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Trade Liberalisation and Industrial Productivity: Evidence from Manufacturing Industries in Pakistan

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This study examines the impact of trade liberalisation on the industrial productivity for a panel of twenty seven 3-digit manufacturing industries in Pakistan over the period 1980-2006. Using a variant of the Cobb-Douglas production function for industrial sector, we estimated output elasticities. The results show positive output elasticities with respect to labour, capital and raw materials for the pre-trade liberalisation period (1981 –1995) as well as post-trade liberalisation period (1996-2006). For the pre-liberalisation period, we observe positive output elasticity with respect to energy, while it turns out to be negative in the post-liberalisation period probably due to energy crisis in Pakistan. In the second stage, we calculate total factor productivity (TFP) and examine the impact of trade liberalisation on TFP for pre-and post-trade liberalisation periods. The results reveal that trade liberalisation proxied by import duty has positive but negligible impact on the TFP in the pre-as well as post-liberalisation periods. On the other hand, effective rates of protection exert large negative impact on the TFP in the post-liberalisation than the pre-liberalisation period.

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1. INTRODUCTION

Manufacturing sector in Pakistan confronts lack of advanced technology, skilled labour force, shortage of energy and inconsistent trade policies, which adversely affect the productivity of manufacturing industries. Mahmood, *et al.* (2007) reported that import substitution policies and high tariffs are the major constraints that undermine the efficiency of manufacturing sector in Pakistan. Low quality products of exporting industries are unable to compete with the world's exports in international markets. Due to lack of competitiveness in the world market, domestic producers do not expand their market share.[1] Manufacturing industries in Pakistan are lagging behind in terms of technological advancement and adaptation of advanced technology which cause low value added and low quality product segments of exports [Mahmood, *et al.* (2009)].

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[1]Mahmood (1989) and Mahmood and Siddiqui (2000) noted that slow growth of large scale manufacturing industries could be due to slow total factor productivity growth of manufacturing industries in Pakistan.

Trade liberalisation has widely been recognised as a key component of industrial development of a country, which refers to dismantling tariff and non-tariff barriers such as quotas, prohibitions, and technical requirements. Trade liberalisation is believed to promote industrial development through specialisation, diffusion of knowledge, learning by doing, provision of advanced technology, innovation of new products and improvements in product's quality which enhances access to foreign markets.[2] Furthermore, trade liberalisation can increase industrial efficiency by eliminating monopoly profits, increasing capacity utilisation and allowing optimal resource allocation [Sheikh and Ahmed (2011)]. The theory of industrial organisation has acknowledged the role of international trade in the determination of industrial efficiency through its impact on productivity, profitability and exports. According to the World Bank (2002), reduction in barriers to the international trade could accelerate economic growth, provide stimulus to new forms of productivity, enhances specialisation, jobs creation and poverty reduction around the world.

The traditional theories of international trade predicted that trade liberalisation can increase the value of production in the economy. Trade generates a static improvement in output and allocative efficiency of the economy [Lopez (2005)]. The Ricardian model explains that trade could be beneficial when a country specialises in the production of goods in which it has a comparative labour-productivity advantage; and these goods are exported. On the other hand, the Hecksher and Ohlin (HO) model pointed out that trade arises due to differences in relative prices of various commodities, factor prices and resource endowments between the countries. They demonstrated that trade could be beneficial when countries export those commodities that use their abundant factors more intensively in their production process.[3] As the economy opens, there is a shift in resources towards the sectors that use more abundant factors, and the value of total productivity increases [Lopez (2005)]. Samuelson (1948, 1949) extended the HO model and concluded that factor prices equalised between the trading nations when resources are reallocated from less efficient industries to more efficient industries. MacDougall (1951, 1952) empirically analysed the comparative advantage and HO theories using data from British and American manufacturing industries and concluded that both countries could produce more by enhancing trade. The endogenous growth models and standard partial equilibrium model of trade hypothesised that trade liberalisation can play an important role in boosting exports and hence economic growth through technology transfer [Hoque and Yusop (2010)]. Krugman (1979, 1991) found that value of total productivity increases following a movement from autarky to free trade in some models of economies of scale with monopolistic competition. Nataraj (2011) reported that new trade and endogenous growth models predict a variety of channels through which trade liberalisation could increase productivity among domestic firms including increased managerial efforts, innovations, knowledge spillover,

[2]Kemal, *et al*. (2002) and Amjad, *et al.* (2012).

[3]Salvatore, D., International Economics, 8th (eds.) John Willey and Sons, Inc, pp. 33-36. First, this concept was explained by the Adam Smith (1776) in his famous book 'An Inquiry to the Nature and Causes of the Wealth of Nations' and then David Ricardo (1817) in 'On the Principles of Political Economy and Taxation'. They explained that trade could be beneficial when countries could specialise according to the principles of absolute and comparative advantages. Detailed review of trade theories can be seen in Lopez (2005).

technological advancement, exploitation of economies of scale, specialisation in research and development (R&D), increased labour skill and industrial learning, and exit for the least productive firms [see for example, Grossman and Helpman (1990); Romer (1990); Rodrik (1992a, 1992b); Krueger (1998); Melitz (2003); Aghion, *et al.* (2005)].

The proponents of trade liberalisation argue that opening of domestic markets to foreign competition and Foreign Direct Investment (FDI) can lead to more efficient allocation of resources that may result in the improvements of productivity of local industries, which in turn lead to higher economic growth. However, the opponents of trade liberalisation argue that domestic firms may not be able to absorb efficiency gains because of credit constraints that prevent adaption of foreign technology as well as investments in new technology [Young (1991); Pack (1994); Topalova and Khandelwal (2011)]. Similarly, the Keynesian economists believed that reduction of import duties contributes to an excess of imports over exports and hence the trade deficit. Furthermore, trade liberalisation can raise unemployment and wage inequality in developed countries, whereas it may increase exploitations of workers, de-industrialisation and marginalisation, increase poverty, global inequality and degradation of the environment in developing and low income countries [Froyen (1996); ILO (2001)]. These two conflicting views about trade liberalisation have important implications for trade policy. If the latter holds, benefits of trade may not have realised unless additional policies are formulated to facilitate technology transfer as well as ease credit constraints [Topalova and Khandelwal (2011)]. Therefore, examining the impact of trade liberalisation on industrial productivity is crucial for policy analysis.

The main objective of the present study is to examine the impact of trade liberalisation on industrial productivity by considering twenty seven 3-digit manufacturing industries in Pakistan for the period 1981-2006.[4] Examining the impact of trade liberalisation is useful because it help to identify the mechanisms through which trade policy reforms affect industrial productivity. It is worth noting that the Government of Pakistan (GoP) launched a series of macroeconomic reforms in the late 1980s and early 1990s that included trade liberalisationand exports promotion besides inflation, fiscal and current account management [Afzal and Ali (2008); McCartney (2015)]. The objective of these reforms was to improve efficiency of domestic manufacturing industries, encourage exports and imports through gradual reduction of import tariffs and simplification of non-tariff barriers. Over a short period of time, Pakistan has drastically reduced tariff and non-tariff barriers to stimulate trade. Existing empirical evidence with regard to trade liberalisation and firm productivity are conflicting. For example, Tybout, *et al.* (1991) find no evidence of increased firm productivity following the trade liberalisation, whereas Krishna and Mitra (1998), Harrison (1994), Tybout and Wrestbrook (1995), Pacvcnik (2002), Trefler (2002), Fernandes (2007), Amiti and Konigs (2007) and Topalova and Khandelwal (2011) have found support for the hypothesis that manufacturing sector's productivity increases following trade liberalisation.

In Pakistan numerous studies have been carried out, inter alia, Ali (2012), Din, *et al.* (2003), Yasmin, *et al.* (2006), Majeed, *et al.* (2010), Sheikh and Ahmed (2011), Amjad, *et al.* (2012), Khan and Qayyum (2007), Qayyum and Khan (2009), Khan and Ahmad (2012), among others. These studies found positive relationship between trade liberalisation and economic growth. One major problem with these studies is that they utilised sum of exports

[4]Details of industries are given in Appendix A.

and imports relative to GDP as a measure of trade liberalisation. However, both exports and imports are directly impacted by trade openness, that is, lower import duties and effective rates of protection results in more trade.[5] This creates a potential problem of endogeneity and simultaneity which was not addressed by previous studies while examining the impact of trade liberalisation on economic growth. Furthermore, no study so far is available that examined the impact of trade liberalisation on firm's productivity in Pakistan. The present study is significantly different from earlier studies carried out in Pakistan in at least two aspects: First, it examines the impact of trade liberalisation on industrial productivity; the present study applied standard approach following Amiti and Konings (2007), Fernandes (2007) and Hamid and Pichler (2009). Initially, we estimate parameters of industrial production function using the methodology outlined by the Levinsohn and Petrin (2003) in order to construct industrial productivity measures. In the next stage, we examine the impact of trade liberalisation on the manufacturing sector's Total Factor Productivity (TFP). We focus on pre-and-post trade liberalisation periods to compare the impact of exogenous variations in trade protection.[6] Second, to deal with the endogeneity problem from production function, the present study utilises proxy variable approach following Olley and Pakes (1996), Levinsohn and Petrin (2003) and Kilinc (2013). Moreover, Fernandes (2007) and Nijikam and Cockburn (2011) removed the endogeneity problem from production function and analysed the impact of trade policy reforms on firm's productivity at plant-level in different countries. Recently, Kilinc (2013) estimated unobserved productivity of entrant firms by introducing inverse demand function approach in the structural model. Following Levinsohn and Petrin (2003) and Kilinc (2013), this study uses an inverse demand function approach to estimate the structural production function. This methodology is more appropriate to control for the endogeneity of inputs due to productivity shocks. After estimating the TFP, an impact of trade policy reforms is analysed for pre-and-post-trade liberalisation periods. Besides, the present study uses import duties and effective rates of protection as alternative measures of trade policy rather than outcome indicator such as a sum of exports and imports as percentage of GDP. This has the benefit of being a direct measure of trade liberalisation and of being exogenous and more relevant than the sum of exports and imports relative to the GDP.

The rest of the paper is organised as follows: Section 2 overviews the trade liberalisation in Pakistan. Section 3 presents the literature review. Model specification, data and econometric methodology is presented in Section 4. Empirical results are discussed in Section 5, while the conclusions along with policy recommendations are given in the final section.

2. AN OVERVIEW OF TRADE LIBERALISATION IN PAKISTAN

There is a general consensus among the economists and policy-makers that economies with liberal trade policies and greater openness show stronger growth and better overall economic performance. Trade liberalisation increases trade openness, brings domestic prices closer to international prices, fosters domestic market competition and facilitates technology diffusion and upgradation [World Bank (2006)].

[5]It is worth mentioning here that lowering import duties and effective rates of protection stimulates trade only when country reduces domestic resource costs on continuous basis. This point is indicated by reviewer 1. We are thankful.

[6]This study considers pre-WTO and post-WTO regimes as pre-and-post trade liberalisation periods respectively.

These developments strengthen firm-level productivity growth and efficiency in resource allocations, thereby boosting exports performance and economic growth. The theoretical justification of free trade and benefits of international specialisation have been discussed in the writings of Bhagwati (1978) and Krueger (1978). Through the 1950s to 1980s, many developing countries adopted inward-looking trade and investment policies as an integral part of their development strategy. The main feature of this policy regime was high tariff and a range of non-tariff barriers such as industrial licensing and controls at home coupled with import and exchange controls externally [Chaudhary, *et al.* (2007) and McCartney (2015)]. However, import substitution policy regime was an unsuccessful across developing countries. This evidence provided theoretical and empirical rationale for outward-looking trade and investment policies in many developing countries including Pakistan in the late 1980s and early 1990s [McCartney (2015)]. Particularly, developing countries including Pakistan have shifted towards globalisation and the World Trade Organisation (WTO) regime. The main objective of outward-looking economic policies was to increase competitive pressure on the incumbents by easing the entry of new producers, encourage more imports of inputs and intermediate goods, transfer of know-how, increase positive externalities in the form of technology transfer and productivity improvements [Mukherjee and Chanda (2016)]. Being a founder member of the General Agreement on Tariffs and Trade (GATT) in 1947 and the WTO in 1995, Pakistan continuously supported open, transparent and rules-based multilateral trading system [WTO (2015)].[7] The trade liberalisation under the WTO regime has produced far-reaching implication for the trade policy in Pakistan. Before the trade liberalisation and formation of the WTO, Pakistan adopted protectionist and import substitution policies in the 1950s and 1960s with the objective to achieve self-sufficiency and protect its domestic infant industries from foreign competition.[8] Under the restricted trade policy regime, average protection was exorbitant at 271 percent in 1963-64, which caused to inefficiencies, low quality products, unskilled labour and isolation of Pakistan's industry from foreign markets and resulted many domestic industries with negative value added [Ahmed (2014)].[9] In order to stimulate industrial productivity and to expand industrial base, Pakistan followed a partial trade liberalisation policy during the period 1965-1969 through devaluation of domestic

[7]The formation of the WTO in January 01, 1995 under the Marrakech Agreement, replaced the GATT. The WTO provides a forum to promulgate trade related rules and regulations for bilateral and multilateral trade agreements between the countries. It is a platform for handling trade related disputes between trading nations. The purpose of this organisation is to promote market friendly investment environment through the elimination of trade distortions across countries. It facilitates countries in the process of trade liberalisation and provides excess to foreign markets by reducing tariff and non-tariff barriers. The WTO has also rules with regard to dumping, transfer pricing mechanism, quality issues, labour standards, environmental issues, government regulations, etc. [Nasir (2012)].

[8]The period 1950-60 to 1964-65 also witnessed a number of changes in the Pakistan's economy. These include (i) introduction of the Export Bonus Scheme (EBS) and host of other incentives to strengthened exports, (ii) a substantial increase in foreign aid, (iii) liberalisation of imports and other direct controls, and (iv) beginning of the green revolution in agriculture sector [Saeed (1995)].

[9]During 1963-64, the effective rates of protection on furnished goods was 883 percent, followed by manufacturing sector (271 percent), intermediate goods (155 percent) and capital goods (88 percent) [Lewis and Guisinger (1968)]. In the presence of high effective rates of protection, domestic value added of some key industries was very low or negative in terms of international prices [Haque (2015)]. For example, during the 1963-64 the share of GDP at domestic prices was 7 percent, whereas the share of GDP at international prices was 0.4 percent [Saeed (1995)].

currency in 1967, establishment of a dual exchange rates system in 1968, foreign exchange reforms coupled with tariff reductions and selective relaxation of import controls [Kemal, *et al.* (2002)].[10] These measures brought down effective rates of protection from 271 percent in 1963-64 to 125 percent in 1968-69.[11] However, the growth gained in 1960s was taken off by the nationalisation of commercial banks, insurance companies and a large number of industrial units in the early 1970s. Besides nationalisation, the GoP abolished the multiple exchange rate system, the EBS and devalued domestic currency by about 58 percent *vis-à-vis* US dollar in 1972. These measures altered the incentives offered to the manufacturing sector [Saeed (1995)]. As a result, the manufacturing sector growth decreased from 9.9 percent in the 1960s to 5.5 percent in the 1970s [Ali (2012)]. However, the industrial policy during the 1980s reversed the nationalisation process started during the 1970s. During the 1980s, high priority was given to restore the businesses confidence which was eroded due to nationalisation policy regime. Beside the denationalisation of a number of public enterprises, the GoP started a series of restructuring reforms to liberalise and deregulate the economy. Furthermore, the GoP also provided a number of incentives to revive private investment. As a consequence, the share of private investment increased from 41.39 percent in 1980-81 to 44 percent in 1989-90 [Din, *et al.* (2007)]. In short, prior to the 1990, high nominal tariff rates, excessive non-tariff barriers, complex imports and investment licensing system, exchange controls and progressive import substitution was the main cornerstone of trade policy regime in Pakistan. The actual reforms period was started since the late 1980s under the umbrella of Structural Adjustment and Stabilisation Programmes (SAP); however, major changes in industrial policy were introduced in the early 1990s. Since 1990, the GoP embarked on a series of policy measures including liberalisation of FDI, liberalisation of exchange rate and payment systems, removal of the requirements of operating licenses in most industries, relaxation of import licensing requirements for capital and intermediate goods, reduction of harmonised tariffs across industries and deregulation of administrative controls including elimination of quantitative restrictions on imports [Din, *et al.* (2007)].

Pakistan has made significant progress in liberalising its trade and investment regime through the gradual reduction of tariff rate and the number of tariff lines, and removal of non-tariff barriers. For example, the maximum tariff rate on imports has come down from 225 percent in 1986-87 to 13.5 percent in 2012. The average tariff rate was cut down from 66 percent in 1990 to 14 percent in 2008. Further, the number of tariff slabs was reduced from 14 in 1996-97 to 5 (i.e. 5 percent, 10 percent, 15 percent, 20 percent and 25 percent) in 2008, while other quantitative restrictions on imports were lifted except for those items related to security, health, public morals, religion and culture. All the para-tariffs (e.g. Iqra surcharge, flood relief surcharge, regulatory duties and the import license fee) were merged in to the statutory tariff regimes and import duties on 4000 items were reduced. These measures have brought down effective rates of protection, reduced anti-export bias and promoted competitive business environment in

[10]Pakistan adopted multiple exchange rate system in the late 1960s that included import taxes and export subsidies. Due to this the effective exchange rate for exports was 50 percent greater than official exchange rate [Dorosh and Valdes (1990)].

[11]During 1968-69, the effective rates of protection of furnished goods was 179 percent, followed by manufacturing sector (125 percent), intermediate goods (61 percent) and capital goods (58 percent) [Kemal (1978)].

Pakistan [Hussain (2005); Qayyum and Khan (2009)].[12] The simple average tariff rate (unweighted) on industrial products decreased from 20.2 percent in 2001 to 14.08 percent in 2008, while the number of Statutory Regulatory Orders (SROs) that exempted certain industries from import duties has fallen from 35 in 2002 to 14 in 2008.[13] A number of laws were promulgated to bring the trade regime in line with the WTO regulations.[14] Furthermore, the government trading monopolies and interventions were eliminated in the agriculture sector to boost exports [Pursell, *et al.* (2011)]. It is expected that the removal of government controls and regulations, and the opening up of local markets to foreign competition can stimulate the exports and productivity of manufacturing industries.

Unfortunately, the reform process backtracked after the onset of the Global Financial Crisis (GFC) in 2008.[15] The maximum tariff increased from 25 percent in 2009 to 35 percent in 2013; simple average tariff (unweighted) increased from 14.08 percent in 2008 to 14.78 percent in 2009, and thereafter it followed declining trend and reached 13.90 percent by 2013. Number of tariff slabs increased from 5 to 9 in 2010. These trade-reducing measures reversed trade-to-GDP ratio from 36.73 percent in 2008 to 30 percent by 2013.

As a part of tariff and non-tariff reforms, Pakistan liberalised its exchange rate and investment regime to integrate domestic economy with the world economy. For example, restrictions on the capital transactions were partially relaxed and foreign borrowing and outward investments were allowed in 1994. Full convertibility of the Pakistani Rupee was established on current international transactions in 1994. Exchange rate system was unified in 1999; interbank foreign exchange market was established in 2000 and switched over form the managed to free floating exchange rate system in July 2000. In 2013, the GoP launched Strategic Trade Policy Framework (STPF) 2012-2015 to enhance Pakistan's export competitiveness in the short as well as in the long run and to increase Pakistan's cumulative exports to US $95 billion during the period 2012-2015. Furthermore, STPF expected to strengthen the trade sector regulations, strengthen governance and institutional capacity, and to enhance exports competitiveness.[16] Since the enforcement of STPF 2012-15, Pakistan's exports crossed $25 billion mark for the first time in 2013-14. However, the pace of exports growth was disrupted due to exogenous shocks coupled with domestic factors and the exports registered about 4.87 percent decline during the year 2014-15. Besides other measures,

[12]For example, the effective rates of protection of import-competing production in all traded goods sectors in 2003 was 25 percent as compared to 58 percent in 2001 and 72.2 percent in 1997 [Din, *et al.* (2007)]. Din, *et al.* (2007) also found anti-export bias in the liberal trade regime to be much smaller in magnitude as compared to the price raising impact of the existing import tariff structure.

[13]Actually large number of SROs could distort the effectiveness and transparency of trade policy and promotes rent-seeking culture in Pakistan [Iqbal, *et al.* (2015)].

[14]Such as anti-dumping, countervailing measures, intellectual property rights, etc.

[15]In the wake of global financial crisis in 2008, over 30 percent of the tariff lines of the WTO members could be increased ultimately without providing compensation to affected trade partners [Handley (2014)].

[16]Recently, the GoP launched STPF 2015-18 to achieve the targets to raise exports to $35 billion mark. Furthermore, improvement of exports competitiveness, transition from factor driven economy to efficiency driven and innovative driven economy, and increasing share in regional trade through competitiveness and market access are the key features of the STPF 2015-18. The STPF 2015-18 is based on the following four pillars: (i) product sophistication and diversification, (ii) market access, (iii) institutional development, and (iv) strengthening and facilitation of trade [*The News* (2016)].

the GoP has strengthened institutional capacity and governance structure under the STPF 2012-15.[17]

Like other developing countries, Pakistan opened up its economy under the regulations of the GATT for foreign firms. Under the WTO regulations, Pakistan was bounded to reduce tariffs on agricultural and manufacturing goods. 81 percent of tariffs on agriculture imports were bounded, while non-agricultural commodities such as minerals, leather products, travel goods, wood-products and transport equipments were bounded at 20-30 percent of tariffs. The export-oriented industries were allowed to import machinery without trade restrictions and were duty free. Further, foreign exchange was easily available for industries and commercial importers [Chudhary (2004)]. However, after the onset of GFC of 2007-08, trade reforms back tracked and average import duties were increased for some products. For example, import duties on beverages and tobacco increased from 46.8 percent in 2008 to 48.9 percent in 2012, duties on electrical machinery increased from 14.5 percent in 2008 to 14.7 percent in 2012 and duties on non-electrical machinery increased from 9.1 percent to 9.3 percent during the same period [WTO (2014)]. However, import duties on some products remained the same or showed a little decrease. For instance, import duty on chemicals and transport equipments showing no change. Similarly, import duty on leather and footwear products decreased from 16.5 percent to 14.9 percent, whereas import duty on cotton products also decreased from 8 percent to 7 percent and petroleum products from 13.1 percent to 10.6 percent during 2008 to 2012 [WTO (2014)].

Reduction in tariffs on manufactured products stimulates investors to increase production as well as exports. Relaxation of trade impediments and easy excess to foreign markets foster the exports and imports of manufactured goods. Table 1 depicts the tariff structure and terms of trade after the existence of the WTO in 1995.

As shown in Table 1, Pakistan reduced tariff rate on all products (unweighted) from 50.10 percent in 1995 to 13.5 percent in 2012, which stimulated exports and imports of manufacturing industries as well as overall exports and imports during the period 1995-2012. The indices of manufactured exports increased from 186.63 in 1995 to 641.15 in 2012, recorded 253.54 percent growth, while imports of manufacturing goods were increased from 161.17 to 823.33 during the same period, registering 410.85 percent growth. Similarly, conspicuous increased in overall exports indices from 168.61 in 1995 to 679.44 in 2012, whereas imports indices increased from 164.22 to 1233.49 during the same period.

Figure 1 illustrates that reduction in MFN average tariff rate enhanced the imports of machinery and technical products that caused to increase the productivity of manufactured goods and exports as well. It is evident from Figure 1 that after 1995 tariff rate followed a gradual declining trend, while the imports and exports of manufactured products followed an increasing trend after 1995, exports seemed to be larger than

[17]These measures include: (a) establishment of (i) domestic commerce wing, (ii) Pakistan Land Authority (PLA), (iii) EXIM Bank, (iv) Leather Export Promotion Council, (v) Services Trade Development Council, (vii) Trade Dispute Resolution Organisation, and (viii) Resource Management Unit. (b) Rationalisation of tariff policy, (d) Strengthening of training and product development institutes, (e) Revamping of exports promotion agencies and the trade monitoring mechanism, and (f) constitution of a trade committee headed by Minister of Commerce [WTO (2015)].

imports of manufactured products. After 2003, there is sharp increase in both exports and imports; however, increase in imports seems to be larger than exports (Figure 1).

Table 1

Terms of Trade and Indices of Unit Value (1990-91=100)

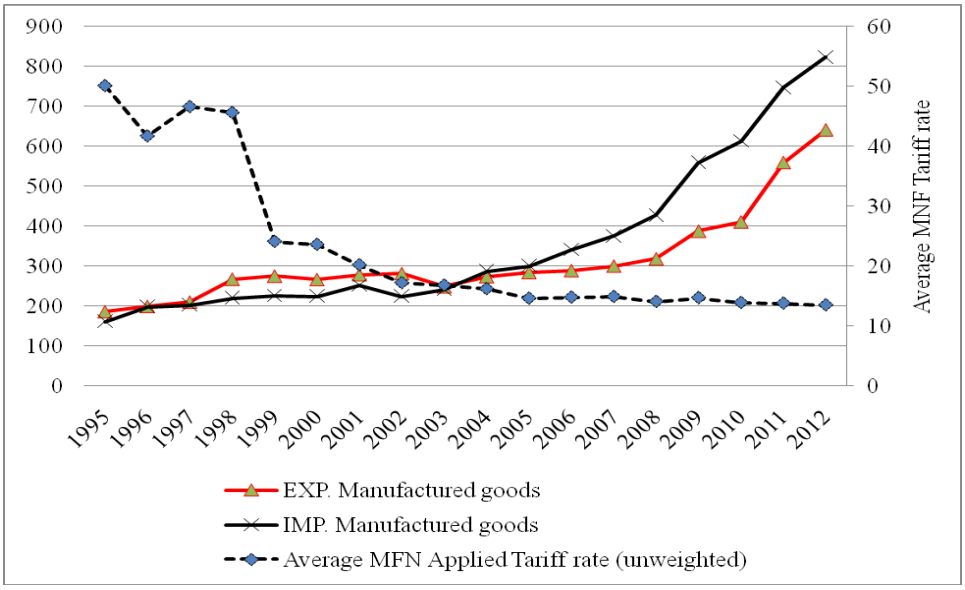
Year	Tariff Rate, MFN (Unweighted) Mean, all Products (%)[a]	Exports of Manufactured Goods	Imports of Manufactured Goods	Exports of all Goods	Imports of all Goods
1995	50.10	186.63	161.17	168.61	164.22
1996	41.70	199.88	198.76	185.36	185.48
1997	46.60	210.74	203.43	204.85	201.71
1998	45.60	267.89	220.74	245.62	198.87
1999	24.10	275.59	226.26	258.4	223.32
2000	23.60	266.96	224.61	253.77	259.03
2001	20.20	279.04	251.50	271.47	298.44
2002	17.20	281.83	224.97	271.18	298.56
2003	16.80	248.93	240.82	254.02	309.52
2004	16.20	274.02	287.80	279.65	355.43
2005	14.61	284.72	301.00	288.84	392.45
2006	14.79	289.58	340.71	299.31	460.38
2007	14.90	300.76	375.06	310.03	495.33
2008	14.08	318.97	427.6	350.40	632.30
2009	14.71	387.90	559.24	450.40	790.82
2010	13.90	411.00	612.77	478.07	839.60
2011	13.80	559.56	747.32	593.19	1,013.10
2012	13.50	641.15	823.33	679.44	1,233.49

Source: State Bank of Pakistan, Statistical Bulletins with base year (1990-91=100).

[a]data on tariff rate is available at http://www.indexmundi.com/facts/pakistan/tariff-rate.

MFN stands for most favoured nation.

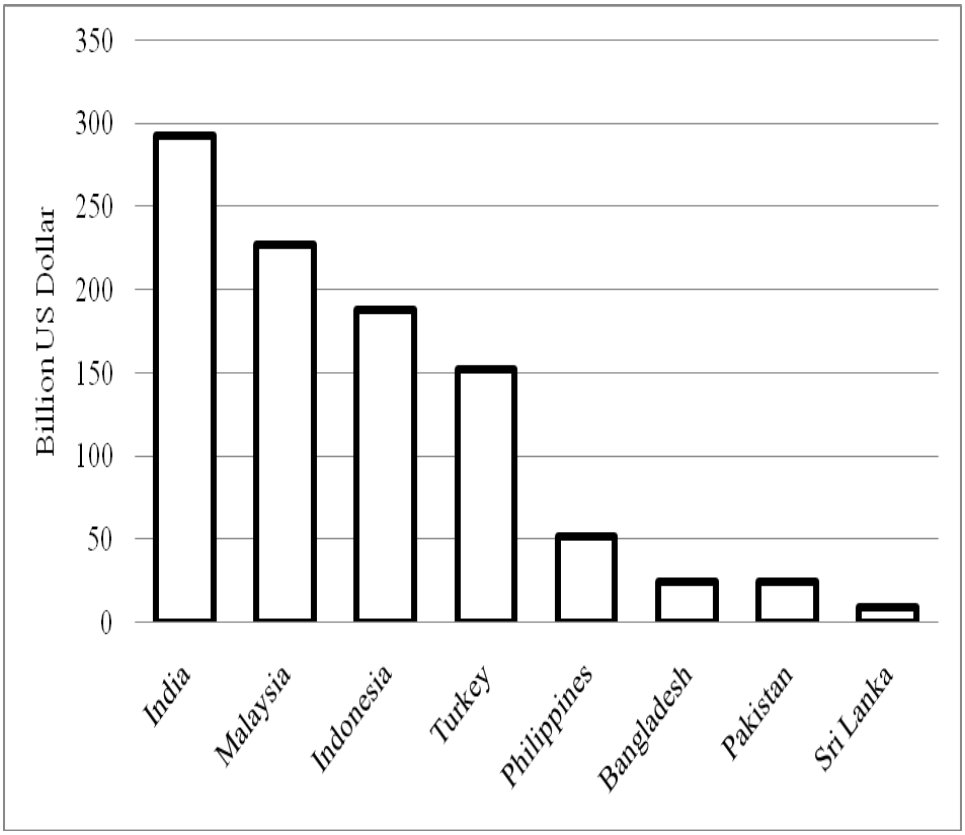
Fig. 1. Trends in Tariff Rate, Exports and Imports Indices (1995-2012)



Based on the trade policy review we may deduce that despite extensive trade liberalisation measures, Pakistan's exports performance is not satisfactory when compared with other developing countries. Figure 2 compares Pakistan's exports performance against its neighbouring and regional economies.[18] It is evident from Figure 2 that in 2012 India ranked top position with US $293.2 billion exports, followed by Malaysia ($227.4 billion), Indonesia ($188.1 billion), Turkey ($152.6 billion), the Philippines ($52 billion), Bangladesh ($25.0 billion), Pakistan ($24.6 billion) and Sri Lanka ($9.5 billion). The main reason of low exports could be that Pakistan is still pursuing some form of inward-looking trade policy. For instance, in 2012-13, 40 percent of the Pakistan's tax revenues were received from imports, while for other competing countries this figure was less than 15 percent [Ahmed (2014)].

Fig. 2. Comparison of Pakistan's Exports Performance (2012)

[18]During the 1960s Pakistan was a relatively outward-looking country and its economic activities are more integrated with the rest of the world. Its volume of manufacturing exports exceeded the Philippines, Indonesia and Malaysia. However, in 2012, Pakistan's exports are only a fraction of the exports of any of these individual countries [Ahmad (2014)].



Source: Statistical Yearbook for Asia and the Pacific 2013.

In order to boost trade, Pakistan needs to further reform its trade policy regime because tariff rates on key exports of Pakistan's competitors is significantly low (Table 2).

Table 2

Comparison of Average MFN Applied Duties on Industrial Products (2015)

Commodity Group	China	India	Indonesia	Malaysia	Sri Lanka	Pakistan
Fish and Fish Products	10.6	29.9	5.9	0.7	15.1	10.7
Mineral and Metals	7.8	7.9	6.4	7.6	7.7	11.5
Chemicals	6.7	7.9	5.1	2.7	3.0	9.0
Wood Papers, etc.	4.5	9.0	4.4	10.18	11.7	13.9
Textiles	9.6	11.8	9.2	8.8	3.3	14.7
Clothing	16.0	12.3	14.4	0.2	14.7	19.9
Leather, Footwear, etc.	13.5	10.1	8.6	10.7	15.0	13.7
Non-electrical Machinery	8.2	7.1	4.8	3.5	3.0	8.6

Electrical Machinery	9.0	7.2	5.7	4.3	7.1	13.6
Transport Equipments	11.4	9.4	9.8	11.1	6.2	24.1
Manufactures, n.e.s.	11.6	8.8	6.7	4.5	9.1	11.9

Source: WTO (2016). n.e.s= not elsewhere specialised.

As shown in Table 2, Pakistan's average MFN applied duties on industrial products are the highest among other developing countries. Unlike other developing countries, Pakistan has not eliminated its import substitution policies despite the implementation of the WTO agreement on trade related investment measures (TRIMS) in 2000.

Among other factors, poor quality governance and management structure and lack of coordination among the implementing and management agencies could be the main reasons of trade policy ineffectiveness in Pakistan [Pakistan (2011)]. Therefore, Pakistan may revisit its trade liberalisation programme, further rationalise tariff structures, eliminate regulatory duties and further strengthen governance structure in order to increase exports relative to imports. To this end, Pakistan must learn from the trade policies adopted by the most successful developing nations like Turkey, Indonesia and Malaysia if Pakistan wants to achieve the same levels of trade and development. [19]

2.1. Identification of Reforms Period

Previous studies conceived reform period by ignoring a structural break in data with reference to trade liberalisation and productivity growth nexus. The present study finds evidence of a structural break in data in 1995 using the Chow (1960) structural break test. Following the Chow's (1960) structural break test, data is divided into before and after the break sub-periods.[20] We observed a structural break around 1995, after the existence of the WTO, when tariffs and other trade barriers were reduced and moved towards free trade regime.[21] Figure 3 highlights the behaviour of Effective Rates of Protection (ERP) for manufacturing industries.[22] As shown in Figure 3, Pakistan liberalised its trade regime through reduction in trade protection after formation of WTO in 1995.

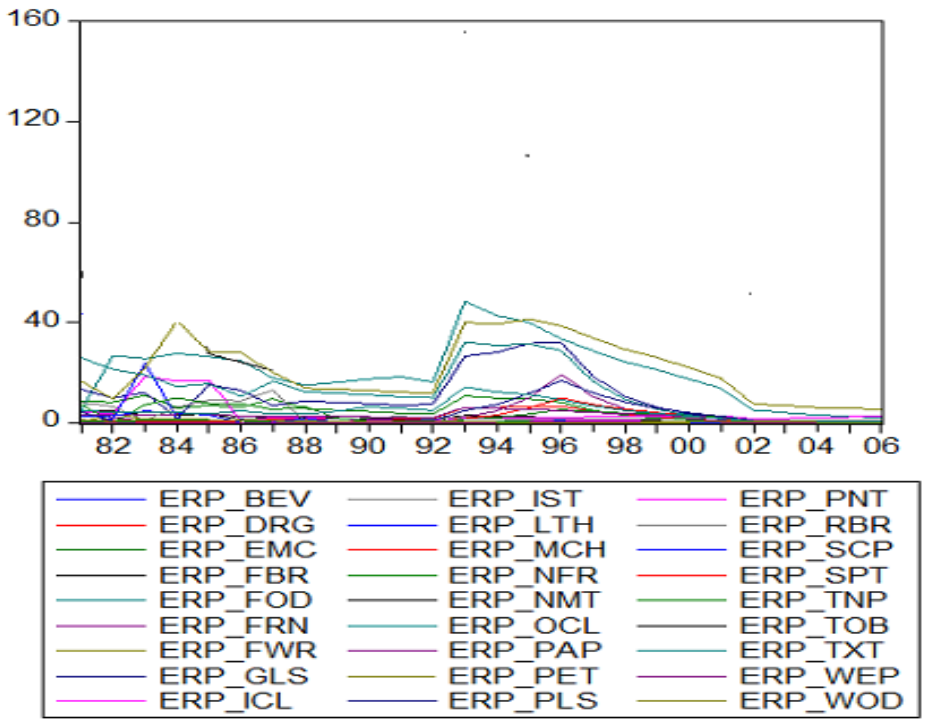
Fig. 3. Trend of Effective Rates of Protection in Manufacturing Industries

[19]In 1980, Pakistan and Turkey had $3 billion worth of exports. Pakistan retained protectionist policies, raising tariffs and encouraging import substitution policies. In contrast, Turkey integrated its economy with the European Union (EU) by dismantling import substitution policies. In 1996, Turkey lowered its tariffs to the level comparable to those of the EU countries. Today, Turkey's exports are over $170 billion, while Pakistan's exports are yet to surpass $25 billion. Turkey per capita income is around $9,000, while Pakistan's per capita income is just $1,000 [Ahmad (2014)].

[20]Break shows the impact of WTO reforms in 1995 which reduced tariffs and other non-tariff barriers that affect industrial productivity [Chaudhary (2004)].

[21]The structural break methodology is given in the Appendix B.

[22]In the absence of data on ERP, we calculated ERP as import duty divided by value added for each industry following Chand, *et al*. (1998) and Njikam and Cockburn (2011). This measure is conceptually analogous to the measure of ERP [Njikam and Cockburn (2011)].



3. REVIEW OF LITERATURE

Most theoretical models of trade predicted that trade liberalisation increases firm's productivity [Samuelson (1948, 1949); MacDougal (1951); among others]. Trade reforms could results in reallocation of resources from less productive to more productive firms [Melits and Ottaviano (2008); Bernard, *et al.* (2003); Melitz (2003)]. Trade policy reforms increase competition which may force domestic firms to improve their efficiency by moving down their average cost curves [Helpmand and Krugman (1985)], trade reforms force firms to concentrate on core competency products [Bernard, *et al.* (2006)], reduce management slack and increase X-efficiency gains [Hicks (1935)], raise innovation incentives among local firms to prevent entry from foreign competitors [Aghion, *et al.* (2005)]. Furthermore, theoretical trade models also predict productivity gains resulting from better access to superior inputs and technology that increase technical efficiency [Gross man and Helpman (1991); Rivera-Batiz and Romer (1991); Topalova and Khandelwal (2011)]. Helpman and Grossman (1990) and Rodrik (1992) suggested that trade liberalisation enhance productivity under imperfect competition through diffusion of knowledge, upgradation of domestic technology and skills development. It is worth mentioning here that all the theoretical trade models do not predict that trade liberalisation increases aggregate productivity [Topalova and Khandelwal (2011)]. For example, Young (1991) argues that trade liberalisation may restrict developing countries into a particular sector that are not conducive to economic growth. Bolaky and Fredund (2004) and Hoekman and Javorick (2004) found that the

potential gains from trade liberalisation will not be realised unless complementary policies are in place. Particularly, Bolaky and Fredund (2004) find that trade does not stimulate economic growth in countries with excessive business and labour regulations and these regulations could prevent reallocation of resources among different sectors of the economy. Similarly, Harrison (1994) and Karishna and Mitra (1998) denounced that resources are not allocated in the areas of comparative advantages. They suggested that trade could be made more beneficial by reducing monopolies and increasing competition. Trade liberalisation lowers workers bargaining, reduces supernormal profits enjoyed by domestic firms and the price-cost markups [Harrison (1994); Krishna and Mitra (1998)]. Gosh (2011) showed that productivity growth is not reliably higher after reforms than prior to reforms in case of India. He finds that at sectoral level, interest rate channel, financial acceleration and labour market variables play an important role in determining productivity growth. However, at macro level, trade policy, FDI and credit availability are found to be important in accounting for productivity growth. Ahsan and Mitra (2014) find that trade liberalisation led to increase labour's share in revenue for small labour-intensive firms, but a reduction in this share is observed in case of large less labour-intensive firms. The study also finds that trade liberalisation, in general, led to a decline in bargaining power of workers.

Numerous studies with reference to Pakistan found positive relationship between trade liberalisation and economic growth. For example, Kemal, *et al.* (2002) found long-run causality between real GDP and exports in Pakistan. Yasmin, *et al.* (2006) demonstrated that trade liberalisation enhanced economic growth, availability of consumer goods and employment opportunities. However, few studies examined the impact of trade reforms on industrial productivity. For instance, Khan and Ahmed (2012) showed that trade liberalisation stimulates productivity growth through different channels such as private sector investment, manufactured exports and imports of capital goods. Ali (2012) analysed the impact of trade reforms on textile, leather and surgical, and sports industries and concluded that imports are the main driver of exports and by reducing tariff would increase exports because imports of industrial inputs become cheaper. Sheikh and Ahmed (2011) found positive effect of trade liberalisation on technical efficiency of agro-based manufacturing industries of Pakistan.

Overall literature, cited above, concludes that trade reforms such as reduction in trade barriers and adoption of outward-oriented policies are conducive to industrial productivity in developing countries like Pakistan. There is a need to further analyse trade dynamics in manufacturing industries in Pakistan. The present study tries to investigate the pre-and post-trade liberalisation impact on industrial productivity by subjecting the simultaneity problem from production function. Furthermore, this study not only examines the effect of import duty on TFP of industrial sector but also considers the impact of effective rates of protection on firm's TFP.

4. DATA DESCRIPTION, MODEL SPECIFICATION AND METHODOLOGY

4.1. Data Description

This study is based on the balanced panel data of twenty seven 3-digit manufacturing industries of Pakistan over the period 1981-2006.[23] This data is taken from Census of Manufacturing Industries (CMI) of Pakistan published by the Pakistan Bureau of Statistics, GoP. The missing data is interpolated using the compounding growth rate formula. Following Fernandes (2002) and Kim (2000) Effective Rates of Protection (ERP) is used as a proxy of trade liberalisation.[24] The industrial value added is used as dependent variable, whereas energy (costs of fuel, electricity and water), capital (all fixed assets), labour cost in terms of employment cost (including non-cash benefits), raw materials including raw and semi-finished materials which consist of imported as well as those domestically produced, and ERP are used as independent variables. The ERP is calculated as import duty divided by industrial value added following the Chand, *et al.* (1998) and Nijikam and Cockburn (2011). Import duty is also used as an additional measure of trade liberalisation.

To capture the effect of price changes, we deflated all the variables by Wholesale Price Index (WPI) considering 2005 as base year.[25] The data on WPI is collected from various issues of Statistical Bulletin published by the State Bank of Pakistan.

4.2. Model Specification and Methodology

The present study utilises a variant of Cobb-Douglas production function for the estimation of industrial productivity. Since, in estimating the industrial production function, it is important to account for the correlation between input and productivity levels, as profit maximising firms respond to increase in productivity by increasing use of factor inputs [Ghosh (2013)]. Therefore, Ordinary Least Squares (OLS) method ignores this potential endogeneity problem and assumes that inputs are exogenous and not correlated with external shocks [Griliches and Mairesse (1995)]. However, in real world inputs choices are endogenous and correlated with unobserved productivity shocks because each firm has its own material choices and management skills. To deal with endogeneity problem, this study adopted Levinsohn and Patrin's (2003) methodology and uses firm's raw material inputs as the control variable to correct for the endogeneity in the firm's production function because it is more likely to be correlated with unobserved productivity shocks [Fernandes (2007)]. To analyse the effect of trade policy on industrial productivity, a two-stage approach is adopted [Pavcnik (2002); Javorcik (2004); Amiti and Konings (2007); Topalova and Khandelwal (2011)]. In the first-stage, we estimate the industrial production function specified by Equation (1) following the Olley and Pakes (1996) methodology. To compute unobservable demand shocks, we control for the simultaneity problem as suggested by the Levinsohn and Patrin (2003) and De Loecker (2011). Following Banga and Goldar (2007) the industrial production function is specified as:

[23]Twenty seven 3-digit manufacturing industries are included and details are given in Appendix A. The latest available data of CMI is up to 2006.

[24]One important limitation of this measure is that if a country lower tariffs on raw material, while tariffs on furnished products are not lowered or not lowered as much, then ERP will show an increase in protection.

[25] WPI is more relevant to manufacturing products. Capital is deflated by building and material component, raw material is deflated by raw material component in terms of WPI, energy is deflated by fuel, lighting and lubricants, excise duty is deflated by manufacturing productivity and other variables are deflated by general WPI.

$$Y_{it} = \alpha + \beta_L L_{it} + \beta_K K_{it} + \beta_{EF} EF_{it} + \beta_{RM} RM_{it} + \omega_{it} + \varepsilon_{it} \quad \ldots \quad \ldots \quad (1)$$

Where Y_{it} denotes valued-added of industry i at time t, L_{it}, K_{it}, EF_{it} and RM_{it} denotes firm's employment; capital; consumption of electricity and fuel, and cost of raw materials respectively. The term ω_{it} is the unobserved industry-specific productivity shocks that may be correlated with the firm's inputs, and ε_{it} is the random error term which is assumed to be independently and identically distributed (*iid*). All variables are transformed into logarithmic form. The estimation of Equation (1) takes two steps.[26] In the first step, we estimate raw materials demand function specified by Equation (1a): [27]

$$RM_{it} = RM_{it}(\omega_{it}, K_{it}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1a)$$

Inversion of the raw materials demand function give an expression for productivity shocks (ω_{it}) as a function of firm's raw materials and capital. The productivity shocks function now depending on the observable industrial variables, such as:

$$\omega_{it} = g_t^{-1}(RM_{it}, K_{it}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1b)$$

Using Equations (1a) and (1b), we can transform Equation (1) in the following ways:

$$Y_{it} = \alpha + \beta_L L_{it} + \beta_{EF} EF_{it} + \varphi_{it}(RM_{it}, K_{it}) + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where

$$\phi_{it}(RM_{it}, K_{it}) = \beta_0 + \beta_{RM} RM_{it} + \beta_K K_{it} + g_t^{-1}(RM_{it}, K_{it}) \quad \ldots \quad \ldots \quad (2a)$$

Olley and Pakes (1996) suggested that Equation (2a) can be estimated by OLS, whereas Nijikam and Cockburn (2011) applied forth order polynomial expansion to estimate first stage parameters. However, we used Feasible Generalised Least Squares (FGLS) as an alternative approach which is useful in the presence of autocorrelation and hetroscedasticity. To this end, we first generated the conditional expectations function of the form: $E(Y_{it} \mid RM_{it}, K_{it}), E(L_{it} \mid RM_{it}, K_{it})$ and $E(EF_{it} \mid RM_{it}, K_{it})$ to compute first stage parameter estimates of labour, and energy and fuel (i.e. $\hat{\beta}_L, \hat{\beta}_{EF}$). Assume that $E(\varepsilon_{it} \mid RM_{it}, K_{it}) = 0$, the difference between Equation (2) and its expectations conditional on raw materials and capital is given by:

$$Y_{it} - E(Y_{it} \mid RM_{it}, K_{it}) = \beta_L(L_{it} - E(L_{it} \mid RM_{it}, K_{it}) - \beta_{EF}(EF_{it} - E(EF_{it} \mid RM_{it}, K_{it})_{it}$$

$$+\varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Equation (3) is estimated by OLS method, and once the conditional expectations are estimated using OLS regressions of output, labour and energy on raw materials and

[26] Fernandes (2007, p. 56).

[27] Levinsohn and Petrin (2003) argued that if demand function for intermediate inputs is monotonic in the firm's productivity at all levels of capital, then raw materials can serve as valid proxy for the unobservable demand shock [Topalova and Khandelwal (2011); Fernandes (2002, p. 8); Nijikam and Cockburn (2011)].

capital (RM_{it}, K_{it}), we then obtain consistent parameter estimates for labour and energy. The raw materials demand function $RM_{it} = RM_{it}(\omega_{it}, K_{it})$ does not explicitly depend on plant-level input and output prices, we partially address this issue by allowing that materials demand function (along with the productivity function resulting from its inversion ($g_t^{-1}(RM_{it}, K_{it})$) differ across two periods [see Fernandes (2002)].[28] To get the consistent parameter estimates of the function $\phi_{it}(.)$, we employ FGLS method to regress $V_{it} = (Y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_{EF} EF_{it})$ on (RM_{it}, K_{it}).

In second stage, we use two moment conditions, which are consistent with over-identification conditions to derive consistent estimates (β_K, β_{RM}). It is assumed that productivity shocks (ω_{it}) follows a first order Markov process, i.e. $\omega_{it} = E(\omega_{it} \mid \omega_{it-1}) + \xi_{it}$, where ξ_{it} is unexpected productivity shock which is assumed to be independent and identically distributed (*iid*). Following Olley and Pakes (1996), we generate two moment conditions depicted by Equations (4) and (5) that are estimated by employing Two Stage Least Squares (TSLS) method. The first moment condition stated that capital at time *t* is uncorrelated with the unexpected productivity shock at time *t*. The second moment condition indicated that raw materials at time *t*–1 are uncorrelated with the unexpected productivity shock at time *t*. That is:

$$E[Y_{it} - \beta_L L_{it} - \beta_{EF} EF_{it} - \beta_{RM} RM_{it} - \beta_K K_{it} - E(\omega_{it} \mid \omega_{it-1}) \mid K_{it-1})] = E(\varepsilon_{it} + \xi_{it} \mid K_{it-1}) = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

$$E[Y_{it} - \beta_L L_{it} - \beta_{EF} EF_{it} - \beta_{RM} RM_{it} - \beta_K K_{it} - E(\omega_{it} \mid \omega_{it-1}) \mid RM_{it-1})] = E(\varepsilon_{it} + \xi_{it} \mid RM_{it-1}) = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

Where the residuals in the moment conditions $\varepsilon_{it} + \xi_{it}$ are estimated as:

$$\varepsilon_{it} + \xi_{it}(\beta_K^*, \beta_{RM}^*) = Y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_{EF} EF_{it} - \beta_{RM}^* RM_{it} - \beta_K^* K_{it} - E(\omega_{it} \mid \omega_{it-1}) \quad (6)$$

Where $(\beta_K^*, \beta_{RM}^*)$, the initial values might be the OLS values obtained from the estimation of industrial production function. We begin by noting that,

$$E(\omega_{it} \mid \omega_{it-1}) = E(\omega_{it} + \varepsilon_{it} \mid \omega_{it-1})$$

The conditional expectations $E(\omega_{it} \mid \omega_{it-1})$ can be estimated using following regression model:

$$\hat{\omega}_{it} + \varepsilon_{it} = \hat{\varphi}_{it0} + \hat{\varphi}_{it-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Where;

$$\hat{\omega}_{it} + \varepsilon_{it} = Y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_{EF} EF_{it} - \beta_{RM}^* RM_{it} - \beta_K^* K_{it} \quad \ldots \quad \ldots \quad \ldots \quad (7a)$$

[28] Pre-WTO regime (1981-1995) and post-WTO regime (1996-2006).

$$\hat{\omega}_{it-1} = \hat{\varphi}_{it}(RM_{it-1}, K_{it-1}) - \beta^{*}_{RM} RM_{it-1} - \beta^{*}_{K} K_{it-1} \quad \ldots \quad \ldots \quad \ldots \quad (7b)$$

Finally, we obtain parameter estimates $\hat{\beta}_K$ and $\hat{\beta}_{RM}$ by applying TSLS method, where TSLS function weights moment conditions by their variance-covariance matrix. We included over-identifying conditions as mentioned by Levinsohn and Petrin (2003), population moment conditions given by vector of expectations $E[(\xi_{it} + \varepsilon_{it})Z_{it}]$. Where Z_{it} is the vector of instruments, namely $\{K_{it-1}, RM_{it-1}, L_{it-1}, EF_{it-1}, RM_{it-2}\}$. Finally, we estimate $\hat{\beta}_K$ and $\hat{\beta}_{RM}$ by estimating the following TSLS function.

$$Q(\beta^{*}) = \{\sum(\xi_{it} + \varepsilon_{it})Z_{it}\} = 0 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

Since the main focus of this study is to investigate the impact of trade liberalisation on the industrial productivity using effective rates of protection (ERP_{it}) and excise duty on imports as measures of trade policy.[29] The total factor productivity (TFP_{it}) based on Equation (1) can be expressed as:

$$\hat{\omega}_{it} + \varepsilon_{it} = Y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_{EF} EF_{it} - \hat{\beta}_{RM} RM_{it} - \hat{\beta}_K K_{it} = TFP_{it} \quad \ldots \quad \ldots \quad (9)$$

Where pr_{it} is the TFP_{it} computed from combining the estimated function $\phi_{it}(.)$.

$$\hat{\omega}_{it} = \hat{\varphi}_{it}(RM_{it}, K_{it}) - \hat{\beta}_{RM} RM_{it} - \hat{\beta}_K K_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9a)$$

$$TFP_{it} = \beta_0 + \lambda_t + \beta_1 ED_{it} + \beta_2 ERP_{it} + \alpha_i + u_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

The TFP_{it} is computed after controlling for the endogeneity and simultaneity problem, excise duty on imports (ED_{it}) and ERP_{it}. Having obtained the TFP_{it}, first we examine the impact of industry-level inputs on the industrial productivity. Subsequently, we examine the impact of trade liberalisation on the TFP_{it}. Particularly, we mainly focus on the impact of trade liberalisation on the TFP_{it} in the pre-and-post liberalisation periods.

5. EMPIRICAL RESULTS AND DISCUSSION

Based on the Chow's (1960) structural break test, we divided data sample into two sub-periods, that is, from 1981-1995 (pre-trade liberalisation) and 1996-2006 (post-trade liberalisation) and estimated output elasticities with respect to inputs for the both periods separately. The industrial production function is estimated by employing the Pooled-based Ordinary Least Squares (POLS) model, Fixed Effects (FE) and Random Effects (RE) models. To account for cross-sectional heterogeneity, we have

[29] Edward (1998) criticised the use of trade volume as proxy of trade liberalisation. He argued that trade volume is not related to the actual trade orientations of a country. He argued that tariff levels and quota reflect the degree of government interventions and trade policy and its opening raises the productivity.

estimated FE and RE models using cross-sectional weights. Therefore, the estimates are robust to cross-correlation and differenced error-variances in each cross-sectional unit. Our estimation results obtained by the POLS, FE and the RE models are approximately close to each other. To choose between the FE and the RE models, we apply the Hausman statistics and the results supporting for the appropriateness of the RE model.

5.1. Estimates of Industrial Production Function

Table 3 presents the estimates of industrial production function for the pre-and-post-liberalisation periods. The results reveal that the coefficient on energy, labour and raw materials exerts positive and statistically significant impact on the industrial output.

Table 3

Estimates of Industrial Production Function

Dependent Variable: Y_{it}

Variables	Pre-liberalisation (1981-1995)			Post-liberalisation (1996-2006)		
	POLS (1)	FE (2)	RE (3)	POLS (4)	FE (5)	RE (6)
Constant	1.27*	1.78*	1.51*	1.50*	0.54*	0.67*
	(21.67)	(16.72)	(6.55)	(64.66)	(2.53)	(2.95)
EF_{it}	0.13*	0.14*	0.12*	–0.06*	–0.07*	–0.14*
	(10.78)	(8.61)	(4.03)	(–10.51)	(–2.48)	(–3.33)
L_{it}	0.17*	0.17*	0.17*	0.25*	0.50*	0.46*
	(9.73)	(8.14)	(3.33)	(13.31)	(22.20)	(8.21)
K_{it}	–0.03	0.01	0.03	0.26*	0.12*	0.21*
	(–1.44)	(0.84)	(0.96)	(13.34)	(4.22)	(5.61)
RM_{it}	0.73*	0.64*	0.67*	0.53*	0.55*	0.55*
	(61.00)	(30.98)	(14.67)	(48.97)	(14.18)	(10.54)
R^2	0.99	0.99	0.86	0.99	0.99	0.88
$\overline{R}^2$	0.99	0.99	0.86	0.99	0.99	0.88
F-stat	8936.71	4989.97	621.99	8739.96	2562.43	554.47
CRS	0.79	13.36	1.34	0.79	13.36	4.58
	[0.373]	[0.000]*	[0.248]	[0.373]	[0.000]*	[0.033]**
Hausman	–	–	1.91	–	–	0.00
Test: $\chi^2(4)$			[0.752]			[1.000]

Note: * Indicate significant at the 1 percent level of significance. Values in the parenthesis are the t-statistics. OLS, FE and RE indicate Ordinary Least Squares, Fixed Effects Model and Random Effects Model respectively. CRS= Constant Returns to Scale. The RE model is estimated by employing the Swamy and Arora estimator of component variance. [.] indicate p-values.

The results shown in columns (2) to (4) of Table 3 are similar in terms of their size and signs of the coefficients. However, the Hausman test supports the results reported in column (3). Thus, we preferred to explain the results based on the RE model. The results reveal that the coefficient of energy and labour are positive and statistically significant, and equals 0.12 and 0.17 respectively, confirming the theoretical predictions

that increase in labour and energy inputs causes industrial productivity to increase in the pre-liberalisation period. The coefficient of capital is positive and equals 0.04, but remains statistically insignificant. The reason could be the inefficient allocation of capital resources in the large scale manufacturing industries in Pakistan during the pre-liberalisation period. These results are in line with those by Burki and Khan (2004). The coefficient of raw materials is positive and equals 0.67 which implies that increase in raw materials exerts significant positive impact on industrial productivity. The bias in the coefficients of capital and raw materials could be due to possible correlation among the inputs and productivity shocks [Ghosh (2013)]. The results suggest that a 1 percent increase in energy supply, labour and raw materials would lead to increase industrial productivity by 0.12 percent, 0.17 percent and 0.67 percent respectively in the pre-liberalisation period. Finally, the estimated elasticities verify the constant return to scale property of the production function because the sum of the elasticities in the case of the RE model is 0.99 in the pre-liberalisation period. This implies that all decision making units are operating at optimal scale [Mahmood (2012)].

The output elasticities with respect to inputs for the post-liberalisation period (1996-2006) are shown in columns (5) to (7) of Table 3. The results reveal that production elasticities with respect to labour, capital and raw materials are positive and statistically significant, whereas the elasticity of energy supply has negatively signed and statistically significant using either of the estimation method. The output elasticities under the RE model are relatively higher than that of POLS and FE models. The Hausman test confirms the appropriateness of the RE model.

The results show that a 1 percent increase in labour, capital and raw materials would increase industrial output by 0.46 percent, 0.21 percent and 0.55 percent in the post-liberalisation period respectively. However, the output elasticity with respect to energy supply is negative and significant, which implies that the reduction in energy supply would reduce industrial output in the post-liberalisation period. The negative impact of energy on the industrial productivity could be due to frequent power failure, load-shedding and high prices of electricity. Mahmud (2000) has noted that energy crisis is perpetual and major constraint for the manufacturing industries in Pakistan. Similarly, Siddiqui (2004), Mahmood (2012) and Shakeel, *et al.* (2013) also reported that energy outages adversely affected exports and trade benefits in Pakistan. [30]

Overall, we may deduce that output elasticities with respect to labour, capital and raw materials are generally positive during the pre-and post-liberalisation periods, however, the size of elasticities are relatively larger in the post-liberalisation than pre-liberalisation period. It is worth mentioning here that during the post-liberalisation period, we observed that industries are adopting advanced technology or replacing old capital because the size of the coefficient of capital significantly increased from 0.03 in the pre-liberalisation period to 0.21 in

[30]According to the World Bank's SAIES (2014), 74.5 percent of the firms ranked electricity outages as a major constraint to their productivity growth in Pakistan. Furthermore, about 9.2 percent sales losses faced by the Pakistani firms were due to power outages in 2013. Similarly, Kessides (2013) reported that power outages contributed to over US $3.8 billion loss to industrial sector along with a loss of over 400,000 jobs and US $1.3 billion in export earnings in 2009 [ADB (2010)]. The electricity induced power outages have reduced GDP growth by 2 percent annually for the past several years in Pakistan [World Bank (2014)].

the post-liberalisation period. This finding is in line with Liberman and Johnson (1999) who reported that investment in new equipments led to higher productivity. The other important finding is the output elasticity of energy that turned out from positive in the pre-liberalisation to negative in the post-liberalisation periods. This implies that outages of energy supply adversely impacted the performance of manufacturing industries in Pakistan during the post-liberalisation period. In addition, in the pre-and-post-liberalisation periods, raw materials appeared to be the major determinant of industrial productivity as compared to labour and capital in Pakistan. This indicates that availability of high quality raw materials in the domestic market produces positive and significant impact on the industrial productivity. This finding is consistent with the earlier finding of Mazumder, *et al.* (2009) and Mahmood (2012). Finally, the production function exhibits increasing returns to scale which confirms our earlier findings that efficiency of labour and capital has significantly improved in the post liberalisation period due to upgradation of existing technologies and workers skills or adoption of new technology. [31]

5.2. Estimation of Total Factors Productivity

The TFP for twenty seven 3-digit industries is estimated in two-stages following the Levinsohn and Petrin (2003). In the first stage, the coefficients of labour and energy are estimated separately for the pre-and post-liberalisation periods. Using the estimated coefficients of labour and energy, we computed unobservable demand shocks from the function $\phi_{it}(.)$ as:

$$\phi_{it} = Y_{it} - 0.18L_{it} - 0.12EF_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

Where Y_{it} is regressed on capital and raw materials to estimate the unobservable demand shocks- $\phi_{it}(RM_{it}, K_{it})$ (equation (2a)) using FGLS method. After the estimation of demand shocks, the estimates of capital and raw materials are obtained by employing TSLS method to control for the endogeneity problem. By conditioning the simultaneity problem, we computed the firm 's TFP_{it} using the following equation.

$$TFP_{it} = Y_{it} - 0.18L_{it} - 0.12EF_{it} + 0.28K_{it} - 0.53RM_{it} \quad \ldots \quad \ldots \quad \ldots \quad (12)$$

For the post-liberalisation period, $\phi_{it}(.)$ is computed using the coefficients of energy and labour, that is:

$$\phi_{it} = Y_{it} - 0.22L_{it} + 0.13EF_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (14)$$

Now Y_{it} is regressed on capital and labour to estimate the demand shocks– $\phi_{it}(RM_{it}, K_{it})$. The firm's TFP_{it} for the post-liberalisation period is computed

[31]The sum of the production elasticities is equal to 1.22 in the post-liberalisation period as compared to 0.99 in the pre-liberalisation period.

using the coefficients of capital and raw materials, obtained using TSLS method. That is:

$$TFP_{it} = Y_{it} - 0.22L_{it} + 0.13EF_{it} + 1.028K_{it} - 1.73RM_{it} \quad \ldots \quad \ldots \quad \ldots \quad (15)$$

After the computation of TFP_{it}, the impact of trade liberalisation is analysed for the pre-and post-liberalisation periods.

5.3. Impact of Trade Liberalisation on the Total Factors Productivity

The impact of trade liberalisation on firms TFP_{it} is reported in Table 4. Table 4 shows the impact of the ERP_{it} on TFP_{it} in the pre-and post-liberalisation periods using the POLS, FE and the RE models. However, the Hausman test confirms the usefulness of the RE model which provides more consistent estimates than the POLS and the FE models.

Table 4

Effect of Trade Liberalisation on Total Factor Productivity: Regression Results

Dependent Variable: TFP_{it}

Variables	Pre-liberalisation (1981-1995)			Post-liberalisation (1996-2006)		
	POLS (1)	FE (2)	RE (3)	POLS (4)	FE (5)	RE (6)
Constant	5.88*	5.98*	5.97*	2.51*	2.80*	2.76*
	(150.94)	(235.90)	(18.96)	(51.35)	(56.29)	(6.18)
ERP_{it}	–0.006*	–0.01*	–0.008*	–0.0006	–0.02*	–0.02*
	(–4.50)	(–5.30)	(–2.64)	(–0.15)	(–8.10)	(–7.00)
ED_{it}	9.34E-06*	5.16E-06*	4.42E-06*	7.29E-06*	3.99E-06*	6.08E-06*
	(7.30)	(5.63)	(4.46)	(3.74)	(3.37)	(4.81)
RIO_{it}	–0.47**	–0.23	–0.36**	1.59*	1.14*	1.13*
	(–2.09)	(–1.64)	(–1.92)	(2.64)	(4.95)	(3.91)
R^2	0.24	0.94	0.07	0.13	0.96	0.12
$\overline{R}^2$	0.24	0.94	0.07	0.13	0.96	0.11
F-stat	42.96	204.66	9.64	15.14	245.30	13.26
Hausman Test: χ^2 (3)	–	–	0.00 [1.000]	–	–	0.00 [1.000]

Note: See notes below Table 2.

The result reveals that reduction in ERP_{it} would increases TFP_{it} in the post-liberalisation period. The magnitude of the coefficient of ERP_{it} is –0.02 which suggests that a 1 percent reduction in ERP_{it} is associated with an increase in TFP_{it} by 0.02 percent in the post-liberalisation period. In other words, higher trade protection would lower TFP_{it} in the post-liberalisation period. This result is consistent with the

finding of Topalova and Khandelwal (2011); they found beneficial effects of trade liberalisation on industrial productivity in India. In contrast, a 1 percent reduction in ERP_{it} would increases TFP_{it} by 0.008 percent in the pre-liberalisation period. Moreover, excise duty on imports has a positive impact on the TFP_{it} in the pre-as well as post-liberalisation periods, though the impact of this variable is too small and negligible. Yu (2009) finds similar evidence for Japan. The ratio of investment to industrial output (RIO_{it}) bears a negative sign, suggesting that increase in RIO_{it} exerts negative impact on the TFP_{it} in the pre-liberalisation period. The results suggest that a rise in RIO_{it} by 1 percent lowers TFP_{it} by 0.36 percent in the pre-trade liberalisation period. One reason of this finding could be the lack of new investment in the manufacturing sector and inefficient use of existing capital resources, that produce negative impact on the industrial productivity. The other reason could be the high cost of investment which adversely affected the TFP_{it} . Ghosh (2013) found similar results for India. Contrary to the pre-liberalisation period, RIO_{it} exerts positive impact on the TFP_{it} in the post-liberalisation period. The result indicates that a 1 percent increase in RIO_{it} would increases TFP_{it} by 1.13 percent in the post-liberalisation period. One important implication of this finding could be that trade liberalisation reinforced with efficient use of capital resources that can lead to removal of inefficiencies in manufacturing industries in Pakistan. Sheikh and Ahmed (2011) find similar results for a panel of agro-based industries in Pakistan.

Overall, ERP_{it} exerts relatively large impact on the TFP_{it} in the post-liberalisation period than pre-liberalisation period. This implies that reduction in ERP_{it} significantly enhances the TFP_{it} in the post-liberalisation period in Pakistan. This finding further implies that reduction in ERP_{it} is a pre-requisite to enhancing TFP_{it} . The reduction in excise duty on imports produces positive but minimal impact on the TFP_{it} in the pre-liberalisation as well as post-liberalisation periods in Pakistan. Finally, we observed large positive impact of investment on the TFP_{it} in the post-liberalisation period. Accordingly, it may be inferred that the adoption of economic liberalisation policies since the 1990s and onward created favourable environment for the utilisation of domestic resources more efficiently than protected economic policy regime.[32]

6. CONCLUSION AND POLICY IMPLICATION

Manufacturing industries in Pakistan have been facing tariff, non-tariff and other trade barriers for a long period of time. Lack of technological advancement and low quality products adversely influences industrial competitiveness in the international market. This study examines the impact of trade liberalisation on industrial productivity for a panel of twenty seven 3-digit manufacturing industries in Pakistan over the period 1981-2006. The sample is divided into two sub-periods, namely pre-liberalisation period (1981-1995) and post liberalisation period (1996-2006). A variant of the Cobb-Douglas

[32] The major limitation of this study is the non-availability of data; CMI reported data only up to 2005-06.

production function is used to estimate the output elasticities with respect to inputs by employing the OLS, FE and GLS-based RE models. The results show that output elasticities with respect to inputs have positive and significant impact on the industrial productivity in the pre-and post-liberalisation periods except for output elasticity of energy. The output elasticity energy supply seemed to be negative in the post-liberalisation period.

In the second stage, TFP_{it} is estimated for all sampled industries and analysed the impact of trade liberalisation separately for the pre-and post-liberalisation periods. For the pre-liberalisation period, the results indicate that reduction in ERP_{it} exerts positive impact on the TFP_{it}, however, the magnitude is quite low (i.e. –0.008). With regards to post-liberalisation period, the findings suggest that a reduction in ERP_{it} significantly enhances TFP_{it} with reasonable magnitude (i.e. –0.02). These results, in general, imply that protection of industrial sector through tariff and other trade impediments are the major hurdles on the industrial development and economic growth in Pakistan. The import tariffs have positive effect on TFP_{it}; however, the size of the coefficient is almost zero in the pre-and post-liberalisation periods. Investment relative to industrial productivity exerts negative impact on the TFP_{it} in the pre-liberalisation period; while it has positive impact on the TFP_{it} in the post-liberalisation period. Overall, the results appear to indicate that trade liberalisation have played a significant role in explaining TFP_{it} in the industrial sector in Pakistan.

On the basis of above discussion we can deduce some policy implications. Firstly, a reduction in ERP_{it} significantly increases TFP_{it}. Therefore, further reduction in the rates of protection, tariff and non-tariff barriers could enhance industrial productivity; improve quality of products and increase exports potential. Secondly, results in the post-liberalisation period reveal that energy input adversely affected industrial productivity; therefore, measures are needed to address the issues related to load-shedding and shortages of energy supply to the industrial sector on priority basis. Third, availability of raw materials appears to be the most significant determinant of industrial productivity in the pre-liberalisation as well as post-liberalisation periods. Therefore, there is need to provide cheap and quality raw materials to the industrial sector. To this end, there is need to develop trade related infrastructure, reduce import restriction on raw material and improve the quality of raw materials through research and development. Finally, the results show that the effect of physical capital on industrial output seems negative in the pre-liberalisation period, and turns to be positive and significant in the post-liberalisation period. Therefore, import of capital goods should be encouraged which is the main source of technological advances in the country.

APPENDIX A

Table 1A

List of 3-Digit Manufacturing Industries

S. No.	Name of Industry	S. No.	Name of Industry
1	Beverage	15	Other Chemical Products
2	Drug and Pharmaceutical Products	16	Paper Products
3	Electrical Machinery Apparatus and Appliance	17	Petroleum and Refining
4	Fabricated Metal Products	18	Plastic Products
5	Food	19	Printing and Publishing
6	Furniture and Fixture	20	Rubber Products
7	Footwear	21	Scientific Measuring and Optical Goods
8	Glass and Glass Products	22	Sports
9	Industrial Chemical	23	Transports Equipment
10	Iron and Steal	24	Tobacco
11	Leather and Leather Products	25	Textile
12	Machinery	26	Wearing Apparel
13	Non-Ferrous Metal	27	Wood and Wood Products
14	Non-Metallic Minerals	–	–

APPENDIX B

The model for the period 1981-2006 is given by:

$$y_{it} = a + bL_{it} + cK_{it} + dE_{it} + eM_{it} + fERP_{it} + gED_{it} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \text{(i)}$$

We have estimated Equation (i) for two sub-periods, that is:

1981-1995: $y_{it} = a_1 + b_1 Lit + c_1 K_{it} + d_1 E_{it} + e_1 M_{it} + f_1 ERP_{it} + g_1 ED_{it} + \varepsilon_{it} \quad \ldots \quad \text{(ii)}$

1996-2006: $y_{it} = a_2 + b_2 L_{it} + c_2 K_{it} + d_2 E_{it} + e_2 M_{it} + f_2 ERP_{it} + g_2 ED_{it} + \varepsilon_{it} \quad \ldots \quad \text{(iii)}$

To examine the structural stability of the estimated industrial production function, we have tested following null and alternative hypotheses.

$$H_0 = a_1 = a_2, b_1 = b_2$$

$$H_a = a_1 \neq a_1, b_1 \neq b_2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(iv)}$$

We applied the Chow's structural break test as:

$$F = \frac{RSS_C - (RSS_1 + RSS_2)/k}{RSS_1 + RSS_2 / n - 2k}$$

RSS_c = is the residual sum of squares for aggregate data set.

RSS_1 = is the residual sum of squares for before the break period data set.
RSS_2 = is the residual sum of squares of after the break data set.

$$F = \frac{38.49 - (17.48 + 15.51)/7}{17.48 + 15.51/26 - 2(7)}$$

$$F = \frac{38.49 - (32.99)/7}{32.99/12}$$

$$F = \frac{38.49 - 4.71}{2.75} = \frac{33.78}{2.75} = 12.28$$

$$d.f = \frac{K}{n - 2k} = \frac{7}{12}$$

Critical value at 5 percent level of significance is 2.91.
Critical value at 1 percent level of significance is 4.64.

The calculated F-statistic is greater than that of critical value. Hence, we reject the null hypothesis of no structural break in the industrial production function.

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