TRADE LIBERALIZATION AND TOTAL FACTOR PRODUCTIVITY GROWTH (1971-2007)

SADIA MAJEED, QAZI MASOOD AHMED and MUHAMMAD SABIHUDDIN BUTT*

Abstract. Using the framework of endogenous growth model, this paper empirically analyses the relationship between Trade Liberalization (TL) and Total Factor Productivity (TFP) growth in large scale manufacturing (LSM) sector of Pakistan during the period 1971-2007. First we measure the TFP growth using growth accounting technique. Secondly Auto Regressive Distributed Lag (ARDL) modeling approach has been applied to measure the relationship between TL and productivity growth. The estimated coefficients of openness are negative and statistically significant implies that the TL policy of the government has not yet brought about any epoch-making economic results particularly for the growth rate of TFP in LSM sector. The elimination of government intervention and restrictions has characterized all policy stances, yet liberalization alone is not sufficient to produce significant, conspicuous economic achievement. Government must also play important role in capitalizing infrastructural projects, in order to lay the foundation for a healthy competitive environment for the manufacturing sector.

I. INTRODUCTION

The role of trade and openness in economic development has been a key debate in the development literature for most of the second half of the century. The standard view of gains from trade is that the reduction of trade barriers will increase economic efficiency, by allowing consumers and

*The authors are, respectively, Assistant Professor, NED University of Engineering and Technology, Karachi; Associate Professor/Research Director, Institute of Business Administration, Karachi; and Senior Research Economist/Associate Professor, Applied Economics Research Centre, University of Karachi, Karachi (Pakistan).

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producers to buy items from the lowest cost source. However, in recent years economists have sought other possible effects of trade. These includes the possibility that many industries have increasing returns to scale, which will magnifying the effects of any trade-induced growth; that increased trade will lead to more capital accumulation and that expanded trade can increase productivity through out the affected industries. According to Global Economic Respects: “A reduction in world barriers to trade could accelerate growth, provide stimulus to new forms of productivity — enhancing specialization, and lead to a more rapid pace of job creation and poverty reduction around the world” (World Bank, 2002).

The focus on productivity stems an observation that productivity\footnote{Broadly defined; include efficient use of resources, technological progress and efficient management.} is a crucial factor leading to sustainable economic growth. Countries that are more open to the rest of the world have a greater ability to absorb technological advances generated in the leading nations.\footnote{Romer (1990, 1992), Grossman and Helpman (1991) and Baro and Sala-i-Martin (1995).} However, the transfer of technology and associated knowledge spillovers from advanced to developing countries through export and import routes will be more successful in economies with better and more advanced education (Coe and Helpman, 1995). Increasing economy’s skill base can have a positive effect on the growth of total factor productivity (TFP)\footnote{TFP defined as the relationship between output produced and an index of composite of inputs, meaning the sum of all the inputs of basic resources notably labour, capital goods and natural resources. Eatwall and Newman (1991) captioned TFP as ‘multi-factor’ productivity.} — the best overall measure of competitiveness, by facilitating structural change and technological improvements. Endogenous growth models emphasis that human capital and knowledge capital leading to improvement in technology creation, adoption and absorption are important determinants of productivity growth.\footnote{Arran (1967), Bruton (1995), Dehlman et al. (1985), Dension (1967), Lichtenberg (1994), and Lomer (1986).} Furthermore, the return on investment in R&D, leading to technological development, is substantial. The impact of Trade Liberalization (TL) on productivity growth in the manufacturing sector remains a controversial issue (Satish and Kunal, 2002). However, contradicting the findings of several earlier studies, recent studies on productivity trends in developing countries has concluded that TFP growth in manufacturing accelerated after 1991 economic reforms in less-developing countries (Unel, 2003; Tsl, 2003).
A key contribution of present study to the existing literature is that since earlier studies estimated the trend rate of TFP growth in Pakistan as a whole, not on the sectoral basis, while present study is empirically examine the consequences of TL on the growth of Large-Scale manufacturing (LSM) sector in Pakistan, by examining the correlation between degree of openness and productivity. As an indicator of productivity, TFP indices of the LSM sector of Pakistan will be used. In order to capture the true effect of TL, we use different measures of openness in the analysis. In the study we use secondary data to measure productivity in the LSM sector of Pakistan and openness. The major data sources are government publications like Economic Survey of Pakistan (various issues), Pakistan Statistical Year Book, Censes of Manufacturing Industries (CMI) (different issues), 50 Years of Pakistan and Federal Bureau of Statistics. One confronts in doing research on manufacturing sector of Pakistan is lack of availability of adequate data. CMI is the only major source of detailed data on manufacturing sector but it has not been published regularly and it is officially acknowledged that there is underestimation of large-scale value added reported in CMI due to non-response factor. Assuming the under reporting makes only a negligible impact, CMI data could be used as an appropriate measure. To interpolate CMI data for inter-census years Trend Analysis and Quantum Index of Manufacturing (QIM) are used. The sample period of the study is 1971-2007.

The paper organized as follows: section II covers the relevant literature. Section III develops the methodology of the growth accounting. Section IV quantifying the measures of openness and V discuss the estimation technique. Section VI has estimation results and VII conclude the results and give some policy implications.

II. REVIEW OF RELEVANT LITERATURE

In recent years, the relation between TL and economic growth in developing countries has become a central topic of debate among development economists. There are number of studies linking economic growth to the openness of the trade regime (Little, Scitovsky and Scott, 1970; Krueger, 1978; Heitger, 1987; Romer, 1989; Michaely, Papageorgiou and Choksi, 1991; Dollar, 1992; Edwards, 1992; Harrison, 1995; Onafowora and Owoye, 1998). On the other hand, some other studies find little evidence to support a link between TL and economic growth (Sachs, 1987; Agosin, 1991; Taylor, 1991; Shafaeddin, 1994; Clarke and Kirkpatrick, 1992; Greenaway and Sapsford, 1994; Karunaratne, 1994; Jenkins, 1996; Greenaway, Morgan and Wright, 1997).
The impact of TL on productivity growth of manufacturing sector remains a controversial issue (Satish and Kunal, 2002). Contradicting the findings of several earlier studies, recent studies on productivity trends in developing countries has concluded the impact of TFP growth in manufacturing in LDCs (Unel, 2003; Tsl, 2003). A close look at the methodology adopted in these studies, however reveals certain severe shortcomings, raising doubts about the reliability of the findings. Corden (1974), Martin and Page (1983), Tybout (1992) and Pack (1988) explain why more open trade regimes lead to productivity improvements in the industrial sector. However, no clear confirmation of the hypothesis that countries with an outward orientation benefit from greater growth in productivity in manufacturing sector. During the 1980s TL seemed to be contagious in the developing world and was undertaken extensively in three regions: Latin America, Asia and Africa. Yet each region seems to have followed a different approach. The issue has been investigated at different levels: plants, firms or industrial sectors, with different measures of TL, with different model specifications.

Studies on the TFP growth in the context of Pakistan economy, to date are limited both in number and in sectoral details. Wizarat (1998, 2002) showed that for the period 1955-56 to 1980-81; TFP contributed only 7% to growth of LSM sector, despite the fact that sector grew rapidly during this period. For the period 1955-91, results show an increase in TFP trend in the period of 1955-65, stagnation in the period 1966-70 and a decline in the decades on 1970s and 1980s and the contribution of TFP to economic growth has been negative (–27%). Mahmood and Siddiqui (2000) analyze the state of technology and productivity in Pakistan manufacturing industries and suggested some strategic directions to build technological competence. Pasha et al. (2002) pointed out that the TFP growth of the manufacturing sector shows a persistent declining trend during the period 1973-98.

Sabir and Ahmed (2002) studied the impact of structural adjustment policies on TFP, concluded that, the average growth in TFP has declined from 2.8% in the pre-reform period (1973-88) to 0.7% in the post-reform period (1988-02), in the manufacturing sector it declined from 5.9 to 1.9%, respectively. Fatima et al. (2003) analyze the impact of international trade on TFP growth in Pakistan and found that openness has positive impact on the TFP growth in Pakistan, but due to high taxation, government intervention and regulation of domestic companies, TFP growth was low. Khan (2006) establishes macro determinants of TFP. Covering the sample period 1960-2003, the results confirm that macroeconomic stability, foreign direct investment, and financial sector development play an important role in the

III. METHODOLOGICAL FRAMEWORK

The mechanics linking trade and productivity is yet an open question in the theoretical framework. Endogenous growth theory, following the work of Romer (1986) and Lucas (1988), identify a number of factors that determine the growth rate of an economy. Among which increasing returns to scale, capital accumulation, innovations, openness to trade, research and development, and human capital formation are considered as the key factors in explaining the growth process in the economy.

It is well known that protection reduces the efficiency by shielding domestic market from external competition, and restricted access to imported inputs and technologies.\(^5\) This result in the lower level of output and welfare then what could have been achieved in the absence of protection. It has been argued that liberalization — by improving a bias against exports and allowing resource allocation in line with the nation’s comparative advantage — increase exportable output and exports intensity (Krueger, 1987; Bhagwati, 1988). However, Rodrick (1992) argues that there are no reasons to believe that protection discourages the productivity improvement; in fact it is import liberalization that retards productivity growth by shirking the domestic firm’s sales and reducing the incentives to invest in technological effort. Due to low supply elasticities in LDCs, TL may not improve export performance (Stein, 1992; Mosley, 1993). In this context it is not clear whether liberalization really improves export intensity in LDCs. Likewise, the impact of liberalization on import penetration is inconclusive. If increased competition and greater access to imported inputs and technologies make domestic industries competitive then the import penetration would fall, otherwise not. Thus liberalization increases or reduces import penetration depends on the competitiveness of import competing sector, and whether TL really improves productivity growth in least developing countries required an empirical examination.

The mechanism mentioned above is incorporated with the standard neo classical production function to deduce a reduced form that gives TL role in growth. The Solow growth-accounting technique (Solow, 1957) requires only the assumption of constant returns to scale in the production function and perfect competition. We estimated production function to obtain the respective weights of inputs through Ordinary Least Square (OLS). We can specify an aggregate production function as:

\[ Y_t = A_t f(K_t, L_t) \] (1)

Where ‘Y’, ‘K’ and ‘L’ are value added, physical capital stock and labour force respectively, and ‘A’ is the TFP of LSM sector in Pakistan.

We differentiate the above production function with respect to time, and obtain the growth rate of output decomposed into sources of growth:

\[
\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \frac{\dot{K}}{K} \frac{K}{Y} + \frac{\dot{L}}{L} \frac{L}{Y} \] (2)

The \( \frac{\dot{A}}{A} \) and \( \frac{\dot{L}}{L} \) are the shares of capital (\( \alpha_k \)) and labour (\( \alpha_l \)) in total output respectively. Since the share of capital one minus the share of labour under the assumption of constant returns to scale, the growth rate of output is decomposed into TFP growth and the weighted sum of the growth rate of inputs of capital and labour is as follows:

\[
\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + (1 - \alpha_k) \frac{\dot{K}}{K} + \alpha_l \frac{\dot{L}}{L} \] (3)

Table 1 presents results of the estimates of Cobb Douglas production function for LSM sector. All the variables are in logarithmic form. The sum of the coefficients of labour force and capital stock is one (approximately). This indicates that underlying production function is constant return to scale and neutral in technical progress. This also implies that the overall growth rate of factor inputs is the weighted sum of the growth rate of inputs of labour and capital with the weights adding up to unity.
### TABLE 1

Estimations of LSM Sector Production Function in Pakistan

<table>
<thead>
<tr>
<th>Dependent variable: Real Value-Added in Manufacturing Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>0.23</td>
</tr>
<tr>
<td>(1.03)</td>
</tr>
<tr>
<td>[0.22]</td>
</tr>
</tbody>
</table>

* Figures in ( ) and [ ] show the values of t-statistics and standard error, respectively. * show the level of significance at 1%.

Source: Author’s estimation.

Having data on the growth rates of output and inputs along with the factor shares, we can measure TFP growth from the above equation as residual output growth, after subtracting the contribution of measured input growth from output growth. Therefore, the above equation can be presented in the following equation:

$$\frac{\hat{A}}{A} = \frac{\hat{Y}}{Y} - (1 - \alpha_k) \frac{\hat{K}}{K} - \alpha_i \frac{\hat{L}}{L} \quad (4)$$

### IV. QUANTIFYING OPENNESS AND TRADE ORIENTATION

The literature on trade policy reforms includes several distinct concepts of ‘TL’. It encompasses both openness and changes in trade orientation. Openness in an economy wide measures, whereas trade-orientation is the industry specific measure (Das, 2002). The lack of an agreed upon definition of TL makes it difficult to provide a ‘right’ measure of openness or trade orientation (Pritchett, 1996).\(^6\) Measures of openness are usually of two kinds: incidence and outcome. Incidence based measures attempt to measure trade policies by direct observation of the policy instrument. The outcome-based measures assess the deviation of the actual outcomes from what the outcome would have been without the trade barriers (Baldwin, 1989). Most research

\(^6\)Most empirical studies on the relationship between trade and economic performance have relied upon one or two indexes and have thus left themselves opened to criticism by reform skeptics. Further, Pritchett (1996) observes that various trade policy indicators are uncorrelated, thereby implying that different dimensions of trade policy may have different effects on growth.
has examined the relationship between economic growth and trade volumes, not policies — this is partly because measuring 'policy' poses difficult questions. It is sometime difficult to interpret the observed correlation between trade policies and growth (Levine and Renelt, 1992). Our focus in this study, however, is on the measures of trade orientation, which use to capture the impact of TL on industrial productivity growth. Important measurements used in this study are; Import penetration (IP), Price comparisons (QR), trade flows (TF) and IS and EP.

V. MODEL SPECIFICATION AND ESTIMATION TECHNIQUE

To examine the impact of openness on the growth rate of TFP we have employed autoregressive-distributed lag (ARDL) bound test approach to cointegration analysis. The ARDL modeling approach popularized by Pesaran and Pesaran (1997), Pesaran and Smith (1998), Pesaran and Shin (1999), and Pesaran et al. (2001), has numerous advantages. The main advantage of this procedure is that it can be applied regardless of the stationary properties of the variables in the sample and the model takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework (Laureseson and Chai, 2003, p. 28). Moreover, a dynamic Error Correction Model (ECM) can be derived from ARDL through a simple linear transformation (Banerjee et al., 1993, p. 51), which allows for inferences on long-run estimates, which is not possible under alternative co-integration procedures (Sezgin and Yildirim, 2002). ARDL method has additional advantage of yielding consistent estimates of the long-run parameters that are asymptotically normal irrespective of whether the variables are I(0), I(1) or mutually integrated since there is no need for unit root pretesting, but it is still important to complement the estimation process with unit root test in order to ensure that none of the variables are integrated of higher order, i.e. I(2). Moreover, unit root tests yield different conclusions not only due to their different power, but also due to different lag length selected in each test.

It also shows that appropriate lags in the ARDL are corrected for both residual correlation and endogeneity. As long as the ARDL model is free of residual correlation, endogeneity is less of a problem (see Pesaran and Shin, 1999). The important advantage of ARDL against the single equation co-integration analysis such as Engle and Granger (1987) is that the latter is suffers from problems of endogeneity while the ARDL method can distinguish between dependent and explanatory variables. Indeed, one of the important advantages of ARDL procedure was that the estimation is possible
even when the explanatory variables are endogenous (Alam and Quazi, 2003). Hence, ARDL provides robust results in small sample sizes. Most importantly the model could be used with limited sample data (30 observations to 80 observations) in which the set of critical values were developed originally by Narayan (2004) by using GAUSS.

In view of the above advantages to illustrate the ARDL modeling approach the following simple model is considered:

$$GRTFP = \beta_0 + \beta_1 Y + \beta_2 K + \beta_3 L + \beta_4 HDI + \beta_5 \text{Openness} + u \quad (5)$$

Where, $\beta$'s are parameters, $u$ is error term and independent variables include value added ($Y$), stock of physical capital ($K$), labour force ($L$), human development index ($HDI$) and Openness (including different measures). The dependent variable is growth rate of TFP ($GRTFP$). For the above equation the unrestricted error correction version of the ARDL model is given by:

$$\Delta GRTFP_t = \beta_0 + \beta_1 GRTFP_{t-1} + \beta_2 Y_{t-1} + \beta_3 K_{t-1} + \beta_4 L_{t-1} + \beta_5 HDI_{t-1} +$$

$$\beta_6 \text{Openness}_{t-1} \sum_{i=1}^{m} \beta_{7i} \Delta GRTFP_{t-i} + \sum_{i=0}^{m} \beta_{8i} \Delta Y_{t-i} + \sum_{i=0}^{m} \beta_{9i} \Delta K_{t-i} +$$

$$\sum_{i=0}^{m} \beta_{10i} \Delta L_{t-i} + \sum_{i=0}^{m} \beta_{11i} \Delta HDI_{t-i} + \sum_{i=0}^{m} \beta_{12i} \Delta \text{Openness}_{t-i} + u \quad (6)$$

The first part of the above equation represents the long-run dynamics of the model whereas second part shows the short-run relationship in which $\Delta$ is the first difference operator, $u_t$ is a white noise disturbance term and the equation indicates that growth rate of TFP tends to be influenced and explained by its past values so it involves other disturbances or shocks. Therefore, equation (6) was modified in order to capture and absorb certain economic shocks. The ARDL approach involves two steps for estimating the long-run relationship (Pesaran et al., 2001). First step is to examine the existence of long-run relationship among all variables in the equations under estimation. Second step is to estimate the long-run and the short-run coefficients of the same equation. We run the second step only if we find a long-run relationship in the first step (Narayan et al., 2004). So in order to test the long-run relationship equation (6) should be conducted by imposing restrictions on estimated long-run coefficients of the variables. The null and alternative hypotheses are as follows:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0 \quad \text{(No long-run relationship)}$$

$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0 \quad \text{(Long-run relationship exist)}$$
The F-test has a nonstandard distribution, which depends on: whether variables included in the model are I(0) or I(1), the number of regressors and whether the model contains an intercept and/or a trend. Given a relatively small sample size in this study of 37 observations, the critical values used are as reported by Narayan (2004), which based on small sample size between and 80 observations.\(^7\) The test involves asymptotic critical value bounds, depending whether the variable are I(0) or I(1) or mixture. Two sets of critical values generated, one set refers to the I(0) series and other for the I(1) series. Critical values for the I(1) series are referred to as upper bound critical values, while the critical values for I(0) series are referred as the lower bound critical values. If the calculated F-statistic is larger than the upper bound critical value, then the null hypothesis of no co-integration is rejected, and conclude that there is evidence of a long-run relationship between the variables irrespective of whether the variables are I(0) or I(1). If the test statistic is below the lower bounds, then the null hypothesis of no co-integration cannot be rejected and if it falls inside the critical value band, the test is inconclusive.

If there is evidence of long-run relationship (co-integration) of the variable, the following long-run models are estimated:

\[
GRTFP(P) = \beta_1 + \sum_{j=1}^{k} \beta_j GRTFP(P)_{t-1} + \sum_{i=0}^{p} \beta_3 Y_{t-i} + \sum_{i=0}^{p} \beta_4 K_{t-i} + \sum_{i=0}^{6} \beta_5 L_{t-i} + \sum_{i=0}^{6} \beta_6 HDI_{t-i} + \sum_{i=0}^{6} \beta_7 OPENESS_{t-i} + \mu_t
\]

Model I

Once co-integration is established, lag length is selected for each variable. The ARDL method estimates \((p+1)^k\) number of regressions in order to obtain optimal lag length for each variable, where \(p\) is the maximum number of lag to be used and \(k\) is the number of variables in the equation. The model can be selected using the model selection criteria like Schwartz-Bayesian Criteria (SBC) and Akaike’s Information Criteria (AIC). SBC is known as the parsimonious model: selecting the smallest possible lag length, whereas AIC is known for selecting the maximum relevant lag length. For annual data, Pesaran and Shin (1999) recommended choosing a maximum of 2 lags. From, this the lag length that minimizes SBC is selected.

---

\(^7\)Pesaran and Pesaran (1997) and Pesaran et al. (2001), however, generated critical values based on 500 and 1000 observations and 20,000 and 40,000 replications, respectively, which suitable for large sample size.
The ARDL specification of the short-run dynamics can be derived by constructing an Error Correction Model (ECM) of the following model:

$$\Delta GRTFP(P) = \beta_1 + \sum_{i=1}^{p} \beta_2 \Delta GRTFP(P)_{t-1} + \sum_{i=0}^{p} \beta_3 \Delta Y_{t-1} + \sum_{i=0}^{p} \beta_4 \Delta K_{t-1} + \sum_{i=0}^{p} \beta_5 \Delta L_{t-1} + \sum_{i=0}^{p} \beta_6 \Delta HDI_{t-1} + \sum_{i=0}^{p} \beta_7 \Delta OPENESS_{t-1} + \beta_8 ECM_{t-1} + \mu_t$$

Model II

where, $ECM_{t-1}$ is the error correction term, defined as:

$$ECM_t = GRTFP(P) \beta_1 - \sum_{i=1}^{p} \beta_2 \Delta GRTFP(P)_{t-1} - \sum_{i=0}^{p} \beta_3 \Delta Y_{t-1} - \sum_{i=0}^{p} \beta_4 \Delta K_{t-1} - \sum_{i=0}^{p} \beta_5 \Delta L_{t-1} - \sum_{i=0}^{p} \beta_6 \Delta HDI_{t-1} - \sum_{i=0}^{p} \beta_7 \Delta OPENESS_{t-1}$$

(7)

All coefficients of short-run equation are coefficient relating to the short-run dynamics of the model convergence to equilibrium and $\beta_8$ represent the speed of adjustment.

To ascertain the goodness of fit of the ARDL model, diagnostic test and stability test are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the model. The structural stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ). Examining the prediction error of the model is another way of ascertaining the reliability of the ARDL model. If the error or the difference between the real observation and the forecast is infinitesimal, then the model can be regarded as best fitting.

VI. ESTIMATION RESULTS

Prior to the testing of co-integration, we conducted a test for order of integration of each variable using Augmented Dickey-Fuller (ADF) test. Even though the ARDL frame work does not require pre-testing variables to be done, the unit root test could convince us whether or not the ARDL model should be used because if any variable in Model I is integrated of $I(2)$ or higher order then procedure is not applicable. Table 2 shows that there is a mixture of $I(1)$ and $I(0)$ of underlying regressors and therefore, the ARDL,
testing could be proceeded. Table 2 shows that growth rate of TFP in LSM sector (GRTFP), Human Capital (HDI), import penetration (IP), export promotion (EP), terms of trade (TOT) and trade flow (TF) are stationary at the level, i.e. I(0). Value added (Y), capital (K) and labour (L) are stationary at I(1). All the independent variables are in form of log.

### TABLE 2
Unit-Root Estimation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level Intercept and Trend</th>
<th>First difference Intercept and Trend</th>
<th>No. of Lags</th>
<th>No. of Lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRTFP (P)</td>
<td>–8.835*</td>
<td>–8.563</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Value added (Y)</td>
<td>–0.188</td>
<td>–6.580*</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Labour force (L)</td>
<td>–1.127</td>
<td>–10.448*</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Capital (K)</td>
<td>–0.500</td>
<td>–7.112*</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HDI</td>
<td>–4.102*</td>
<td>–6.740</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>IP</td>
<td>–3.383*</td>
<td>–5.471</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>EP</td>
<td>–3.992*</td>
<td>–6.457</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TF</td>
<td>–4.811*</td>
<td>–5.689</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOT</td>
<td>–0.815*</td>
<td>–1.819</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE: * represents the level of significance at 1%, having critical values of –4.234972, –3.540328, –3.202445 with intercept and trend at level and at first difference.

The next step is estimating the Model I to examine the long-run relationship among the variable. As suggested by Pesaran and Shin (1999) and Narayan (2004), since the observations are annual, we choose 2 as maximum order of lags in ARDL and estimate for the period of 1970-2007. We also used the SBC to determine the optimal number of lags to be included in the conditional ECM model, whilst ensuring there was no evidence of serial correlation as emphasized by Pesaran et al. (2001). The lag length that minimizes SBC is one. The calculated F-statistics is display in Table 3.
TABLE 3

F-Statistic of Cointegration Relationship (Lag Length Selection)

<table>
<thead>
<tr>
<th>Lag Order</th>
<th>F-Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(6,22) = 1.423</td>
</tr>
<tr>
<td>1</td>
<td>(6,15) = 6.050*</td>
</tr>
<tr>
<td>2</td>
<td>(6,8) = 1.2725</td>
</tr>
</tbody>
</table>

NOTE: The relevant critical value bounds for F-statistics (an unrestricted intercept and no trend) are taken from Table CI. iii in Nayaran (2004). At 99% level, the critical value bounds for F-statistics are 4.016 and 5.797, indicates that computed statistics falls above the upper bound value.

The calculated F-statistics = 6.050) is higher then the upper bound critical value at 1% level of significance (5.797) using unrestricted intercept and no trend for the model. This implies that the null hypothesis of no co-integration cannot be accepted at 1% level of significance, therefore there is co-integration between the variables.

The empirical results of the long-run model: growth rate of TFP in LSM sector in Pakistan are presented in Table 4. All the explanatory variables are in form of log and openness is measured by the different quantity based measures including IP, EP, TF and TOT. The significant variables those appear to affect growth rate of TFP in LSM sector are $Y$, $K$ (–1), $L$ (–1), IP, TOT and HDI also have the significant coefficient. We include the one year time lag of $K$ and $L$ in the long-run model of growth rate of TFP in order to take into account the gestation period. Results illustrate that the contemporary value added ($Y$) has the affirmative effect on the growth rate of TFP of LSM sector and the impact is maximum among all the explanatory variables. $K$ and $L$ has the lag effect on the growth rate of TFP and among these two explanatory variables $K$ have more impact on growth rate of TFP then the L. HDI has a negative effect on the growth rate of TFP in LSM sector. As research has proven that it is social and human development that makes a strong basis for sustainable economic development. Focusing exclusively on the liberalization of the economy neglecting other aspects of human and social development cannot be productive.

All the measures of the openness mentioned above showing the negative impact on the growth rate of TFP in LSM sector in Pakistan. Statistically significant negative coefficients of the different measures of the openness in
the long-run model suggested that rapid progress in TL do not caused a rise in productivity. The results of earlier studies show that when protection is reduced at moderate rate, the rise in productivity is highest, but when protection is reduced at an excessively fast rate or when it is not reduce at all, the rise in productivity is low (Ourata and Yokota, 1994).

### TABLE 4

Long-Run Model (Model I)
Dependent Variable GRTFP

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients (Openness measured as IP)</th>
<th>Coefficients (Openness measured as EP)</th>
<th>Coefficients (Openness measured as TF)</th>
<th>Coefficients (Openness measured as TOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-2.737* (-1.725)</td>
<td>-2.651* (-1.672)</td>
<td>0.365 (0.428)</td>
<td>-2.784* (-1.660)</td>
</tr>
<tr>
<td>Y (-1)</td>
<td>-9.464* (-36.775)</td>
<td>-9.447* (-36.776)</td>
<td>-9.715* (-73.795)</td>
<td>-9.465* (-34.743)</td>
</tr>
<tr>
<td>K</td>
<td>-8.258* (-63.277)</td>
<td>-8.233* (-61.872)</td>
<td>-7.945* (-105.230)</td>
<td>-8.297* (-61.042)</td>
</tr>
<tr>
<td>K (-1)</td>
<td>8.314* (83.801)</td>
<td>8.302* (82.248)</td>
<td>7.942* (114.661)</td>
<td>8.364* (83.614)</td>
</tr>
<tr>
<td>L</td>
<td>-1.962* (-57.008)</td>
<td>-1.953* (-55.507)</td>
<td>-1.953* (-120.211)</td>
<td>-1.969* (-54.499)</td>
</tr>
<tr>
<td>L (-1)</td>
<td>2.000* (59.222)</td>
<td>2.008* (59.478)</td>
<td>1.966* (111.253)</td>
<td>2.001* (55.505)</td>
</tr>
<tr>
<td>HDI</td>
<td>-1.656* (-1.639)</td>
<td>-1.505 (-1.479)</td>
<td>0.380 (0.686)</td>
<td>-1.786* (-1.683)</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.0816* (-1.744)</td>
<td>-0.098* (-1.779)</td>
<td>0.047* (1.711)</td>
<td>-0.0051 (-0.2622)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.9986</td>
<td>0.998</td>
<td>0.9985</td>
<td>0.9984</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.9982</td>
<td>0.998</td>
<td>0.9981</td>
<td>0.9980</td>
</tr>
<tr>
<td>DW- Statistic</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Notes: * shows the level of significance at 1%. Value in parentheses is of t-statistic.

Source: Author’s estimates.
The coefficient of the IP ratio anticipated to be positive since penetration of imported goods would cause competition in the domestic market and consequently rationalization of the competing sector as a whole or closing down of unprofitable enterprises would lead to improves sector productivity. There has been rise in the import penetration following the liberalization program (see Figure 1 in Appendix). However the estimation results are contrary to expectation. The estimated coefficient is negative and statistically significant implies that the increasing presence of imported goods lowered the productivity of the competing sector. This result can be interpreted in a way that increase in import penetration following liberalization did not result in improvement in competitiveness if import substitution industries and that the import liberalization proceeded so rapidly that earnings deteriorated.

There has been rise in the export promotion following the liberalization program (see Figure 2 in Appendix). However, its impact on the growth rate of TFP in LSM sector is negative and statistically significant. Increase in the export promotion despite poor productivity performance of the export oriented industries in the post-liberalization period, appears due to the lucrative export intensives which did not put real pressure to improve efficiency. Due to more open trade policy and high import penetration, a moderate increase in exports does not appear very supportive to increase the productivity. But still there is a room for exports to improve the productivity of the sector if exports increase greatly.

The coefficient of TF (import plus export to GDP ratio) is expected to be affirmative, since externality might be brought about for manufacturing exporters through the acquisition of commodity knowledge, production techniques and other benefits from foreign customers. If so, an export shock would be positively reflected on the growth rate of TFP in LSM sector of Pakistan. There has been nominal increase rise in the trade flows following the liberalization program (see Figure 3 in Appendix). However, the estimation results show that the coefficient is negative and statistically significant, i.e. the direction of the productivity effect is negative. Due to more open trade policy and high import penetration, a moderate increase in exports does not appear very supportive to increase the productivity.

The impact of TOT on the growth rate of TFP in LSM sector found to be statistically unclear in the long run model (Model I), however negative like other measures of the openness. There has been gradual decrease in TOT during the analysis period (see Figure 4 in Appendix). The negative coefficient reflects the deficiency of the economy in adopting or imitating the technology that trickles through trade. There could also be the reason of
maximum dependence of domestic economy on the foreign manufacturing goods. Theory indicates that the TL effect positively on the TFP growth, but the results is still inconclusive in case of developing countries.

**TABLE 5**

Error Correction Model (Model II)  
Dependent Variable $\Delta$GRTFP

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients (Openness measured as IP)</th>
<th>Coefficients (Openness measured as EP)</th>
<th>Coefficients (Openness measured as TF)</th>
<th>Coefficients (Openness measured as TOT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>–0.051 (–0.379)</td>
<td>–0.089 (–0.692)</td>
<td>–0.162 (–1.329)</td>
<td>0.038 (0.285)</td>
</tr>
<tr>
<td>$\Delta$(GRTFP(–1))</td>
<td>–0.055 (–0.925)</td>
<td>–0.066 (–1.103)</td>
<td>–0.060 (–0.941)</td>
<td>–0.0071 (–0.115)</td>
</tr>
<tr>
<td>$\Delta$ (K(–1))</td>
<td>4.379* (3.410)</td>
<td>4.722* (3.775)</td>
<td>5.704* (5.267)</td>
<td>3.270* (2.310)</td>
</tr>
<tr>
<td>$\Delta$ (L)</td>
<td>–2.045* (–8.767)</td>
<td>–2.013* (–8.266)</td>
<td>–2.074* (–8.588)</td>
<td>–2.051* (–9.372)</td>
</tr>
<tr>
<td>$\Delta$ (L(–1))</td>
<td>1.623* (4.467)</td>
<td>1.699* (4.666)</td>
<td>1.902* (5.670)</td>
<td>1.405* (3.804)</td>
</tr>
<tr>
<td>$\Delta$ (HDI)</td>
<td>–6.860 (0.348)</td>
<td>–5.975 (0.804)</td>
<td>–4.838 (–0.604)</td>
<td>–8.552 (–1.228)</td>
</tr>
<tr>
<td>$\Delta$ (Openness)</td>
<td>–0.416 (–1.487)</td>
<td>–0.442 (–1.270)</td>
<td>–0.584* (1.677)</td>
<td>–0.0036 (–0.041)</td>
</tr>
<tr>
<td>ECM (–1)</td>
<td>–0.476* (–2.831)</td>
<td>–0.413* (–2.622)</td>
<td>–0.363* (–2.370)</td>
<td>–0.661* (–3.497)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.977</td>
<td>0.976</td>
<td>0.975</td>
<td>0.979</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.969</td>
<td>0.967</td>
<td>0.966</td>
<td>0.972</td>
</tr>
<tr>
<td>DW-statistic</td>
<td>1.9</td>
<td>1.9</td>
<td>2.0</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Notes: * shows the level of significance at 1%. Value in parentheses is of $t$-statistic.

Source: Author’s Estimates.
The results of the error correction model (ECM) for the growth rate of TFP in LSM sector in Pakistan are presented in Table 5. Most of the coefficients in the ECM are significant except HDI. The lagged error term ($ECM_{t-1}$) is negative and significant at 1% level for the different measures of the openness. Short-run behavior of the growth rate of TFP does not support the short-run relation among the explanatory and dependent variable. The coefficients of $ECM_{t-1}$ ranges between $-0.363$ to $-0.661$ for different measures of openness indicates average rate of convergence to equilibrium. In short-run model the growth rate of the $Y$ has the highest positive impact on the growth rate of the TFP in LSM sector, whereas $K$ and $L$ have lag effect. Result shows that in short-run also all the measures of openness and HDI have negative but insignificant impact on the growth rate of TFP except TF having negative significant coefficient.

Diagnostic tests for serial correlation, normality, heteroscedasticity and functional form for long-run and short-run models are considered and finally, when analyzing the stability of long-run coefficients together with the short-run dynamics CUSUM and CUSUMSQ are applied.

VII. CONCLUSION

The evidence of positive relationship between TL and economic growth is not as convincing in the case of majority of developing countries as it is in the case of developed countries. TL of the Pakistan’s economy during the 1990s, initiated largely under the IMF pressure, has not been dynamic in improving its social and economic development. Pakistan’s economic growth rate was fairly good from last 5 to 6 years, after a sluggish economic growth in decade of 1990s. But the benefits of that growth do not transferred to the social sector of the economy. The share of the manufacturing sector in Pakistan’s economic growth has declined steadily; mainly due to the way liberalization was carried out could not lead to a successful outcome. The reforms process was done only partially, due to lack of required institutional infrastructure and there were concerns that Pakistan will continue to face serious challenges for its social and economic development in future, as it moves towards liberalization, and it actually happened. Research has proven that it is social and human development that makes a strong basis for sustainable economic development. This is where Pakistan needs to pay attention. TL under the WTO regime is Pakistan’s obligation, but at the same time it should be complied to in a manner with least implications for social sectors of the economy. Any future binding commitments by the Government must be made in consultation with relevant industry and business sectors. Pakistan should not liberalize more than what is required.
Any move towards liberalization should be carefully measured in terms of its prospective costs and benefits.

The above discussion shows that the TL policy of the government has not yet brought about any epoch-making economic results particularly for the growth rate of TFP in LSM sector. The elimination of government intervention and restrictions has characterized all policy stances, yet liberalization alone is not sufficient to produce significant, conspicuous economic achievement. Government must also play important role in capitalizing infrastructural projects, in order to lay the foundation for a healthy competitive environment for the manufacturing sector. The negative coefficient of the openness measures reflects the deficiency of the economy in adopting or imitating the technology that trickles through trade. There could also be the reason of maximum dependence of domestic economy on the foreign manufacturing goods. Theory indicates that the TL effect positively on the TFP growth, but the results is still inconclusive in case of developing countries. The above mentioned results also support the previous studies that the TL does not affect the productivity in case of Pakistan.
REFERENCES


Sabir, M. and Q. M. Ahmed (2003), Macroeconomic Reforms and TFP Growth in Pakistan: An Empirical Analysis. 56th International Atlantic Economic Conference, Quebec, Canada.


World Bank (2002), World Development Indicators

Source: Author’s calculation based on the data from *Pakistan Economic Survey* (various issues).