Employment and TFP Impact of Technologies in the Developing World: Domestic versus Imported Expertise

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Abstract

This study assesses the impact of technology import, input import, foreign ownership of the company and domestic innovation on productivity and employment. For this purpose, we analyze enterprises-level survey data for developing countries across the world. In terms of labour productivity, we noted that it varies inversely with all the three foreign sources. However, the combined effect of foreign technology and imported input on labour productivity is positive which may be indicative of the complementary relationship between the two. Turning to TFP the results are positive: foreign technology, imported inputs - whether measured in terms of dummy or the percentage of inputs imported from abroad - and the status of foreign ownership in the company all three raise the TFP. On employment the impact of foreign technology, imported inputs and foreign ownership is positive. Domestic innovation or research and development expenditure also results in higher levels of employment. Hence, foreign technology and better quality imported inputs can be beneficial for the firms as new opportunities may come up for expansion in activities though the joint effect on employment turns out to be negative.

Keyword: employment, foreign technology, imports, labor productivity

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1. Introduction

For inclusive growth industrialisation is considered to be the most appropriate route, particularly in the case of the developing countries. This is because productivity growth in the agricultural sector has certain upper bounds and the services sector cannot accommodate the unskilled and semi-skilled workers to be shifted from the agricultural sector. However, the fear is that the industry-led-growth due to adoption of capital intensive technology may not be able to generate employment opportunities adequately. Particularly the Fourth Industrial Revolution which is expected to be highly automated and robotized may affect employment adversely. In the backdrop of these concerns, it is important to examine afresh the impact of technology on employment creation and employment destruction. Besides, the distinction will have to be made between the imported technology and the domestic technology as their employment ramifications can be tersely different. The technology innovated in the western developed nations suit the labour markets of those countries which are largely characterised in terms of shortage of human labour (unskilled and skilled). On the other hand, the labor market of the developing countries witness excess supplies of labour relative to demand, and thus, the import of technology in response to UNIDO's suggestion (2005) and the removal of import barriers as a part of economic reforms, may actually result in adverse consequences. As a solution to this, it is suggested that the developing countries may pursue their innovative strategies and develop appropriate technology which need not oppose to their labour market conditions. It then becomes pertinent to assess if the employment implications of the domestic and imported technologies are different or both are equally capital and skill intensive, thus reducing labour absorption significantly. Apart from this, it is equally important to assess if the technology imported from abroad is being used sub-optimally. If so, it may be reflected in terms of reduced TFP.

Technological change is seen as the key to rapid economic growth but it may lead to job losses in the short-to-medium run because the adjustment process may be protracted (Aghion and Howitt, 1996; Baumol and Wolff, 1998). Besides, there is a large body of literature suggesting that technological change may be skill-biased (Acemoglu, 1998 and 2003; Berman, Bound and

Griliches, 1994; Berman and Machin, 2004; Cirillo, 2014; Machin and Van Reenen; 1998). Finally, the type of new technology will have to be considered in the context of employment concerns: though product-oriented technology adoption is usually expected to have a positive effect on employment, process-oriented technology adoption tends to affect employment adversely (Harrison et al, 2014; Edquist et al.,2001).

These findings are usually reported in the literature reflecting on the experience of developed and upper-middle-income developing countries (Pianta, 2004; Piva, 2003; and Vivarelli, 2013 and 2014). The existing reviews offer three general conclusions (Ugur and Mitra, 2017). First, the employment effect of technological change is contingent on a range of moderating factors, including labour market flexibility, product market competition, types of innovation, and international trade. Second, the balance of evidence does not point out a negative effect on employment, but process innovation is more likely to be associated with job destruction whereas product innovation is more likely to be associated with job creation. Finally, the effect is more likely to be negative when the data relates to unskilled labour.

The displacement and compensation mechanisms which are at work have been discussed with great details by Vivarelli (2013 and 2014) who reminds us that labour-saving and deskilling effects of capital-intensive technology has been a concern since the Luddite movement of the early 19th century. However, he also draws attention to the theoreticaldebate which identifies a range of compensation mechanisms. Labour-saving effects of technology can be offset through: (i) additional employment in industries producing the new machines; (ii) higher demand for goods/services due to lower prices; (iii) new investments made using extra profits; (iv) decreases in wages resulting from price adjustment mechanisms; (v) higher income resulting from redistribution of innovation gains; and (6) new products created using new technologies. However, Vivarelli (2014) concludes that the compensation mechanisms require strict assumptions, overlook the secondary adverse demand effects that may result from falling wages, and may not all work in tandem. Therefore"…economic theory does not have a clear-cut answer regarding the employment effect of innovation." Hence, one should "… focus on aggregate, sectoral, and microeconomic empirical analyses that take into account the different forms of technical change … the various compensation mechanisms and the possible hindrances they face."

This paper proposes to examine the impact of technological progress both on productivity and employment in developing countries. Since much of the technological progress is taking place in the developed countries and the developing countries are simply aiming at importing the technology from abroad an empirical strategy to assess the impact of technological progress on employment can be pursued by capturing the effect of technology import on employment. Import of technology from the developed world is seen to be inappropriate for the labour market situations prevailing in developing countries. Technology innovated in the developed world is deliberately made to be capital and skill intensive as the supplies of unskilled and semi-skilled variety of labour are not overwhelming. On the other hand, most of the developing countries, which have the challenge of shifting labour from primary to non-farm activities, are confronted with the situation of excess supplies of unskilled and semi-skilled labour relative to demand. Hence, technology imported by them from the developed countries may not mitigate the labour market problems that they face. On the other hand, their resources are scarce to pursue innovation independently and develop technology which would be appropriate for the prevailing labour market conditions. In fact, UNIDO emphasized on the fact that if the wheel has already been discovered in some parts of the world it does not have to be rediscovered by the developing countries; rather the scare resources can be saved for developmental purposes. Besides, domestic innovation itself can be labour saving and thus, it may not necessarily help reduce the 'employment problem'. However, some of the studies pointed out in the past that the labour substitutability of domestic capital and technology is less in comparison to that of the imported capital and technology (Kato and Mitra, 2008): the labour requirement per unit of output tends to fall with a shift in the capital composition away from domestic to imported variety. With globalization and with a major decline in the import cost a number of firms even in the labour intensive sectors have been motivated to import technology from abroad (Das and Kalita, 2009), which reduced the contribution of the labour intensive sector to create employment in the economy. Rise in the utilization of imported inputs through trade expansion can affect employment adversely. But the existence of forward and backward linkages between the innovative firms and their upstream or downstream counterparts is also important to make the employment effect of technology adoption positive (Hirschman, 1969). Further, if the innovative firms are able to capture new markets overseas, the employment effects can turn out to be positive (James, 1993).

Governance and labour market institutions also impact on the magnitude of employment gains versus loss occurring due to technological changes. If labour market laws and institutions are rigid and do not provide sufficient incentives for investment in skill up-gradation, technology adoption may lead to job-loss (Pissarides and Valanti, 2004). Similarly, weak governance specific institutions may motivate managers to adopt productivity-augmenting strategies at the cost of labour demand (Sen, 2001). Another important finding, as noted by Ugur and Mitra (2017), relates to the adverse impact of technology adoption on employment if technology is likely to cater to the demand of high-income consumers. In other words, the demand of high income consumers involves a spectrum of goods which require capital intensive technology in contrast to the goods entering the consumption basket of the low income consumers. The meta-regression results of Ugur and Mitra (2017) study are in line with the findings of their narrative synthesis which suggest that the employment effect of technology adoption is likely to be positive when it involves skilled-labour demand and when technology adoption involves product innovation. However, the findings are based on a narrow evidence base, consisting of 58 estimates from 7 primary studies. Hence, we may bear in mind that the overall employment effect of technology adoption is uncertain due to multiplicity of the mediating factors that affect the balance between the displacement and compensation effects of the technology adoption.

In order to revive the proposition of industry-led growth some of the developing countries lay considerable focus on startups so that inclusive growth is attained in due course. But whether such new units are actually able to generate employment or they are motivated to import highly capital intensive technology, needs to be investigated empirically. Besides, what kind of products they are likely to manufacture is a crucial issue. As mentioned above, catering to high income consumers may not be highly beneficial in terms of employment generation. At the same time manufacturing labour intensive high value products may meet both the objectives of enhancing foreign exchange earnings and employment creation.

Given this background the present paper proposes to examine the issue of technology import and its impact on employment in the manufacturing sector. Based on the World Enterprise Survey data of the World Bank the paper considers countries other than the high income ones. The firms falling within the manufacturing sector mostly belong to the formal component. It begins by assessing the effect on performance indicators, i.e., total factor productivity and labour productivity, and subsequently delves into the employment aspect, which is considered in relative as well as absolute terms, that is, labour to value added ratio or rate of growth in employment and logarithm of employment respectively. We also attempt to examine the employment effects of technology in different regions of the world.

The rest of the paper is structured as follows. Section 2 reflects on sources of technology and knowledge spill over through imported inputs, foreign technology transfers and R&D. Section 3 presents the description of the variables considered in the analysis and displays some of the descriptive statistics through graphical analysis. Section 4 assesses the impact of importing status and foreign technology on total factor productivity and labour productivity. Section 4 deals with the employment aspect and finally section 5 summarises the major findings.

2. Sources of technology and knowledge: Imported inputs, R&D and foreign technology transfer

Imported inputs are considered one of the vital sources of the transmission and implementation of new technologies in the development literature (see Grossman and Helpman, 1991, and Frankel and Romer 1999). This source is especially vital for developing and emerging economies where new technologies are comparatively scarce mainly due to low levels of per-capita capital, lack of skills and training of workers, and inefficient and low productive institutions. More precisely, in a globalized competitive world, firms in developing countries are heavily reliant on high quality imported intermediate inputs. These inputs have become an essential channel for obtaining new technology, which eventually leads to augmenting the productivity and income of these countries. Adopting technologies by means of imported inputs, developing countries are benefitted from outcomes of R&D of developed countries to enhance its productivity and efficiency in the production. Grossman and Helpman (1991) along with others have argued that the output of firms is decisively dependent not only on better quality of imported intermediate inputs but also on their extensive varieties. Therefore, accessing varieties of imported inputs can potentially increase the productivity of firms and this channel could be key in sectors that need a large range of specialized inputs in the production process. Furthermore, imported inputs also enhance the productivity of domestic firms with access to the latest and advanced technologies embodied in imported inputs that are not accessible locally (Lawrence and Weinstein, 1999). Imported inputs also stimulate productivity performance through the emulation process. This takes place because intense market competition, as well as exposure to foreign firms, expedite technological acquisition. This process often causes rapid technological adoption and productivity growth improvements.

On the other hand, the technological change through in-house-R&D activities and its impact on productivity is also a well-recognized channel of productivity enhancement in the growth models (e.g., Grossman and Helpman, 1990). However, the linkage between in-house R&D efforts, import, and productivity enhancement is rather complex and controversial. The existing literature is divided on the relationship between foreign technology through various sources and in-house R&D efforts. They could share a substitutive or complementary relationship.

Knowledge and technological spillovers are vital sources that connect international trade to endogenous growth theories. Grossman and Helpman (1991) have shown that how trade in general and imports, in particular, can push domestic innovative outcomes by transmitting critical technological information, rising competition, enhancing entrepreneurial behavior and expanding the reach of the market. However, imported inputs may also be unfavorable affect R&D efforts as firms may too much start to rely on foreign sources for technological enhancement. Grossman and Helpman (1991) further maintained that the performance of R&D in less developed economies is perhaps not understood fully. Lessen focus and investment in R&D and innovative activities often understood that technological progress does not perform a substantial role in the development process of these economies. Unmistakeably, the process of development and industrialization in these economies has not been managed by their domestic own knowledge, and innovation, rather on various foreign sources and imported inputs is one of the critical sources.

Despite a concrete theoretical background, the empirical findings on these issues are very mixed. For example, recent studies of Amiti and Konings (2007), Kasahara and Rodrigue (2008), Goldberg et al. (2010), Jones (2008) and Halpern et al. (2009), have demonstrated a significant role of imported inputs which include both raw materials and capital goods. On the contrary, Lawrence and Weinstein (1999), Van Biesebroeck (2003) and Muendler (2004) have shown an insignificant or not very sizable effect of this activity. Some recent studies for developing countries have shown a positive performance effect of importing. For instance, Edwards, et al., (2018) for South African firms and Xu and Mao, (2018) for Chinese firms have found several positive effects on the performance.

The impact of innovation on productivity performance (both labour productivity and TFP) have received vast attention and debate in the standard literature. The diffusion of knowledge and technologies through various sources is considered a crucial source for growth and development (e.g., Romer, 1990). However, the diffusion of knowledge, innovation and technology is not restricted to national boundaries. In fact, knowledge and technology are portable from one nation to another nation, which finally decides the level of productivity (Griffith et al., 2004). One of the crucial sources of international knowledge diffusion is international technology trade and licensing (Basant and Fikkert, 1996; Cardamone and Agostino, 2008 and Mitra et al., 2014).

As the globalization process moving forward, a high level of competition and new innovative products are making local innovation efforts, foreign technology transfer and spillover more critical for the survival of firms. However, the related literature is largely focused on the cases from developed countries, with few exceptions, such as Ferrantino (1992), Raut (1995), Basant and Fikkert (1996), and Sharma (2012, 2016). The issue in developing economies cases has been somewhat overlooked despite an increasing interest in knowledge-related over physical capital accumulation in the production process.

There is a range of empirical studies that examine the effects of in-house R&D and the performance of firms. A large number of studies are invariably shown for a significant and positive role of R&D in the performance of firms. For instance, the empirical estimates of Cuneo and Mairesse (1984), Griliches and Mairesse (1990), Lee (2016), and Shin, Kraemer and Dedrick (2017) have found a comparatively sizable R&D impact. However, Griliches (1979, 1986), Raut (1995), Comin (2004) Griffith et al. (2006) and Khanna, and Sharma, (2018) have estimated moderate to minimal effects of R&D. In the Indian scenario, Sharma (2012, 2014) could not find any prominent role of R&D in firm performance. The empirical literature on foreign technology transfer also shows a rather mixed outcome. For instance, studies of Xu and Wang (1999), Eaton and Kortum (1996), Keller (2004), Rodrigue and Kasahara (2008) and Sharma (2019) have demonstrated a sizable and significant influence of importing technology on productivity. However, some others, for example, Kraay, et al. (2001) and Keller and Yeaple (2003) have shown a comparatively insignificant impact on productivity.[3]

To test the effects of imported inputs, R&D and foreign technology transfer on the performance of developing countries' firms, we set a simple performance indicator (Z) function as:

$$Z_i = f(import_i, Ftech_i, R\&D_i, X_i) \quad (1)$$

In this setting, we use several alternative performance indicators, i.e. employment, skilled employment, labour output ratio, TFP and LP. In the model, import, Ftech and R&D are firms' importing status or intensity, foreign technology licensing and R&D status respectively. X is the firm specific control variable of firm *i.* We include several curial control variables depending on the performance indicator. This includes age, capital assets, capital-labor ratio, foreign ownership, wage and others. Thus, the empirical model to be estimated is:

$$Z_{it} = \beta_0 + \beta_1 import_i + \beta_2 Ftech_i + \beta_3 RD_i + \beta_4 X_i + u_i \quad (2)$$

To know whether the source of foreign technology factors, i.e., importing and foreign technology licensing are complementary or substitute, we also estimate the following model:

$$Z_{it} = \beta_0 + \beta_1 import_i + \beta_2 Ftech_i + \beta_3 RD_i + \beta_4 X_i + \beta_5 import_i * Ftech_i + u_i \quad (3)$$

3. Data, Construction of Variables and Broad Patterns

We use enterprises level data from the Enterprise Surveys conducted by the World Bank. We use data from surveys conducted between 2006 and 2017. Data of the Enterprise Survey data from different countries can be used together because of a very similar sampling strategy, questions and survey instruments have been adopted. This study utilizes all countries data, across the regions and income groups except high income countries. Total number of firms covered in this study is 72,057. It is noteworthy that we include on all industries of manufacturing firms in our analysis but exclude other firms of other sectors.

[3]It is noteworthy that macro-level data based studies have by and large indicated for a positive and significant effect, while micro-level data based studies have failed to find important role technology transfer on the productivity performance.

The surveys are conducted by the World Bank and they partner across all geographic regions, covering all sized firms. The surveys are designed and conducted to a representative sample of formal private enterprises in the non-agricultural sector. The Surveys gather a wide array of information, both qualitative and quantitative nature through physical interviews and interaction with firm managers and owners. In this study, we have specifically used the survey data related to employment, capital assets, imports, foreign technology transfer, R&D along with some basic information from the balance sheet.. Details of variables and their construction are presented in Table 1. It is noteworthy that we utilize all countries data, across the regions and income groups except high income countries (according to the World Bank classification, 2017).

As described in Table 1 sales figures are taken as a proxy for gross output from which after deducting the raw material expenses the proxy for gross value added is derived. Sales per worker is taken as a broad measure of labour productivity. The dependence on foreign technology and input is captured in a number of ways: if establishment at present is using technology licensed from a foreign-owned company, excluding office software it is captured in terms of a dummy (Ftech). The dummy (Foreign) represents if private individuals of foreign origin are associated with the company or the company itself belongs to a foreign national. Similarly, if the material inputs are imported directly, the dummy (Import) is taken to capture it. Import intensity, on the other hand, is defined as % of material inputs of foreign origin. Please see Table 1A of appendix for summary statistics of variable used in the analyses.

Table 1: Data Description and Descriptive Statistics

Variable	Definition
Ln(Q)	Sales of firm in the financial year, converted in logarithm
Ln(GVA)	Sales excluding raw material expenses, converted in logarithm
Ln(LP)	labor productivity (approximated by Sales/Number of workers), converted in logarithm
Ln(TFP)	TFP, converted in logarithm
Labour growth	% growth in labour from t-3 year
Ln (labour)	Number of permanent, full-time production workers in the establishment, converted in logarithm

R&D status	=1 if firm is doing R&D, otherwise 0
Ln(Capital)	Log of value of machinery, vehicles, and equipment, that is the value of assets after depreciation
Foreign Technology (Ftech)	=1 if establishment at present is using technology licensed from a foreign-owned company, excluding office software; otherwise 0
Ln(capasset)	Replacement cost of capital, converted in logarithm
Foreign	=1 if foreign ownership,0 otherwise
Age	Age of the firm
Ln(K/N)	Capital/number of workers, converted in logarithm
Import	=1 if the material inputs and/or supplies purchased in fiscal year were imported directly; 0 otherwise
Import intensity	% of Material inputs and/or supplies of foreign origin

Measuring Total Factor Productivity

One of our indicators of performance is total factor productivity (TFP). To compute TFP of firms, we first specify the production function for estimation. We specify it in a value-added production function form, where the dependent variable Q is value added, K represents capital asset and N represents number of workers. Since our data is from a cross-sectional survey, we form the following model:

$$Q_i = f(K_i, N_i)\varphi_i \quad (4)$$

If we assume Cobb-Douglass production function and that the TFP index can be written $\varphi_i = e^{v_i}$ it can be specified as

$$Q_i = AK_iN_ie^{v_i} \quad (5)$$

which can be transformed into a linear equation:

$$lnQ_i = lnA + \beta_1 lnK_i + \beta_2 lnN_i + v_i \quad (6)$$

Here, the natural logarithm of the TFP index is equal to the residual term.

Estimation Methodology

The estimating production function has long been debated in the related literature. The ways of dealing with endogenous labor input is an important factor in precisely estimating the function. Because of unobserved productivity or managerial ability of producers, several previous studies have opted for estimating the production functions using the estimation methods based on panel data. In the literature, for panel data analysis, the methods based on fixed and random effects estimation, generalized method of moments (GMM) and system GMM (e.g., Blundell and Bond, 2000), and proxy variable methods of Olley and Pakes (1996), Levinsohn and Petrin (2003) and recently developed method by Ackerberg, Caves and Frazer (2015) are used to take care the potential problems involved with the estimation. In the recent years, panel data is widely available for firms, yet there are still some important data especially survey-based cross sectional data are available for production function estimation. Importantly, in some cases, cross sectional data provides much more observations and information than typical panel data. Therefore, some recent studies have attempted to find an appropriate way of estimating a production function using cross sectional data.

For a cross-section data, it is important to employ a practical method for production function estimation using weaker assumptions. For this purpose, Nevo and Rosen (2012) proposed to improve a partial identification technique for the estimation of the upper and lower bounds of coefficients through the imperfect instrumental variables (IIV) method. The crucial characteristic of IIV method is to allow correlation between labor inputs and the error term. This makes it possible to estimate production function with endogenous factor using cross sectional data. It is important to note that the IIV approach yields results about the intervals of production elasticities. These bound estimates, i.e., upper and lower, can be more advantageous than their biased point estimates as argued Nevo and Rosen and others who employ a partial identification approach.

Usual IV model can be shown as follows:

$$Y = X\beta + e \qquad (7)$$

$$X = Z\gamma + V \qquad (8)$$

where Y is an outcome variable of interest and X is a matrix of potentially endogenous variables. In the setup, Z is a matrix of instruments that are uncorrelated with the error term e and is based on the assumption that X contains some endogenous variable. The coefficient vector cannot be obtained consistent and unbiased estimable by using OLS estimator. The existence of valid instruments Z, which can be excluded from equation 1, thus drives the estimation of the structural parameters of interest β.

The validity of instruments must be fulfilled in one of the two conditions. First, the instrument Z does not directly cause Y once purged of their effect on X. Second, if Z is uncorrelated with e, the instrumental validity condition is met. But this assumption is difficult to test, as it is related to the behavior of the unobservable e. Precisely, when instruments become uncorrelated with many observable factors and clear the identification test, the validity of instrument can be accepted with confidence. This promoted some recent research in attempting to consider relaxation of these assumptions. However, instead of estimating under strict conditions, it has been attempted to estimate the instruments under relaxed assumptions and to obtain that the bounds of coefficients instead of a single value can be estimated under considerably loosened conditions. On these grounds, the bounding approach proposed by Conley et al. (2012) and Nevo and Rosen (2012). Specifically, Nevo and Rosen (2012) documented that assuming a direction for the covariance between the instrument and the stochastic error β could produce two-sided bounds for the coeffients of interest.

If we relax the condition of IV estimator, that is, the correlation assumptions of the classical IV approach, it produces consistent estimates based on the (unobservable) validity assumption E[Ze] = 0. Nevo and Rosen (2012) proposed a linear IV model in which the zero covariance assumption is loosened the assumptions of IV estimator in a similar way. Nevo and Rosen (2012) showed that the replacement of the zero covariance assumption with an assumption regarding the sign of the covariance between IV and the stochastic error leads to useful, convenient, and estimable bounds in the linear IV technique.

Specifically, Nevo and Rosen (2012) considered ρ_{xe} to indicate correlation and σ_{xe} to show covariance, and σ_x to denote standard deviation. The usual IV assumption is therefore represented by $\rho_{ze} = 0$. Nevo and Rosen (2012) replaced this important validity assumption with an assumption regarding the direction of association between instrument Z and the stochastic error term e in equation 1 is $\rho_{xe}\rho_{ze} \geq 0$. This assumption is proposed by Nevo and Rosen (2012) and this shows that the instruments have a similar direction of weakly correlation with the omitted error term as the endogenous variable X.

This assumption, joint with another assumption that provides definition of an IIV as an IV, which has a similar way of correlation with the unobserved error term as the endogenous variable x in the model, however, it is comparatively less endogenous than x:

$$|\rho_{xe}| \geq |\rho_{ze}|$$

Based on this, one may describe a quantity denoting the relative degree of correlation between the instrument and the error term relative to the same correlation between the original endogenous variable and the stochastic error term in the model. If the instrument in the model is negatively correlated with the endogenous variable, this will allow us to estimate the upper and lower bounds on the unbiased coefficients. Furthermore, Nevo and Rosen (2012) show that in case of more than one instrument is existing to use, and if one instrument is better than another one in terms of relevance and validity, then the two-sided bounds can be estimated, even if the original IIVs are positively associated with the endogenous variable X in the model.

The estimation results of the production function are presented in Table 2. Column 1 presents results when OLS estimator is employed. The estimated coefficients of labour is 0.33 while capital is 0.75. This implies that despite labor abundance, the production process is mainly using capital intensive techniques in developing world. The next columns of the table present IIV results, the upper bound are somewhat validated the OLS estimates.

Table 2: Production Function Estimation

	Coefficient	Lower bound	Upper bound
Ln (Labour)	0.33108**	0.0969	0.34961
	(0.0075)		
Ln (Capital)	0.75686 **	0.93145	0.75779
	(0.0031)		
Const	3.9591**		

	(0.07135)	
Adj R-squared	0.7071	
N	35,439	35439
Estimator	OLS	Nevo and Rosen (2012)'s Imperfect IV bounds

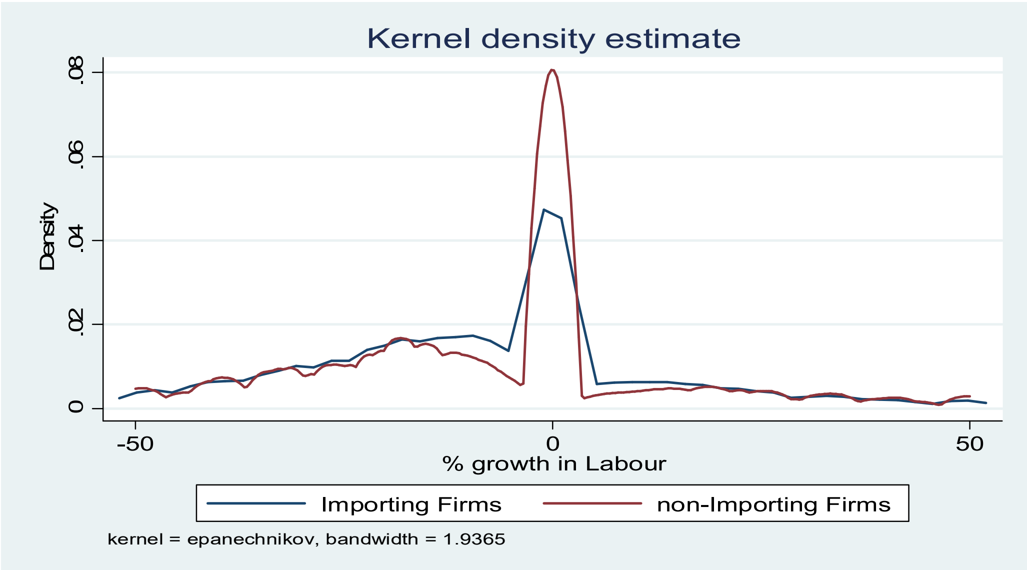
Note: 1. Standard error in brackets. ** Significant at 5% critical level.

Instruments: education of workers and percentage of electricity from own generator

Employment growth: comparison of distribution

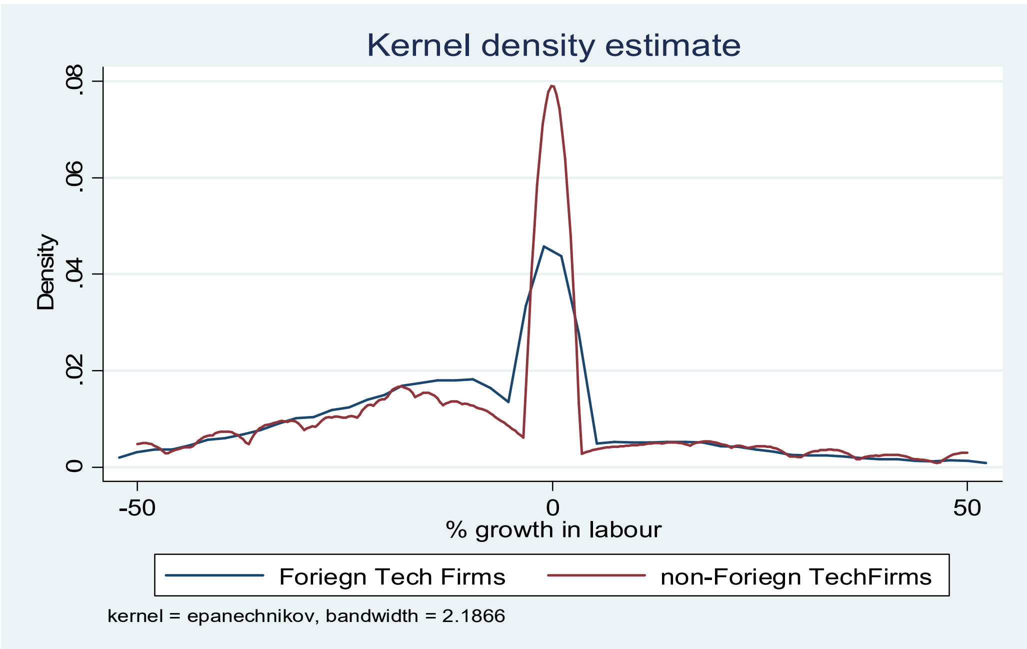
We begin our analysis by presenting the kernel density functions for the rate of growth in employment of the importing and non-importing firms seem to be almost similar, the modal value being zero for both the categories. However, corresponding to the zero employment growth rate the modal frequency for non-importing firms is significantly higher than the number of importing firms (figure 1). But at growth rates marginally negative importing firms exceed the number of non-importing firms. Turning to the attribute of foreign technology dependency, again it is seen that the number of firms with no foreign technology is significantly higher than the ones using foreign technology corresponding to the zero rate of growth in employment which is also the modal value for both the categories. But at growth rates marginally negative the number of foreign technology using firms is greater than the ones not using such technology. At more pronounced negative employment growth rates the importing and non-importing firms or the foreign technology dependent and non-dependent firms are almost equal in number (see figure 2). At the outset it may be noted that the firms importing raw materials or depending on foreign technology are relatively speaking less likely to register zero employment growth rate compared to the ones dependent on the domestic sources. Hence, to begin with the hypothesis that foreign technology tends to reduce the pace of labour absorption is rather not substantiated with evidence.

Figure 1



Source: Authors' computation

Figure 2



Source: Authors' computation

Note: foreign tech firms are those using foreign technology, while non-Foreign Tech firms are not those using foreign technology

4. Determinants of Productivity

Labour productivity is seen to be directly associated with the capital asset of the firm, lending support to the view that mechanization/capital accumulation contributes to rise in labour productivity (Tables 3 and 4). However, all the three dummies representing foreign technology, import of inputs and foreign ownership reduces labour productivity, which goes strongly against the popularly held views. It is quite possible that the decisions relating to foreign technology and imported inputs are made independent of the domestic requirements and the comparative advantages that the importing countries may offer with domestic technology or inputs. The available labour might not be compatible with the imported component. It is equally probable that foreign technology or imported inputs are not appropriately utilized to enhance labour productivity. Appropriate adjustments, adaptations and cost escalations are some of the outcomes, reducing labour productivity. Another important point which emerges from the results is that the combined effect of foreign technology and imported input on labour productivity is positive. This may be indicative of the complementary relationship between the two; in other words, foreign technology may not be compatible with the domestic input supply or the domestic technology is not able to utilize the imported input optimally, suppressing labour productivity growth.

Interestingly, the research and development component, which is usually believed to be a proxy for domestic innovation, is seen to reduce labour productivity. Research and development expenditure is often said to be an outcome of high levels of manipulation carried out by the firms in order to save taxes (Mani, 2009). Besides, adaptation cost and high abatement costs of the foreign technology tend to get included in the research and development expenditure of the firms instead of representing technology creation in true sense. As activities to make imported capital intensive technology operational in a completely different situation are highly expensive, labour productivity tends to decline. In Table 4 as we replace the importing input status of the firm by the percentage of inputs imported from abroad the results by and large remain the same.

Since it is possible to augment one factor productivity by employing more of the other factor of production, we need to consider a better measure of productivity which can be independent of such trade-offs. We, therefore, estimate total factor productivity and assess the impact of foreign technology, imported inputs and research and development on this index.

Table 3

Effects of Imported inputs dummy and foreign technology on labour productivity

	(1) Ln(LP)	(2) Ln(LP)	(3) Ln(LP)
Import	-0.642**	-0.568**	-0.601**
	(0.0203)	(0.0212)	(0.0232)
Ln(capasset)	0.642**	0.647**	0.647**
	(0.00274)	(0.00277)	(0.00277)
Fetch		-0.201**	-0.285**
		(0.0265)	(0.0356)
R&D		-0.152**	-0.151**
		(0.0227)	(0.0227)
Foreign		-0.177**	-0.183**
		(0.0311)	(0.0311)
Age		-0.000487**	-0.000488**
		(0.0000562)	(0.0000561)
Import*fetch			0.186**
			(0.0524)
_cons	4.021**	4.020**	4.025**
	(0.0421)	(0.0422)	(0.0422)
N	42792	42788	42788
adj. R^2	0.562	0.565	0.565

Standard errors in parentheses
* p<0.10, ** p<0.05

Table 4

Effects of Imported inputs and foreign technology on labour productivity

	(1) Ln(LP)	(2) Ln(LP)	(3) Ln(LP)
import intensity	-0.0047**	-0.00392**	-0.00398**
	(0.00025)	(0.000260)	(0.000283)

Ln(capasset)	0.629**	0.638**	0.638**
	(0.00272)	(0.00276)	(0.00276)
Fetch		-0.255**	-0.268**
		(0.0265)	(0.0361)
R&D		-0.221**	-0.220**
		(0.0227)	(0.0227)
Foreign		-0.272**	-0.273**
		(0.0310)	(0.0310)
Age		-0.000501**	-0.000501**
		(0.0000565)	(0.0000565)
import intensity* Fetch			0.000372
			(0.000698)
_cons	4.152**	4.122**	4.123**
	(0.0425)	(0.0425)	(0.0426)
N	42767	42763	42763
adj. R^2	0.556	0.560	0.560

Standard errors in parentheses
* p<0.10, ** p<0.05

Turning to TFP which is considered to be independent of all the factors of production unlike the partial productivity, the results are at par with the findings of a number of studies. Foreign technology, imported inputs - whether measured in terms of dummy or the percentage of inputs imported from abroad - and the status of foreign ownership in the company all three raise the TFP. Further, TFP levels are positively associated with the volume of capital assets. Domestic innovation captured through research and development expenditure is seen to improve the total factor productivity levels. The older firms are associated with TFP gains possibly because of their greater experience and access to information relating to input supplies and marketing of the products. The only conflicting result that we noted from Tables 5 and 6 is that the combined effect of foreign technology and imported input turns out to be negative. This may be rationalized in terms of inappropriate labour available within the domestic economy which in turn affects adversely the TFP in firms more dependent on foreign components as captured through both imported technology and inputs.

Table 5

Effects of imported inputs dummy and foreign technology on TFP

	(1) Ln(TFP)	(2) Ln(TFP)	(3) Ln(TFP)
Import	0.0227**	0.0177**	0.0201**
	(0.00102)	(0.00106)	(0.00117)
Ln(capasset)	0.0432**	0.0430**	0.0430**
	(0.000145)	(0.000145)	(0.000145)
Fetch		0.0117**	0.0171**
		(0.00126)	(0.00166)
R&D		0.00532**	0.00523**
		(0.00112)	(0.00111)
Foreign		0.00903**	0.00936**
		(0.00154)	(0.00154)
Age		0.00787**	0.00791**
		(0.000723)	(0.000723)
Import*fetch			-0.0125**
			(0.00251)
_cons	2.133**	2.109**	2.109**
	(0.00224)	(0.00316)	(0.00316)
N	21824	21822	21822
adj. R^2	0.815	0.818	0.818

Standard errors in parentheses
* $p<0.10$, ** $p<0.05$

Table 6

Effects of imported inputs and foreign technology on TFP

	(1) Ln(TFP)	(2) Ln(TFP)	(3) Ln(TFP)
import intensity	0.000150**	0.000105**	0.000125**
	(0.0000132)	(0.0000133)	(0.0000147)
Ln(capasset)	0.0437**	0.0433**	0.0433**
	(0.000144)	(0.000144)	(0.000144)

Fetch		0.0131**	0.0167**
		(0.00127)	(0.00169)
R&D		0.00743**	0.00737**
		(0.00111)	(0.00111)
Foreign		0.0122**	0.0124**
		(0.00153)	(0.00153)
Age		0.00913**	0.00911**
		(0.000721)	(0.000721)
Import*fetch			-0.000110**
			(0.0000341)
_cons	2.129**	2.102**	2.102**
	(0.00226)	(0.00315)	(0.00316)
N	21818	21816	21816
adj. R^2	0.812	0.816	0.816

Standard errors in parentheses
* p<0.10, ** p<0.05

5. Determinants of Employment

Next we present results relating to employment effects of the foreign technology. Table 7 presents the results for the rate of growth in employment taken to be a function of the volume of capital asset, age of the firm and the variables relating to foreign technology, import of inputs, foreign ownership and research and development expenditure. Foreign technology is seen to reduce the pace of labour absorption (Table 7) though in the Kernal distribution results we had noted that the firms with no foreign technology had a higher modal frequency than the firms with foreign technology. The control variables seem to have made this difference. However, the combined effect of import of inputs and technology on the rate of growth in employment is positive. The other interesting point relates to research and development expenditure which raises the employment growth. These findings can be verified from both the Tables 7 and 8. On the whole, it may be inferred, while import of technology may curtail the pace of labour absorption, domestic innovation may not be all that capital intensive. Hence, the developing countries may like to invest more in research and development which can facilitate both productivity gains and employment gains. The domestic innovation may pursue greater degree of efforts to develop suitable technology keeping in view the prevailing labour market conditions. The dual objectives of non-resource driven growth and employment creation seem to be promising with domestic innovation.

Table7

Effects of imported inputs dummy and foreign technology on employment growth

	(1) Labourgrowth	(2) Labourgrowth	(3) Labourgrowth
Import	-0.195	-0.254	-0.668
	(0.841)	(0.881)	(0.966)
Ln(capasset)	0.527**	0.526**	0.528**
	(0.113)	(0.114)	(0.114)
Fetch		-3.144**	-4.164**
		(1.093)	(1.465)
R&D		2.000**	2.005**
		(0.941)	(0.941)
Foreign		1.536	1.467
		(1.286)	(1.288)
Age		-0.00121	-0.00122
		(0.00224)	(0.00224)
Import*fetch			2.259
			(2.163)
_cons	-17.44**	-17.47**	-17.40**
	(1.735)	(1.742)	(1.744)
N	43437	43433	43433
adj. R^2	0.000	0.001	0.001

Standard errors in parentheses
* p<0.10, ** p<0.05

Table 8

Effects of imported inputs and foreign technology on employment growth

	(1)	(2)	(3)

	Labourgrowth	Labourgrowth	Labourgrowth
import intensity	-0.00375	-0.00314	-0.00524
	(0.0105)	(0.0108)	(0.0117)
Ln(capasset)	0.525**	0.522**	0.523**
	(0.111)	(0.113)	(0.113)
Fetch		-3.163**	-3.624**
		(1.088)	(1.480)
R&D		1.955**	1.962**
		(0.934)	(0.934)
Foreign		1.513	1.489
		(1.277)	(1.278)
Age		-0.00123	-0.00122
		(0.00224)	(0.00224)
import intensity *fetch			0.0132
			(0.0287)
_cons	-17.35**	-17.38**	-17.34**
	(1.737)	(1.748)	(1.751)
N	43409	43405	43405
adj. R^2	0.000	0.001	0.001

Standard errors in parentheses
* $p<0.10$, ** $p<0.05$

However, having said that it may be noted from Tables 9 and 10 that the results pertaining to labour demand function are very interesting. While the employment elasticity with respect to growth is positive, the wage elasticity is negative as expected. The impact of foreign technology, imported inputs and foreign ownership are positive on the total employment. Domestic innovation or research and development expenditure also results in higher levels of employment. Hence, foreign technology and better quality imported inputs can be beneficial for the firms as new opportunities may come up for expansion in activities though the joint effect turns out to be negative. The scale effect without proportionate rise in other resources and capital may result from processing of byproducts, building complementary products, and manufacturing other products which were possibly purchased from other firms earlier. All this would require additional labour and hence, the total volume of employment offered by the firm may actually rise significantly. In fact, the foreign technology and high quality inputs from abroad hold such possibilities for firms to manufacture additional products and generate additional employment without proportionate rise in capital as they involve greater capacity. Even if modern technology is capital intensive and it reduces labour per unit value of output for a given product, still the enhanced activity in the face of greater capacity may contribute to labour demand without proportionate rise in the demand for other resources. Interestingly we observe from Tables 11 and 12 that the ratio of labour to total output of a firm taken to represent the labour content per unit value of output is responding positively to foreign technology, import of inputs, foreign ownership, age and research and development expenditure though with respect to output expansion it tends to decline. Thus, the declining labour content per unit value of output can be compensated through other means, thus scaling up the level of employment. From Tables 11 and 12 we note that the coefficients of the import dummy, foreign technology dummy and foreign ownership dummy are positive but the magnitudes are lower than the negative intercept. In other words, labour to value added ratio is higher for importing firms or foreign owned firms or firms with foreign technology compared to their counterparts without such attributes. However, firms with both foreign technology and imported inputs are not necessarily higher in the scale compared to the firms depending on domestic technology and inputs.

Table 9

Effects of imported inputs dummy and foreign technology on employment

	(1) ln(labor)	(2) Ln(labor)	(3) Ln(labor)
Import	0.548**	0.447**	0.478**
	(0.0102)	(0.0104)	(0.0114)
Ln(wage)	-0.403**	-0.386**	-0.385**
	(0.00251)	(0.00251)	(0.00251)
Ln(GVA)	0.438**	0.418**	0.418**

	(0.00209)	(0.00212)	(0.00212)
Fetch		0.285**	0.353**
		(0.0125)	(0.0163)
R&D		0.254**	0.254**
		(0.0108)	(0.0108)
Foreign		0.274**	0.278**
		(0.0149)	(0.0149)
Age		0.000130**	0.000131**
		(0.0000236)	(0.0000236)
import*fetch			-0.160**
			(0.0248)
_cons	0.874**	0.905**	0.900**
	(0.0222)	(0.0219)	(0.0219)
N	50419	50414	50414
adj. R^2	0.533	0.547	0.547

Standard errors in parentheses
* p<0.10, ** p<0.05

Table 10
Effects of imported inputs and foreign technology on employment

	(1) ln(labor)	(2) ln(labor)	(3) ln(labor)
import intensity	0.00255**	0.00155**	0.00187**
	(0.000125)	(0.000125)	(0.000136)
Ln(wage)	-0.427**	-0.402**	-0.401**
	(0.00252)	(0.00252)	(0.00252)
Ln(GVA)	0.465**	0.436**	0.435**
	(0.00207)	(0.00211)	(0.00211)
Fetch		0.330**	0.396**
		(0.0127)	(0.0168)

R&D		0.302**	0.301**
		(0.0109)	(0.0109)
Foreign		0.370**	0.374**
		(0.0151)	(0.0151)
Age		0.000126**	0.000126**
		(0.0000240)	(0.0000240)
import intensity *fetch			-0.00199**
			(0.000330)
_cons	0.788**	0.858**	0.852**
	(0.0228)	(0.0224)	(0.0224)
N	50395	50390	50390
adj. R^2	0.510	0.532	0.532

Standard errors in parentheses
* p<0.10, ** p<0.05

Table 11
Effects of imported inputs dummy and foreign technology on employment-output ratio

	(1) Ln(labour/output)	(2) Ln(labour/output)	(3) Ln(labour/output)
Import	-0.229**	0.275**	0.296**
	(0.0114)	(0.00967)	(0.0106)
Ln(wage)	-0.935**	-0.529**	-0.529**
	(0.00182)	(0.00246)	(0.00246)
Fetch		0.179**	0.226**
		(0.0116)	(0.0151)
R&D		0.102**	0.102**
		(0.0101)	(0.0101)
Foreign		0.192**	0.195**
		(0.0138)	(0.0139)
Ln(GVA)		-0.437**	-0.437**
		(0.00215)	(0.00215)

Age		0.000156**	0.000157**
		(0.0000214)	(0.0000214)
import*fetch			-0.111**
			(0.0230)
_cons	-2.662**	-0.422**	-0.426**
	(0.0217)	(0.0204)	(0.0204)
N	60381	50360	50360
adj. R^2	0.814	0.904	0.904

Standard errors in parentheses
* p<0.10, ** p<0.05

Table 12
Effects of imported inputs and foreign technology on employment-output ratio

	(1) Ln(labour/output)	(2) Ln(labour/output)	(3) Ln(labour/output)
import intensity	0.00217**	0.00159**	0.00186**
	(0.000113)	(0.000115)	(0.000125)
Ln(wage)	-0.558**	-0.540**	-0.540**
	(0.00239)	(0.00244)	(0.00244)
Ln(GVA)	-0.405**	-0.425**	-0.425**
	(0.00202)	(0.00211)	(0.00211)
Fetch		0.199**	0.256**
		(0.0117)	(0.0154)
R&D		0.130**	0.129**
		(0.0101)	(0.0101)
Foreign		0.235**	0.238**
		(0.0139)	(0.0139)
Age		0.000157**	0.000156**
		(0.0000215)	(0.0000215)
import intensity			-0.00170**

*fetch			
			(0.000304)
_cons	-0.522**	-0.473**	-0.478**
	(0.0206)	(0.0206)	(0.0206)
N	50339	50334	50334
adj. R^2	0.901	0.903	0.903

Standard errors in parentheses
* p<0.10, ** p<0.05

Evidence from quantile regression and region wise results

for understanding about this issue by examining the employment effects of technology at different points of the conditional employment distribution, we adopt quantile regression approach. The results from the quantile regression model (Tables 13 and 14) again confirm that the wage elasticity and growth elasticity of employment are negative and positive respectively. Firms with either imported inputs or foreign technology or foreign ownership raise the employment compared to the firms without any of that. However, firms with both imported inputs and foreign technology report lower levels of employment indicating that less dependence on indigenous/domestic resources curbs employment as production process pursued largely on the basis of methods developed in labour scarce countries are capital intensive. Domestic innovation as measured through research and development also contributes to employment. On the whole, in absolute terms neither foreign technology/inputs nor domestic innovation is harmful for employment. Similar results can be verified from the region-wise distribution of the data (Tables 15 and 16) though considerable variations exist in the coefficient values across space. For example, the elasticity of employment with respect to research and development expenditure varies widely between 0.002 in Europe and Central Asia to 0.32 in Middle East and North Africa. The lowest magnitude in ECA is understandable because employment issues are not as contentious as in other developing areas for which the primary focus of innovation in ECA is productivity gain. These countries are in a constant drive to invest on technological up-gradation for maintaining the productivity tempo and escape the recent productivity decline (Das, 2018). South Asia's employment elasticity with respect to research and development is 0.16 (Table 16) which is only half of that in Africa.

Table 13

Effects of imported inputs dummy and foreign technology on employment: Quantile regression

VARIABLES	(1) ln(labor) 0.25	(2) ln(labor) 0.50	(3) ln(labor) 0.75	(4) ln(labor) 0.90
Ln(wage)	-0.430**	-0.558**	-0.650**	-0.553**
	(0.00307)	(0.00275)	(0.00249)	(0.00741)
Import	0.339**	0.313**	0.301**	0.439**
	(0.0140)	(0.0125)	(0.0113)	(0.0337)
R&D	0.215**	0.176**	0.106**	0.141**
	(0.0132)	(0.0119)	(0.0107)	(0.0320)
Ftech	0.187**	0.242**	0.248**	0.346**
	(0.0199)	(0.0178)	(0.0161)	(0.0480)
import*fetch	-0.0374	-0.122**	-0.130**	-0.154**
	(0.0303)	(0.0271)	(0.0246)	(0.0732)
Foreign	0.165**	0.165**	0.164**	0.348**
	(0.0183)	(0.0163)	(0.0148)	(0.0441)
Ln(GVA)	0.454**	0.581**	0.664**	0.565**
	(0.00259)	(0.00232)	(0.00211)	(0.00626)
Age	5.34e-05*	4.13e-05	0.000101**	0.000366**
	(2.89e-05)	(2.58e-05)	(2.34e-05)	(6.97e-05)
Constant	0.336**	0.324**	0.536***	1.751**
	(0.0268)	(0.0240)	(0.0218)	(0.0649)
Pseudo R2	0.3371	0.4196	0.4561	0.3609
Observations	50,414	50,414	50,414	50,414

Standard errors in parentheses
** $p<0.05$, * $p<0.1$

Table 14
Effects of imported inputs and foreign technology on employment: Quantile regression

VARIABLES	(1) ln(labor) 0.25	(2) ln(labor) 0.50	(3) ln(labor) 0.75	(4) ln(labor) 0.90
Ln(wage)	-0.445***	-0.576***	-0.671***	-0.574***
	(0.00322)	(0.00266)	(0.00246)	(0.00742)
import intensity	0.000984***	0.00110***	0.00158***	0.00318***
	(0.000174)	(0.000144)	(0.000133)	(0.000401)

R&D	0.256***	0.203***	0.129***	0.190***
	(0.0140)	(0.0115)	(0.0107)	(0.0322)
Ftech	0.256***	0.266***	0.247***	0.362***
	(0.0214)	(0.0177)	(0.0164)	(0.0494)
Import intensity *fetch	-0.00111***	-0.00155***	-0.00150***	-0.00104
	(0.000422)	(0.000349)	(0.000322)	(0.000973)
Foreign	0.238***	0.238***	0.213***	0.357***
	(0.0193)	(0.0159)	(0.0147)	(0.0445)
Ln(GVA)	0.471***	0.599***	0.686***	0.586***
	(0.00270)	(0.00223)	(0.00206)	(0.00622)
Age	3.28e-05	4.35e-05*	0.000101***	0.000291***
	(3.06e-05)	(2.53e-05)	(2.34e-05)	(7.07e-05)
Constant	0.293***	0.276***	0.462***	1.672***
	(0.0287)	(0.0237)	(0.0219)	(0.0661)
Observations	50,390	50,390	50,390	50,390

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15
Effects of imported inputs dummy and foreign technology on employment: Region wise results

	(1)	(2)	(3)	(4)	(5)	(6)
	ln(labor)	ln(labor)	ln(labor)	ln(labor)	ln(labor)	ln(labor)
VARIABLES	AFR	EAP	ECA	LAC	MNA	SAR
Ln(wage)	-0.271***	-0.417***	-0.253***	-0.461***	-0.481***	-0.379***
	(0.00524)	(0.00580)	(0.00699)	(0.00503)	(0.00831)	(0.00966)
Import	0.599***	0.442***	0.450***	0.447***	0.449***	0.467***
	(0.0254)	(0.0321)	(0.0308)	(0.0197)	(0.0361)	(0.0309)
R&D	0.126***	0.307***	0.00188	0.186***	0.329***	0.164***
	(0.0326)	(0.0308)	(0.0470)	(0.0171)	(0.0501)	(0.0193)
Ftech	0.250***	0.379***	0.288***	0.273***	0.377***	0.395***
	(0.0355)	(0.0359)	(0.0412)	(0.0352)	(0.0881)	(0.0318)
import*ftech	-0.0683	-0.297***	-0.0684	-0.0700	-0.183*	-0.113
	(0.0542)	(0.0593)	(0.0628)	(0.0461)	(0.108)	(0.0708)
Foreign	0.323***	0.302***	0.398***	0.352***	0.384***	0.0186
	(0.0274)	(0.0328)	(0.0430)	(0.0275)	(0.0553)	(0.0760)
Ln(GVA)	0.335***	0.420***	0.313***	0.491***	0.457***	0.522***
	(0.00469)	(0.00496)	(0.00513)	(0.00449)	(0.00786)	(0.00514)
Age	8.64e-07	0.000108**	0.000406***	5.60e-05	0.000163	0.000174***
	(5.04e-05)	(4.87e-05)	(6.10e-05)	(4.39e-05)	(0.000107)	(6.43e-05)
Constant	0.535***	1.433***	1.260***	0.589***	1.275***	-0.759***
	(0.0530)	(0.0558)	(0.0648)	(0.0380)	(0.0791)	(0.105)
Observations	9,573	8,608	7,667	11,358	4,229	8,979
R-squared	0.506	0.568	0.412	0.658	0.612	0.619

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: AFP: Africa,EAP: East Asia Pacific, ECA: Europe and Central Asia, LAC-Latin America and the Caribbean MNA-Middle East and North Africa, and 0SAR- South Asia

Table 16

Effects of imported inputs and foreign technology on employment: Region wise results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ln(labor) AFR	ln(labor) EAP	ln(labor) ECA	ln(labor) LAC	ln(labor) MNA	ln(labor) SAR
Ln(wage)	-0.288***	-0.423***	-0.263***	-0.489***	-0.498***	-0.378***
	(0.00534)	(0.00579)	(0.00709)	(0.00501)	(0.00824)	(0.00974)
import intensity	0.00283***	0.00465***	0.000372	0.000280	0.00291***	0.00379***
	(0.000298)	(0.000385)	(0.000378)	(0.000256)	(0.000413)	(0.000374)
R&D	0.179***	0.320***	0.0620	0.271***	0.388***	0.187***
	(0.0335)	(0.0310)	(0.0477)	(0.0173)	(0.0504)	(0.0195)
Ftech	0.341***	0.376***	0.387***	0.368***	0.452***	0.365***
	(0.0383)	(0.0361)	(0.0457)	(0.0364)	(0.0946)	(0.0304)
Import intensity *ftech	-0.00189***	-0.00292***	-0.00166**	-0.00190***	-0.00265*	0.000640
	(0.000700)	(0.000806)	(0.000829)	(0.000673)	(0.00148)	(0.000918)
Foreign	0.434***	0.313***	0.493***	0.443***	0.412***	0.0266
	(0.0279)	(0.0330)	(0.0436)	(0.0279)	(0.0560)	(0.0767)
Ln(GVA)	0.359***	0.425***	0.326***	0.524***	0.479***	0.535***
	(0.00472)	(0.00494)	(0.00516)	(0.00439)	(0.00767)	(0.00505)
Age	-5.37e-06	0.000103**	0.000399***	2.36e-05	0.000197*	0.000180***
	(5.19e-05)	(4.88e-05)	(6.21e-05)	(4.49e-05)	(0.000108)	(6.47e-05)
Constant	0.406***	1.417***	1.279***	0.495***	1.144***	-0.955***
	(0.0543)	(0.0559)	(0.0664)	(0.0390)	(0.0800)	(0.105)
Observations	9,567	8,600	7,659	11,358	4,227	8,979
R-squared	0.478	0.566	0.393	0.641	0.602	0.614

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: AFP: Africa,EAP: East Asia Pacific, ECA: Europe and Central Asia, LAC-Latin America and the Caribbean MNA-Middle East and North Africa, and 0SAR- South Asia

6. Conclusion

Most of the developing countries are confronted with a shortage of resources and an excess supply of labour, thus leading to the dual objective of productivity enhancement and employment creation. As technology innovation, which is primarily initiated in the developed countries characterized by a shortage of labour and a surplus of capital, is believed to be capital intensive, it becomes pertinent to doubt the appropriateness of the imported technology and inputs that are compatible with such technology, in the context of the developing countries. Alternately can domestic innovation in these countries contribute to employment creation? In the backdrop of these concerns the present paper using the World Enterprise Survey data assessed the impact of technology import, input import, foreign ownership of companies and domestic innovation on productivity and employment both.

Taking productivity in terms of factor (labour) productivity we noted that all the three potential technology sources: foreign technology, import of inputs and foreign ownership of the company reduces labour productivity, which goes strongly against the popularly held views. It is quite probable that the foreign technology or imported inputs are not appropriately utilized to enhance labour productivity. Another important point which emerges from the results is that the combined effect of foreign technology and imported input on labour productivity is positive. This may be indicative of the complementary relationship between the two; in other words, foreign technology may not be compatible with the domestic input supply or the domestic technology is not able to utilize the imported input optimally, suppressing the labour productivity. Interestingly, the research and development component, which is usually believed to be a proxy for domestic innovation, is seen to reduce labour productivity possibly because research and development expenditure figures are highly manipulated without reflecting on actual innovative pursuits.

Turning to TFP the results are positive: foreign technology, imported inputs - whether measured in terms of dummy or the percentage of inputs imported from abroad - and the status of foreign ownership of the company all three raise the TFP. Further, TFP levels are positively associated with the volume of capital assets. Domestic innovation captured through research and development expenditure is seen to improve the total factor productivity levels. The older firms are associated with TFP gains possibly because of their greater experience and access to information relating to input supplies and marketing of the products. The only conflicting result that we noted is that the combined effect of foreign technology and imported input turns out to be negative. This may be rationalized in terms of inappropriate labour available within the domestic economy which in turn affects adversely the TFP in firms more dependent on foreign components as captured through both imported technology and inputs.

On employment the impact of foreign technology, imported inputs and foreign ownership are positive. Domestic innovation or research and development expenditure also results in higher levels of employment. Hence, foreign technology and better quality imported inputs can be beneficial for the firms as new opportunities may come up for the expansion in activities though the joint effect turns out to be negative. The scale effect without proportionate rise in other resources and capital may result from processing of byproducts, building complementary products, and manufacturing other products which were possibly purchased from other firms earlier. All this would require additional labour and hence, the total volume of employment offered by the firm may actually rise significantly. In fact, the foreign technology and high quality inputs from abroad hold such possibilities for firms to manufacture additional products and generate additional employment without proportionate rise in capital as they involve greater capacity. If modern technology is capital intensive and reduces labour per unit value of output for a given product or reduces the pace of labour absorption (rate of growth), still the enhanced activity in the face of greater capacity may contribute to labour demand without proportionate rise in the demand for other resources. Interestingly we observe that the ratio of labour to total output of a firm taken to represent the labour content per unit value of output is responding positively to foreign technology, import of inputs, foreign ownership, age and research and development expenditure though with respect to output expansion it tends to decline. Thus, the declining labour content per unit value of output can be compensated through other means, such as scaling up the level of activities and employment. The quantile regression results and the regional regression results conform to the favourable effects of both technology acquisition and domestic innovation on the total employment. Hence, the dampening effect of new technology on employment in absolute sense seems to be rather exaggerated while the concern may be justified in relative terms or in reference to unskilled labour particularly. The policy implication of the study is that developing countries may have to invest sizably on skill formation which will contribute to the enhanced employability of the labour force. The changing labour requirement of the new technology – be it imported or domestically manufactured – will have to be understood intrinsically, and accordingly labour will have to be transformed to find its new space in the production process which is undergoing a structural revolution. On the whole, though technology revolution poses concern for labour, our findings offer a sense of optimism as reshuffling of labour within a given firm and expansion in the volume of activities both at the firm and industry levels hold possibilities of net gains in employment. So retraining of labour and up-grading of skill for any future contingency would be the keypoints from policy point of view.

Appendix
Table 1A: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(labor)	71702	3.506	1.430	0.000	10.309
Ln(wage)	62885	11.480	2.786	-6.040	27.259
Importint	69102	25.379	35.742	-14.000	100.000
Import	72057	0.259	0.438	0.000	1.000
R&D	72057	0.185	0.389	0.000	1.000
Fetch	72057	0.141	0.348	0.000	1.000
import intensity	69102	25.379	35.742	-14.000	100.000
Ln(KN)	44208	11.571	3.115	-7.496	31.695
Ln(TFP)	25033	2.797	0.162	1.405	3.406
Foreign	72057	0.100	0.300	0.000	1.000
Ln(GVA)	57580	15.587	4.596	1.946	33.845
Age	72040	47.492	225.937	-192.000	2022.000
Ln(capasset)	44074	15.244	3.362	0.000	36.801

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