka, together with many other developing economies embarked on a rigorous path of economic liberalisation, setting liberal policies aimed at reducing State intervention in the economy. This policy broke with the traditional restricted economies of South Asia and the economy was liberalised in 1977. One of the main objectives of trade liberalisation was with trade to allows a country to shift and diversify from low-value to higher-value exports. According to the dynamic version of the Neoclassical approach to trade, in the 'stages approach to comparative advantage', further extended by the 'flying geese hypothesis' explains the shifts in the structure of exports along the technological ladder. They argue that a country will move from exporting traditional labour-intensive to skills-intensive and accordingly to physical capital-intensive commodities, and then to high-technology human capital and knowledge-intensive commodities in the industrialisation process. In this, technology is a critical component in economic growth. However, Sri Lankan manufacturing exports are heavily concentrated into a single standard labour-intensive commodity, which is clothing. Limited diversification and a narrow concentration of exports typically leads to slower economic growth. Approximately, 43.1 percent of manufacturing exports are concentrated in wearing apparel, followed by rubber products (11.1 percent), food products (10.6 percent) and knitted and crocheted fabrics and articles (7.4 percent). These industries dominate over 50 percent of the manufacturing output and over 60 percent of total manufacturing employment. More than 75.0 percent of manufacturing value addition is comprised of low technology commodities, while 75.0 percent of manufacturing exports are concentrated into low-technology exports. Similarly, more than 80.0 percent of manufacturing employment is concentrated into low-technology exports. Low-technology manufacturing in countries could be explained by the high levels of protection either in the form of tariff or quota afforded to the industry that ultimately delay technology adoption. On the other hand, low technology manufacturing could also be explained by the declining trend in foreign direct investments (FDI's) into manufacturing. FDI's diffuse technology via imitation effects, labour mobility and by exposing domestic firms to severe competition that ultimately forces local firms to adopt new technologies. However, limited empirical evidence supports the view that multinational firms are involved in vertical technology transfers.

While economic theory offers several explanations for the pattern of trade between developed and developing economies and its consequent effect on employment and wages, neo-technology trade theories mostly explain the link between technology, employment and wages. Hence the main objective of this paper is to examine the impact of trade diffused technology on employment and wages in the manufacturing industry as postulated by the neo-technology trade theories. As far as the author is aware, this is the only study that empirically examines the impact of technology on manufacturing employment and wages based on a panel dataset, the case of Sri Lanka.

II. LITERATURE REVIEW

Neo-technology theories are an offshoot of relaxing the assumption of identical technology among the trading partners in the Heckscher-Ohlin trade theory (Heckscher, 1919).

Posner (1961) developed the theory of technological-gap. It assumes dissimilar technology among trading partners while the transmission of technology occurs with a time lag. It predicts that a country will export those goods for which it has a superior technology compared to its trading partner, although both the countries are similarly factor endowed. The product cycle theory was developed by Vernon (1966) as an extension to the technological-gap model. It claims that new products are originally introduced in developed countries as they demand skilled labour, superior technology and other demands for designing and marketing. In North-South trade models, the ability of advanced economies to temporarily monopolise new technology enables their workers to earn a premium wage over their counterparts in developing economies. When the price of the product is high enough and affordable by high-income customers while its production requires skilled labour, it induces competition among developed economies to manufacture this commodity. When the product becomes standardized and easily imitated using unskilled labour, its production will move into labour abundant developing economies.

It is widely agreed among economists that technological changes and international trade have led to changes in skills demand in the labour market (Autor, Dorn, & Hanson, 2013). Using cross-sectional data and a wages model, Bound and Johnson (1992) were one of the pioneers to propagate skills-biased technology. Their findings indicated an increase in the demand for skilled workers and their wages in the United States as a result of skills-biased technology that favoured skilled workers over unskilled workers. Dunne and Schmitz (1995) analysed the impact of technology on employment and wages in the United States. Using a labour demand and a wages model, they found that manufacturing plants with advanced technology prefer skilled workers with high compensation over unskilled workers. Machin and Reenen (1998) extended this survey to six other countries using a panel dataset. Their findings suggest a skills-biased technical change to have a positive impact on the demand for skilled workers and their wages. Similar findings are reported from Sweden where technology engaged in manufacturing is positive on manufacturing wages following Anderton, Brenton, and Oscarsson (2002). Bartel and Lichtenberg (1987) and Bartel and Sichermn (1999) matched a variety of industry-level measures of technological changes to a panel of young workers between the periods 1979 to 1993. They found wage premiums to be associated with the technological change, primarily due to the sorting of skilled workers into those industries that uses high technology. Doms, Dunne, and Troske (1997) analysed how wages, occupational mix and worker education vary with technologies such as programmable controllers, computer automated design and numerically controlled machinery. Similarly, Berndt, Morrison, and Rosenblum (1992) examined the impact of engaging high-tech information technology on the distribution of employment. These studies find high-technology capital to be positive on the growth of white-collar worker hours. It also shows skills upgrading in blue-collar workers due to engaging high-tech information technology. Sachs, Shatz, Deardorff, and Hall (1994) found research and development to have a negative effect on production workers and an insignificant effect on non-production workers keeping in line with the skills-biased technology hypothesis. Berman, Bound, and Machin (1998); Bernard and Jensen (1997); Haskel and Slaughter (1998) found skill-biased technological change to have decreased the demand for less-skilled workers in the United States and throughout the developed world, due to their capital intensive nature .

Of the very few studies in the case of developing economies, Goldar (2000); Krishnan (2010) confirmed technology engaged in Indian manufacturing to be labour saving in nature, while similar findings are reported in the case of Chilean manufacturing plants (Pavcnik, 2002). On the other hand, Giovannetti, Menezes, Tovar, and Manzano (2006) finds capital in the form of technology to be positive on manufacturing employment in the case of Brazil. Onaran (2008) analysed the impact of technology transfers via imported raw materials on employment in the case of Austria. Findings suggest firms and industries that use imported raw materials are in a position to execute manufacturing with the minimum labour required, which ultimately has a negative impact on employment.

In empirically examining the skills biased technology, most literature has resorted to examine the impact of computers on employment and wages. Computers, or simply technology might act as a substitute or a complement to labour (Kruger, 1993). Kruger (1993) examined whether workers who use computers at work earn higher wages compared to workers who do not, using population data. Findings indicated that workers who use computers at work earn 10-15 percent more compared to workers who do not. Feenstra and Hanson (1999) confirmed a 35 percent increase in wages of non-production workers who use computers in the case of the United States. Autor, Katz, and Kruger (1998) finds the spread of computing technology to explain 30-50 percent of the increase in the demand for U.S skilled workers. Osterman (1986) analyses the impact of computers on employment of clerks and managers in the United States using cross sectional data. Findings indicate a negative impact of computers on the demand for clerks and managers in the short term, while in the longer term, computers demonstrated a positive impact on the demand for clerks and managers.

Skills-biased technological changes also discuss the use of educated workers in manufacturing. Bright (1958) examined the effects of automation on job-skills in metal, food and chemical industries. He observed skills requirement to increase initially and subsequently to decrease with the degree of mechanization. On similar lines, Nelson and Phelps (1966) observed the average educational requirements for workers declined as technology matured. On the other hand, firms will also face the challenge to constantly upgrade the skills of their skilled workers as demanded by the constant improvements in technology (Keesing, 1966; Tyers & Yang, 1997). In a different perspective, Brambilla, Lederman, and Porto (2012) using a panel data set of Argentinian manufacturing firms for the period 1998-2000 found that exporters to high-income destinations hired skilled and educated workers as buyers in high-income countries assign more value to higher quality products.

From a technology perspective, the effect of technology on the labour market outcomes has been a core concern for industrial economies, although there is limited discussion and interest in the case of Sri Lanka. Therefore, it is crucial to determine the impact of technology on the labour market outcomes.

III. METHODOLOGY

Data

Data for this research is captured from diverse sources. Manufacturing data is drawn from the Annual Survey of Industries conducted by the Department of Census and Statistics. A distinctive feature of this rich manufacturing dataset is the availability of data at the firm-level. This is a sample survey which supplements the industry census conducted once in every 10 years, providing a nationally representative sample of manufacturing industries. The survey takes the previous year as the reference period and includes all industrial establishments with 5 persons or more. The Industry Census frame is used to determine the sample of establishments to be surveyed each year. The Annual Survey of Industry sample includes 3500 to 4500 manufacturing firms each year. The geographical strata contain all 25 administrative districts of Sri Lanka.

Trade data is drawn from the United Nations Commodity Tarde database. This database is maintained by the United Nations Statistical Division. The database records import and exports data using several commodity classification methods. For this study, the Standard Industry Trade Classification method at a 5-digit level was used to extract import and export data for Sri Lanka with the rest of the world. Exports are valued on free-on-board basis and imports are valued on cost-insurance-freight basis. Exports do not include re-exports.

The data on custom duties is captured using the Tariff Analysis Online database. The Tariff Analysis Online database is maintained by the World Trade Organisation. This database maintains customs duties for each commodity based on the Harmonised System of Coding at a 6-digit level. In addition to custom duties, the government of Sri Lanka also charges a variety of tariffs on imports. Since these charges are outside the scope of customs duties specified by the World Trade Organisation, these extra charges are commonly known as para-tariffs or other levies. They include charges such as National Security Levy, Road infrastructure Development Levy, Value Added Tax on imports, Excise duties, Ports Authority Levy etc. The tariff rates of these additional levies are captured from the Tariff Guides prepared by Sri Lanka Customs. Tariff guides by Sri Lanka Customs are maintained using HS Coding at a 6-digit and 8-digit level.

Conceptual Framework

Is there any evidence that technology diffusion through trade has impacted manufacturing employment and wages as predicted by the Neo-technology trade theory? This is the research question of this paper that we intend to address. The required theoretical basis for empirically testing this research question is supported by the Neo-technology trade theory discussed, together with its empirical evidence. Technology gap theorem predicts that a country will export the goods of those industries in which it has a technology gap advantage over other countries, even though both exporting and importing countries may have similar factor endowments (Posner, 1961). The Product cycle model which is an extension to the technology gap model predicts that when a new product is introduced, it usually requires highly skilled labour until the product technology becomes standardized and can be produced using mass production techniques and less-skilled labour (Vernon, 1966). More conveniently stated, the Neo-technology trade theories predict that the opportunity to engage in trade is based on technology differences although both trading partners. Along these predictions, with the diffusion of technology from developed to developing economies, developing economies are expected to gain by imitating new products and selling them in untapped markets that will trigger a positive effect on the demand for labour and wages. Therefore, the research question stated above can be formulated into the following hypothesis for empirical examination.

Hypothesis: *Technology diffusion in international trade has a positive impact on manufacturing employment and wages in developing economies.*

This study is an attempt to model manufacturing labour and wages in response to a technology stimulus. Therefore, in the labour demand model, the dependent variable is manufacturing labour *(L)*. Based on the hypothesis developed, technology diffusion in international trade is captured by several alternative proxy key independent variables for robustness; Research and development intensity *(RDI)*, the share of imported raw materials consumption *(IRS)*, the share of electricity in total energy cost *(ELS)*.

Research and development intensity *(RDI)* is measured as the share of technicians in total manufacturing employment following Bartel and Sichermn (1999); Bernard and Jensen (1997); Goodman and Ceyhun (1976); Lall (1986); Petri (1988); Scherer (1965); Shatz (1996); Wignaraja (1998). Empirical literature often captures research and development expenditure as a proxy for technology change (Griliches, 1979). While it is preferable to have research and development expenditure at the industry level, this information is simply unavailable from the Annual Survey of Industries. The Annual Survey of Industries neither capture data on research and development expenditure nor on advertising expenditure incurred by the manufacturing firms. In its absence, the share of technicians in total employment is engaged as a proxy which is a technology-capability indicator often identified in literature as an input measure (Anderton et al., 2002).

The share of electricity cost in total energy (*ELS*) is the value of real electricity expressed as a percentage total real energy cost following Aiginger, Ebmer, and Zweimuller (1996); Leamer (1974); Topalova (2004). This variable has been proposed as a measure of technology sophistication in literature (Leamer, 1974).

The share of imported raw material consumption (*IRS*) is measured by expressing the value of real imported raw-material consumption as a percentage of total real raw materials consumed following Bhaduri and Ray (2004); Edwards (2004); Hanson and Harrison (1999); Harrison and Hanson (1999). Imported raw material consumption is estimated by adding imported raw material purchases to opening stocks and deducting closing imported raw material stocks. Total raw material consumption is estimated by adding imported raw material consumption to local raw material consumption. The DCS defines raw materials as all material inputs including raw materials, parts, components, containers and supplies purchased by the establishment for the production process either in this establishment or in another establishment have been included. This variable is often used in literature to denote foreign technology (Keller, 2002; Wagner, 2013) and knowledge spill overs in international trade (Andersson, Loof, & Johansson, 2008) embodied in imported inputs (Amiti & Konings, 2007). The share of imported raw material consumption is expected to have a positive impact on employment and wages in the manufacturing industry.

The share of local raw material consumption (*LRS*) is measured by expressing the value of real local raw-material consumption as a percentage of total real raw materials consumed. Local raw materials consumption is estimated by adding local raw material purchases to opening stocks and deducting the closing of local raw material stocks. Total raw material consumption is estimated by adding imported raw material consumption to local raw material consumption. The use of local raw materials reflects 'local technology'. This variable is used to reflect the impact of using local raw materials on employment and wages in the manufacturing industry.

We also use few control variables in the analysis; manufacturing output *(Q)*, capital intensity *(KI)*, skills intensity *(SKI)*, marginal efficiencies of production *(MEP)*, import penetration ratio *(IP)*, custom duties (CD) and para tariffs *(PT).*

Modelling

Following Hine and Wright (1998) and Greenaway, Hine, and Wright (1999) Milner and Wright (1998), this paper uses the Cobb-Douglas production function of the following form, which serves as the core model in this analysis;

$$Q_{it} = A^{\gamma} K_{it}^{A} L_{it}^{\beta} \quad (1)$$

where for the representative firm in industry *i* in period *t*; *Q* = real output; *K* = capital stock; *L*= units of labour utilised; *A* = technology and α, β represent the factor share coefficients while γ allows for factors changing the efficiency of the production process. Based on this, the following standard labour demand model equation (2) is derived, where *Lit* is total employment, *Wit* is average real wages, *Q*it is the real output and *K*it is real capital intensity in industry '*i*' at time '*t*' and *X*it is a vector of variables which affect the efficiency of production, so it is related to A^{γ}. The vector of variables includes the key independent variable and other control variables that impacts manufacturing employment. The *θ0* is the overall intercept and *θ1, θ2, θ3* and *θ4* are unknown slope parameters to be estimated and the error term u*it*. A profit maximising firm employs labour where the marginal revenue product of labour equals the wage (*W*).

$$\ln L_{it} = \theta_0 + \theta_1 \ln W_{it} + \theta_2 \ln Q_{it} + \theta_3 \ln K_{it} + \theta_4 \ln X_{it} + u_{it} \quad (2)$$

Similarly, wages are determined by numerous factors, and following Greenaway et al. (1999); Hine and Wright (1998); Milner and Wright (1998), and the following wages equation is derived (3), where *Wit* is average real wages, *Lit* is total employment, *Q*it is the real output and *K*it is real capital intensity in industry '*i*' at time '*t*'. *Xit* represents a vector of variables that are engaged in the wage setting process and includes the key independent variable and other control variables that impacts wages. The *β0* is the overall intercept and *β1, β2, β3* and *β4* are unknown slope parameters to be estimated and the error term εit.

$$\ln W_{it} = \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln Q_{it} + \beta_3 \ln K_{it} + \beta_4 \ln X_{it} + \varepsilon_{it} \quad (3)$$

Variables

In the labour demand model, manufacturing labour is the main outcome variable. In the wages model, the main outcome variable is manufacturing wages. Research and development intensity, the share of imported raw material consumption, share of electricity in total energy cost and the share of local raw material consumption in total raw material consumption are proxy key independent variables. The operational definitions of the variable are presented accordingly in table 1.

TABLE 1: Variable definition

Variable	Definition
L	Labour is expressed in its natural logarithmic form. This includes all type of manufacturing labour.
Q	Real output is expressed in its natural logarithmic form.
W	Average real wages are expressed in its natural logarithmic form.
K	Capital intensity is the real output divided by real value of machinery, expressed in its natural logarithmic form.
EI	Export-intensity is the value of real exports expressed as a percentage of real output
IP	Import penetration is measured as the value of real imports expressed as a percentage of real consumption
SKI	Skills-intensity is estimated by expressing the share of skilled factory operatives as a percentage of total manufacturing workers
MEP	Marginal efficiency of production is measured as the average plant size of the top fifty percent of firms expressed as a percentage of total output
CD	Industry structure variables Custom duties is estimated using the simple average tariff of all tariff lines for each four-digit manufacturing industry.
PT	Para-tariffs is estimated using the simple average of all para-tariff lines at each four-digit manufacturing industry level.
RDI	Research and development intensity is measured as the share of technicians in total manufacturing employment
ELS	The share of electricity cost in total energy is the value of real electricity expressed as a percentage total real energy cost
IRS	The share of imported raw material consumption is measured by expressing the value of real imported raw-material consumption as a percentage of total real raw materials consumed
LRS	The share of local raw material consumption is measured by expressing the value of real local raw-material consumption as a percentage of total real raw materials consumed

Analytical Technique

Given that the research question is theory testing and the data is quantitative in nature, a quantitative method of analysis

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is adopted. Therefore, a multiple regression analysis technique is engaged to empirically analyse the impact of trade on employment and wages in the manufacturing industry. This study is based on a trade and industry panel data set covering the period 1994 to 2011. Given that the dataset is a panel, a panel data technique should be employed in the analysis of data. Initially, a pooled ordinary least squares regression was conducted. Accordingly, a Breusch-Pagan Lagrangian multiplier test was conducted to determine whether the pooled regression was consistent or not. The estimated test results were significant, implying that pooled regression is not an appropriate method in this case. Given this, researchers often use a fixed effects model or a random effects model in analysing panel data. Following the Hausman (1978), the fixed effect estimation model is engaged.

Regression Diagnostics

A preference for economic theory over method was followed as recommended strongly by Studenmund (2001) for selecting variables to the model. To complement, several alternative formal model specification tests were performed. This study is based on a trade and industry panel data set covering the period 1994 to 2011 and is an unbalanced panel dataset with gaps. To avoid inflation leading to spurious correlation, all nominal values have been adjusted for inflation to be comparable across different time points. Spurious correlation is caused by nonstationary time series. Accordingly, both the Augmented Dickey Fuller test and the Phillips-Perron unit-root tests were conducted. The null hypothesis was rejected at less than 1 percent level of statistical significance. Several tests for multicollinearity such as the correlation matrix and the sensitivity of the model when adding and deleting independent variables were checked. When tested for multicollinearity, the variance of inflation factor was less than 1.5 except in the case of two variables yet, well below the standard. Models were also tested for heteroscedasticity. Since the dataset we have is a panel that is unbalanced and with gaps, there is no robust mechanism that tests for heteroscedasticity, when using a fixed effects model. Given the limited options, heteroscedasticity is tested using a graphical method of detection (Gujarati, 1998). The models were also tested for serial correlation. The DW statistics for both the labour demand and the wages model converges to 2, thereby indicating no serial correlation. Having conducted different tests and precautions in modelling for labour demand and wages, their robustness is also investigated. The estimated labour demand model is robust in conventional statistical terms. Drawing attention to the final labour demand model, the model is statistically significant at less than one percent as indicated by the F-statistics. It possesses a high level of explanatory power as indicated by the adjusted R-squared (0.8431). On the wages model, according to the conventional statistical measures, the estimated model is robust. The wages model is statistically significant at less than one percent as indicated by the F-statistics. It possesses a satisfactory level of explanatory power as indicated by the adjusted R-squared (0.4846).

IV. Results and Discussion

The results of the labour demand model are presented in table 2, while those of the wages model is presented in table 3.

Labour Demand Model

TABLE 2: Labour demand model- Impact of technology on manufacturing employment

	1	2	3	4
Q	0.7096a	0.7190a	0.7182a	0.7085a
	[61.65]	[60.08]	[59.58]	[61.22]
W	-0.5309a	-0.5244a	-0.5292a	-0.5402a
	[-16.20]	[-15.97]	[-16.15]	[-16.58]
K	-0.0754a	-0.0781a	-0.0770a	-0.0759a
	[-6.91]	[-7.13]	[-7.03]	[-6.59]
EI	0.00001a	0.00001a	0.00001a	0.00001a
	[2.54]	[2.64]	[2.45]	[2.53]
IP	0.00005b	0.00004b	0.00004b	0.00005b
	[2.06]	[2.02]	[2.01]	[2.07]
SKI	0.0032a	0.0037a	0.0037a	0.0037a
	[3.63]	[4.21]	[4.16]	[4.16]
MEP	-0.0039a	-0.0037a	-0.0037a	-0.0039a
	[-7.12]	[-6.76]	[-6.88]	[-7.13]
PT	-0.0052a	-0.0052a	-0.0052a	-0.0052a
	[-5.30]	[-5.21]	[-5.30]	[-5.38]
RDI	-0.0061c			
	[-1.92]			
IRS		-0.0018a		
		[-3.44]		
LRS			0.0016a	
			[2.95]	
ELS				-0.0001
				[-0.18]
Constant	-0.0061a	-1.2507a	-1.3530a	-0.9567a
	[-1.92]	[-3.72]	[-3.82]	[-2.94]
N	1327	1327	1322	1327
R2	0.8479	0.8482	0.8477	0.8450
F	16.02a	15.98a	15.98a	16.39a

t-values in parentheses. a Significance at 1 percent, b at 5 percent, c at 10 percent

The coefficient for research and development intensity is negative and statistically significant on manufacturing employment. This is against theoretical expectations. Neo-technology theory predicts an increase in the demand for labour in developing economies with the transfer of technology from developed economies. With technology transfers, new products and markets are created in developing economies. This in turn is expected to positively influence manufacturing employment.

The coefficient on the share of imported raw material consumption is negative and statistically significant on manufacturing employment. This is possible as high-productive firms opt for high quality imported raw materials over domestic sourcing even at a higher price that can be processed with a minimum labour requirement. High quality imported raw materials induce greater efficiency in the use of labour. Manufacturers prefer imported raw materials and intermediates predominantly owing to the quality of the inputs, delivery dependability and the superior after sales services. Therefore, participation in international trade and the transfer of technology enables firms to realize higher productivity that encourages firms to reduce their workforce and to exclude workers with low abilities. While imported raw materials and intermediates triggers a negative effect [labour-saving effect] on manufacturing employment, the use of 'domestic' raw materials trigger a positive effect on the demand for labour. Use of 'domestic raw materials' denotes 'domestic technology'. The coefficient for the share of domestic raw materials is positive and statistically significant on the demand for labour. As opposed to imported raw materials, use of local raw materials in manufacturing has a labour complementary effect. Therefore, it can be concluded that domestic technologies are labour complementary, while imported technology in the form of imported raw materials is labour substituting.

The next proxy variable that denotes technology is the share of electricity in the total energy cost. Empirical literature often uses this variable to represent industrial sophistication. It reflects the use of advanced technology in manufacturing. The impact of electricity use on employment is negative although not statistically significant. The above findings clearly indicate that technology is labour saving and negative on manufacturing employment in the case of Sri Lanka.

Wages Model

TABLE 3: Wages Model-Impact of technology on manufacturing wages

	1	2	3	4
Q	0.3540a	0.3462a	0.3492a	0.3650a
	[22.76]	[21.31]	[21.55]	[23.72]
L	-0.3303a	-0.3291a	-0.3321a	-0.3388a
	[-15.98]	[-15.82]	[-16.00]	[-16.46]
K	-0.0170c	-0.0144	-0.0155c	-0.0170c
	[-1.92]	[-1.62]	[-1.73]	[-1.92]
EI	0.00001c	0.00001	0.00001c	0.00001c
	[1.66]	[1.56]	[1.75]	[1.84]
IP	0.00002	0.00002	0.00002	0.00002
	[1.47]	[1.49]	[1.50]	[1.55]
SKI	0.0023a	0.0015a	0.0016c	0.0017b
	[3.18]	[2.17]	[2.24]	[2.33]
MEP	-0.0005	-0.0007	-0.0006	-0.0005
	[-1.17]	[-1.53]	[-1.45]	[-1.23]
CD	0.0028b	0.0021c	0.0022c	0.0021c
	[2.24]	[1.70]	[1.78]	[1.65]
RDI	0.0107a			
	[4.27]	0.0014a		
IRS		[3.38]		
LRS			-0.0012a	
			[-2.92]	
ELS				0.0018a
				[2.93]
Constant	5.6267a	5.8015a	5.8953a	5.4672a
	[27.75]	[27.34]	[25.88]	[26.39]
N	1327	1322	1322	1327
R2	0.4940	0.4976	0.4942	0.4741
F	7.22a	7.17a	7.20a	7.82a

t-values in parentheses. a Significance at 1 percent, b at 5 percent, c at 10 percent

The coefficient on research and development intensity is positive and statistically significant on manufacturing wages as expected. Recall that research and development intensity was negative on manufacturing employment due to its labour-saving effect. Therefore, it seems that firms that engage labour saving technology have been able to share efficiency savings with their workers by way of increased compensation.

Similarly, the coefficient on the share of imported raw materials consumption is positive and statistically significant on manufacturing wages, as expected. This is possible as more-productive plants that use high-quality imported raw materials are in a better position to compensate their workers with higher wages due to cost savings from efficiency gains. To corroborate this claim, consider the effect of the share of local raw material consumption on manufacturing wages. The share of local raw material consumption reflects domestic technology. Although it had a positive effect on manufacturing employment, these firms had not been able to make a positive effect on the wages of their employees, due to the inefficiencies inherent in the use of local raw materials.

The coefficient of the share of electricity use in total energy is positive and statistically significant on manufacturing wages as expected. This variable indicates sophisticated manufacturing. Therefore, it confirms that firms and industries that use electricity driven machines and equipment generates greater efficiency gains. Moreover, they are better positioned to deliver better-quality products and to stay in competition. Therefore, it is evident that industries that are sophisticated in technology compensates their employees with increased wages.

Therefore, all proxy technology variables are positive on manufacturing wages as expected. The effect of technology on manufacturing wages confirms the predictions of the Neo-technology trade theory.

V. CONCLUSION

The research objective of this paper focused on examining the impact of technology on manufacturing employment and wages. Accordingly, the empirical examination was conducted in the context of the neo-technology trade theories. All proxy technology variables discussed above were adamantly negative on manufacturing employment, against theoretical expectations. One of the main reasons that contributes to this is the high dependence on imported technology as opposed to home grown technology. Imported technologies are highly capital-intensive and have a negative impact on employment in labour-abundant economies. The low technology export structure is another reason, while it has a detrimental effect on manufacturing employment. Unlike high-technology exports, growth in low-technology exports is slower or the demand for these products is on the decline from high income countries, and that has a negative effect on manufacturing employment. On the other hand, low-technology skills prevent firms from upgrading their products in the market and that would ultimately have a negative effect on product demand and hence, on manufacturing employment. Similarly, Sri Lanka pays less attention to investment in research and development. Investment in research and development is very low and that has a detrimental impact on product and market development and hence on manufacturing employment. On the wages model, all proxy technology variables are positive on manufacturing wages as expected. The effect of technology on manufacturing wages confirms the predictions of the Neo-technology trade theory.

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