LINK BETWEEN LIBERALISATION AND PRODUCTIVITY : A CASE STUDY OF AN INDUSTRY

*Geetu Walecha**

In light of the 1991 reforms, this paper examines the impact of liberalisation on the productivity of chemicals, pharmaceuticals, drugs and fertiliser (Chemicals and Chemical products) sector.

I. INTRODUCTION

The core of production activity for any nation lies in its industrial sector. And a fundamental indicator of indus-trial performance is its level of productivity which is also the source of its long term survival.

Economic policies (specially industrial policies) provide the environ-ment for industrial activity. Any change in the former would lead to changes in the industrial performance. The magni-tude of these changes can be captured through the indicators of industrial performance (productivity, profitability, competitiveness, etc.).

It is argued that economic reforms consisting of liberalisation of trade and industrial policies lead to a more desirable resource allocation. This could lead to improvements in the productivity performance of industry, provided resources are allocated towards more efficient firms and more productive sectors. In addition, increased compe-tition and exploitation of economies of scale could result in productivity gains.

The objective of this paper is to examine the validity of the above argument in the Chemicals and Chemical Products industry in Indian context. The period chosen for analysis is 1985 to 1996. The paper is organised as follows: Section II puts forward the changes in the policy scenario from 1980s to 1990s ; Section III defines productivity and provides the theoretical linkage between liberalisation and productivity ; Section IV brings in the model assumed and the generation of variables; Section V gives the estimation results ; and finally Section VI provides the interpretation of the results and conclusion.

*Lecturer, Department of Economics, Shri Ram College of Commerce, University of Delhi, Delhi. The author is indebted to Professor Suresh D. Tendulkar, Professor K.L.Krishna, Dr. Vivek Srivastava and Mr. Deb Kusum Das for their expert guidance and advice in writing this paper. The author also thanks Manish for his help at various stages of the work, and all the computer experts at Centre for Development Economics, Delhi School of Economics, for their technical support.

II. POLICY REGIME

Background

The Industrial Policy Resolution of the GOI in 1948 set out to secure a continuous increase in production and its equitable distribution assigning the state a progressively important role in the development of industries. The strategy of planned economic development as incorporated in the Industrial Policy Resolution, 1956 was based on (a) the development of a broad industrial base in order to achieve self-reliance; and (b) the promotion of social justice.

The trade policy, till the 1970s, emphasized on quota restrictions and import substitution. In addition, industries producing essential commodities such as edible oils, pharmaceuticals, sugar and fertilizer had been subject to varying degrees of price control. Also, there was a complex system of excise and corporate taxes. These policies led to the development of a diversified industrial base which was highly unspecialized with a resource allocation biased towards heavy industry and the capital goods sector. The absence of domestic competition, along with the unconditional protection from imports, fostered a high cost domestic structure which was domestically inefficient in the utilization of resources and was not competitive abroad. In addition to delays, high administrative costs and rent seeking opportunities associated with the system of imports and industrial licensing, the incentives generated a non-competitive and high cost industrial structure.

In addition to the static misallocation and inefficient resource utilization, the system was dynamically so inefficient because of virtual insulation from external and internal competition as not to encourage technical change. The obvious consequence was both low levels and low rates of growth of productivity.

It is argued that greater openness and liberalization lead to greater industrial efficiency through increased level of competition and cheaper and easier access to foreign technology. Thus one way of increasing productivity levels was through the initiation of a process of economic reforms that would open up the Indian economy.

Reform Measures in the Eighties

The period of industrial stagnation between 1965 and 1975 set forth a process of economic reforms in the 1980s (beginning mid-seventies) recognizing the need for industrial policy reform to complement foreign trade liberalization. It did not involve an abandonment of state control and intervention. These reforms used Fiscal instruments to replace discretionary

and quantitative controls and attempted to introduce stability in the policy environment by outlining a Long Term Fiscal Policy (LTFP) and a medium term (3 year) Import-Export policy.

Industrial Policy

In 1985, many industries were freed from licensing requirement and the definition of MRTP firm was changed along with a relaxation of MRTP restrictions. Up to 49 percent of increase in capacity for moderni-zation and renovation was exempted from licensing. In addition, for the industries where economies of scale were important, the capacity require-ments were relaxed. Also there was a broadbanding of the product mix, i.e. firms having licensed plants were allowed to produce related products with their installed plant and machinery.

For the public sector, there was an emphasis on increasing accounta-bility and autonomy. Steps were taken for the liberalization and development of the capital markets. But no signi-ficant steps were taken for reduction of exit barriers. Under the Sick Industrial Companies Act, 1986, the Board of Industrial and Financial Reconstruction (BIFR) was set up in 1987, to review the viability of sick private sector units and recommend rehabilitation or closure.

Trade and Commercial Policy

The import policy was changed to allow for increased items (capital goods, intermediates as well as raw materials) in the Open General License (OGL) and reduction and rationalization of the duty rates on selected capital goods, intermediates and industrial raw materials. For the items that remained under discretionary control, rules for granting license was made less stringent.

Changes in the export policy included providing incentives for increased exports, in other words, reducing the anti-export bias that existed as a result of the earlier policy regime. These incentives took the form of various exemptions, rebates, etc. Some of the existing provisions and incentives for enabling the import of raw material were streamlined and some new facilities were introduced. The duties on capital goods required for export industries and on industries with export potential were lowered. In 1988-89, profits earned from exports were completely exempted form corporate taxes.

Exchange Rate Policies

Between 1971-79 the rupee depre-ciated by 32 percent in real terms against key currencies. This trend was reversed during 1979-81 and was followed by a corrective real depre-ciation of 7.6 percent after which the real exchange rate stabilized. A flexible exchange rate policy after 1985 had a positive effect on exports.

Tax Policy

The tax structure that existed till the 1970's was highly complex and

demanded simplification from the reforms of the 1980s. The changes that were undertaken in the reforms showed concern for the equity and efficiency aspects in simplifying the tax structure. The long term fiscal policy of 1985 indicated the commitment to provide a stable tax regime. In 1985-86 basic rates of corporate taxes were reduced to 50 percent from 55 percent and a modified value tax (MODVAT) was introduced in 1986. Under this scheme, excise duties paid on inputs could be credited against the duty on final goods provided that the final good was not exempt for excise tax.

Financial Policy

Some reform initiatives included setting up of Securities and Exchange board (SEBI) to promote the growth of capital markets and to protect the interest of investors and simplification of administered structure of interest rate which included the removal of ceilings on interest rate on advances of commercial banks and long term lending institutions. Also, uniform interest rates across sectors and types of borrowers were introduced.

Reform Measures in the Nineties

The reforms of 1991 came in the light of the BoP/foreign exchange crisis of the 1990. Though the reforms were crisis driven, their intensity and scope was much greater than the previous reforms of the 1980s and have far reaching consequences on the overall working of the Indian economy. The highlights of the reforms in the various sectors are presented below.

Industrial Policy

The Industrial Policy statement issued by the GOI on 24 July, 1991 stated: The attainment of technological dynamism and international competitiveness requires that enterprise must be enabled to swiftly respond to fast changing external conditions that have become characteristic of today's industrial world. Government policy and procedures must be granted to assisting entrepreneurs in their efforts. This can be done only if the role played by the government were to be changed form that of only exercising control to one of providing help and guidance by making essential procedures fully transparent and by eliminating delays.

This resulted in the introduction of changes in policies relating to industrial licensing, foreign investment, technology imports, government ownership of industry and special controls on very large private enterprises.

Delicensing

Licensing was abolished in the industrial policy of 1991 in all but 18 industries. The industries in which licensing prevailed are potable alcohol, tobacco products, electronic aerospace and defense equipment, industrial explosives and hazardous chemicals and within pharmaceuticals, drugs that are still the monopoly of the government.

Public Sector Reforms

In 1991, government abolished the monopoly of the public sector industries except those where security and strategic concerns still dominated. These include arms and ammunition and allied defense equipment, atomic energy and nuclear minerals and railway transport. A large number of loss making public enterprises were referred to the BIFR. Essentially two different types of reforms were envisaged: greater autonomy of PSEs and greater private sector ownership. The Disinvestment Commission was set up to advise the government on equity sales.

Foreign Investment

Let us look the changes in the foreign investment policy under two heads: Foreign Direct Investment and Portfolio investment.

Foreign Direct Investment: The liberalization measures of the policy reforms of 1991 permitted foreign direct investment up to 51 percent equity in 48 sectors with automatic approval. The cases pertaining to industries not covered by automatic approval were considered by the Foreign Investment Promotion Board. No approval is required for FDI inflow up to 24 percent of the equity in any Indian firm and up to 20 percent in any new private bank (40 percent for NRIs).

Portfolio Investment : Policies relating to the inflow of investment by foreign institutional investors (FIIs) and through global depository receipts (GDRs) have undergone various changes since 1991. Indian companies were permitted to raise capital through Euro-market issues of GDRs and foreign currency convertible bonds (FCCBs). Indian companies have been allowed to access international capital markets since February 1992. Investing FIIs need to be registered both within their respective countries of origin and with the Securities and Exchange Board of India (SEBI). A single FII can invest up to 10 percent while a group of FIIs can invest up to 30 percent of the share capital of the listed compa-nies. The profits from portfolio invest-ment can be repatriated freely subject to India's foreign exchange regulations.

External Borrowings

The strategy for balance of pay-ments management includes subs-tantial support in the form of external financial flows, external assistance and external borrowings including fast-disbursing assistance from official multilateral and bilateral sources and also through new schemes to attract funds from non-residents, corporate bodies and foreign banks. External commercial borrowings (ECBs) enable Indian companies to augment domestic resources while taking advantage of the lower interest rates prevailing in the international markets. ECBs are permitted, within an annual ceiling that is consistent with prudent debt management, keeping in view the balance of payments position. The limit under US $ 3 million scheme has been raised to US $5 million in

1998-99. Small borrowers can now avail of a higher borrowing limit than before.

Trade and Commercial Policy

Import Licensing: The licensing requirements have become increasingly relaxed over the nineties with the number of items on the negative list (items whose imports required licensing permission) coming down and imports of some restricted items being liberalized through granting of freely transferable Special Import Licenses (SIL). SILs are also granted to large established exporters; exporters of electronic and telecommunications equipment, diamonds, gems and jewellery, deemed exports and manufacturers who have acquired prescribed quality certification.

Tariffs : Prior to 1991, India's tariff structure was among the highest in the world. Following the Chelliah committee(1992) recommendations, India lowered its average applied tariff rate from 125 percent in 1990-91 to 35 percent in 1997-98. The peak rate of the duty has declined from 335 percent to 45 percent for the same period and to 40 percent in 1999-2000.

Export Subsidies: In India, export subsidies are provided indirectly through duty and tax concessions, export finance, export insurance and guarantee, and export promotion and marketing assistance. The emphasis of the export incentive system has been considerably changed and modified since 1991. The cash compensatory scheme (CCS) was abolished in July 1991. The replenishment export licenses were replaced by EXIM scrips which allowed imports to a much wider range of intermediate products. The EXIM scrip scheme was abolished with the introduction of the dual exchange rate scheme for exporters in February 1992. The Export Promotion Capital Goods (EPCG) Scheme, originally introduced in 1991, was liberalized in April 1992 to encourage capital goods imports. The concessional imports duty was reduced from 25 to 15 percent. Finally, export income is exempt from income taxes.

Exchange rate Policies : The macroeconomic stabilization and structural adjustment program, initiated in mid-1991, adjusted the external value of the rupee which was overvalued for most of the preceding period. This had adversely affected exports. An explicit dual exchange rate system was introduced in March 1992 on a temporary basis to facilitate a shift to a more liberal exchange rate regime. The newly Liberalized Exchange Rate System (LERMS) consisted of a free market rate along with an official rate set by the RBI in US dollars.

The foreign exchange budget was abolished and exchange rate unified in March 1993. The rupee was floated and the exchange rate was to be determined by the forces of demand and supply in the foreign exchange market. At that time, the rupee's value was set close to the previous free

market rate of about Rs 31 per US dollar. Regulations relating to exchange earners foreign currency account, basic travel quota, donations, payments of certain services rendered by foreign parties, were to be liberalized up to a specified limit.

Transactions on trade account were freed from foreign exchange controls and more relaxations on current account payments were introduced. Repatriation of investment income by NRIs is now possible in a phased manner over a three year period after tax has been paid as per provisions of the Income Tax Act. The RBI will also favourably consider bona fide requests for additional foreign exchange. During 1994-95, the nominal effective exchange rate depreciated by about 2.9 percent while the real effective exchange rate appreciated by 5 percent due to a high domestic inflation rate. The REER appreciated again during 1996-97 and 1997-98 after registering 4 percent depreciation in 1995-96.

Tax Policies

Measures to reform the direct tax system include a reduction in tax rates applicable to domestic and foreign companies, abolition of surcharge on corporate tax, modi-fication of the MAT to exempt exporters from its purview, five year tax holiday for the telecom and power sector undertakings at the rate of 100 percent followed by 25 percent deduction from profit, five year 100 percent tax holidays to notified industrial parks (between 1-4-1997 and 31-2-2002) and seven year tax holiday to mineral oil exploration undertakings.

Financial Policy

India's financial sector went through a wide variety of reforms during the 1990, 1991 marked the intensification of financial sector reforms in two ways: one by conso-lidating on earlier reform initiatives and the other by extending the reforms to other segments of the financial sector. The three main categories of intermediaries that underwent reforms are the banking sector, the develop-ment finance institutions (DFIs) and non-bank financial companies (NBFCs).

Banking Sector

The reform agenda of the banking was based on the report of the Narsimham Committee on the Financial System (1992) and a follow up report (1998). The magnitude of preemption by the government was reduced by 10% by way of CRR and 25% through the SLR. Interest rates on advances made to the priority sectors was brought in line with the other rates. Banks now have greater freedom to set interest rates but have been simultaneously compelled to pay a higher price for risky lending. There has been very little restructuring of the banking system except for the entry of new private banks. This has, however, not seriously challenged the dominant position of the public sector.

In sum, large strides have been taken in the reduction of government direction and regulation of manu-facturing activity. However, many essential reforms still need to be carried out.

Delicensing, removal of unnece-ssary MRTP controls, and international trade reforms are the more significant reforms that have already been initiated. On the other hand, much needs to be done to reform the small scale and public sector and with respect to labour reforms and those relating to industrial restructuring. Despite the partial nature, the reforms did free the manufacturing sector of many of the unnecessary and harmful controls and regulations imposed by the past policy regime.

This is a broad outline of the reforms carried out in the whole economy, the sector chosen for this study is the Chemicals and Chemicals Products sector and so let us look at a brief outline of the sector, its activities and the reforms carried out over the period concerned.

Chemicals and Chemical Products Sector

The sector can be considered under three broad heads: (1) Chemi-cals; (2) Drugs and pharmaceuticals; and (3) Fertilisers. The sector produces a wide variety of products under these three heads. The chemicals category includes: Potassium chlorate; carbon black; calcium carbide; soda ash; caustic soda; industrial alcohol; dyes and dye intermediates; acetone; phenol; sulphuric acid; synthetic resins; synthetic detergents; industrial explo-sives; paints, varnishes and enamels; and pesticides.

The production of all these products require specific raw materials and some specific production technology. The problem of low productivity arises due to reasons ranging from unavail-ability of inputs and technology to power shortages. Power unavailability is a major source of low productivity levels in the chemicals industry.

For the drugs and pharmaceuticals category 60 % of investment is indigenous and the rest is foreign investment. The technology adopted for the production of various bulk drugs covers intricate and sophisticated fermentation techniques, synthetic operation and extraction and purification of the active principles contained in the plant and animal kingdom. A number of drugs are imported which cannot be produced indigenously but have demand. Also a number of drugs are exported.

The fertiliser category can be differentiated into nitrogenous and phosphatic fertilisers. Indigenous production of fertilisers being inade-quate, imports are required to meet the domestic demand. Imports are even required for the production of fertilisers along with the requirement for process and design engineering, know how and other factors.

Policy Reforms : Various reforms have been undertaken in the chemicals sector after 1991:

- Lowering of customs and excise duties on various components.

- Since 1991, the drugs and pharmaceuticals sector, an important part of the chemical products sector, has been treated as a high priority sector, allowing automatic foreign equity participation up to 51%.
- Tariffs have been lowered in the 90s though they still remain higher than average.
- The nitrogenous fertilisers have been decontrolled since June, 1994 and only urea continues to be under statutory policy control.
- With the objective of promoting a balanced use of NPK (Nitrogen, Phosphorus and Potassium) fertilisers in conjunction with organic manures, compost, green manure and bio-fertilisers with added emphasis on the use of micronutrients in high fertiliser consuming, intensely cultivated regions, the scheme of balanced and integrated use of fertilisers was launched in 1991-92.

III. LIBERALISATION-PRODUCTIVITY CONNECTION

The theory of comparative advan-tage predicts an increase in the value of domestic production with libera-lisation since exposure to international prices brings about a reallocation of factors of production towards areas of comparative advantage.

The traditional theory of trade policy does not address the issue of how greater openness might be related to rate of growth of productivity and output. There are, however, a number of writings that make this link. The micro-economic branch of this literature centres around the potential gains from increased competition and the exploitation of scale economies that could result from a more liberal policy regime. Increased competition and exposure to foreign markets is also linked to the adoption and diffusion of improved technologies. Then there are the macroeconomic arguments that link appropriate exchange rate policies with the exploitation of scale economies through increased exports, and with better capacity utilisation resulting from the availability of imported inputs.

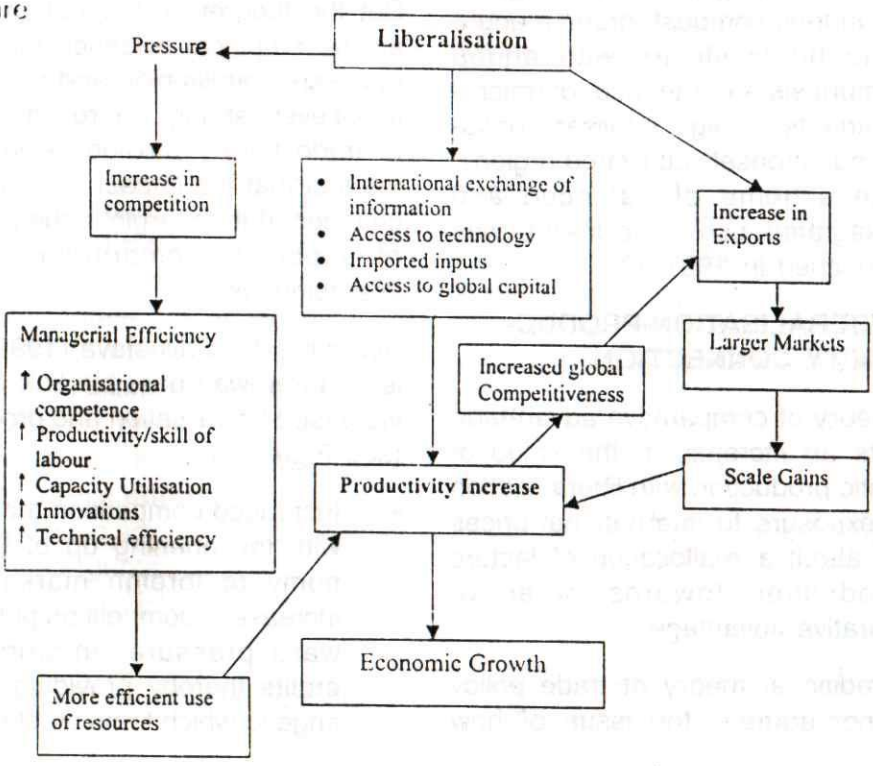
But the theoretical foundation as well as the empirical evidence for the link between liberalisation and productivity is not every strong. The recent literature of trade theory provides evidence to the fact that the impact of trade policy changes at the margin in the presence of imperfect competition are not unambiguous.

According to Srivastava (1999), there is a three-way possible link between increased liberalisation and productivity (see Figure 1):

- Increased competition that results with the opening up of the economy to foreign markets. An increase in competition puts downward pressure on prices and profits thereby providing a challenge to which firms must respond.

They may do so by increasing their technical efficiency. This can be achieved through greater organisational competence, improved managerial efficiency, higher productivity of labour, better capacity utilisation and more innovations. The resultant increase in the efficiency of resources can be interpreted as an increase in productivity.

- Liberalisation enables cheaper and easier access to foreign technologies, global capital, imported inputs and makes possible greater international exchange of information. Krueger(1998) argues that imports have the knowledge capital embodied in them that can be used by local producers. Since existing policies restricted the availability of such goods, the full productivity growth potential could not be realised. Relaxation of these restrictions can then lead to a better productivity performance.
- The third channel is increased exports made possible by the realistic exchange rate policies associated with liberalisation. The resultant increase in access to larger markets allows firms to exploit economies of scale. Scale gains lead to an increase in productivity. Productivity improvements allows firms to compete more effectively in export markets.



However, economic theory does not provide us with unambiguous answers regarding the 'net' effects of these factors. In the Indian context, there is further ambiguity due to the fact that restrictions remain in a number of areas. For example, lack of mobility of labour and capital make efficient industrial restructuring difficult. In addition, size and entry restrictions remain due to reservations for the small scale sector. Consumer goods imports continue to be subject to quota restrictions. Financial sector reforms are still being implemented and there are a number of areas where reforms are incomplete. Thus, there is a need for empirically investigating this hypothesis. In view of this it is useful to investigate how the policy changes in the policy regime of India were expected to and have actually influenced efficiency and profitability at the level of the firm and industry.

The major reforms in India's economic policy reforms include delicensing, abolition of public sector monopoly, easing of MRTP restrictions, increased opportunities for foreign investment, relaxation of import restric-tions and foreign exchange regulations, greater export subsidies and tax concessions.

Delicensing encourages new entrants and allows producers a greater choice in deciding the product mix. This should increase competition and lead to better capacity utilisation. Abolition of public sector monopoly leads to reduction in inefficiencies and increase in competition and productivity as new and more competent private firms enter into hitherto reserved sectors. Easing of MRTP restrictions would enable easier expansion of capacity and push firms down their average cost curves. Increased inputs imports as a result of the easing of restrictions increases labour productivity as each unit of labour has more and better capital to work with. This increases efficiency and output. Tax concessions leading to greater domestic investment would further accelerate growth.

Productivity Defined

Productivity is the ratio of output to inputs and is a measure of efficiency in production. Single factor productivity refers to output produced per unit of an input such as labour or capital, example labour productivity is defined as

$$\text{Labour productivity} = \frac{\text{output}}{\text{labour units}}$$

Similarly, productivity of capital or any other input can defined. We can also see the productivity of the entire bundle of inputs. This is called Total Factor Productivity (TFP).

$$\text{TFP productivity} = \frac{\text{output}}{\text{weighted bundle of all inputs}}$$

Total Factor Productivity Growth (TFPG) is hence calculated as the difference between the growth of output and the growth of inputs (suitably weighted).

TFPG = Growth of output-growth of weighted inputs

Thus, total factor productivity is that part of output growth which is not explained by increase in input use. In this sense, positive TFPG reflects technical change and any other improvements in the management of resources. At the level of the firm improvements in productivity lead to lower costs and possibly higher profits. At the level of the economy, improvements in productivity allow for people to work less, consume more, have a greater variety of products to choose from and hence, enjoy higher standards of living over the long run.

What are the possible sources of productivity growth? In the long run, improvements in productivity are achieved through technical progress. In the shorter run, increased efficiency results form improvements in managerial efficiency and organisational competence; innovation; fuller utilisation of capacity; economies of scale; and improvements in labour management and skills. This list is not exhaustive, and anything leading to a more efficient resource management is identified as a productivity gain.

IV. MODEL ASSUMED

It is assumed that firm i in period t is constrained by the production technology represented by

$$Q_{it} = A\, e^{h(i,t)}\, f_t\,(k_{it}, L_{it}, M_{it}) - - - - (1)$$

Where Q_{it} represents output of ith firm at time t and k_{it}, L_{it} and M_{it} represent the capital, labour and material inputs for it. The Hicks neutral productivity factor $A\, e^{h(i,t)}$ is allowed to be different across firms and overtime. It is further assumed that h(.) can be parameterised as

$$h(i,t) = u(i) + \lambda(t) + v_{it} - - - (2)$$

where u_i=u(i) depends on unobservable firm level differences such as differences in managerial efficiency and quality of inputs. $\lambda(t)$ represents productivity and policy shocks common to all firms during any time period and v_{it} represents all other omitted variables and is assumed to be a mean zero error term.

Thus, u_i is an individual effect ; $\lambda(t)$ is assumed to be a linear function of time.

Substituting the value of h(i,t) from equation (2) and taking logs on both sides, equation(1) can be written as

$$\text{Log } Q_{it} = a + u_i + \lambda t + \log f_t\,(k_{it}, L_{it}, M_{it}) + v_{it} - - - - \quad (3)$$

Where a=logA

Assuming f_t(.) to be Cobb Douglas, equation (3) can be written as

$$\text{Log } Q_{it} = a + u_i + \lambda t + \text{alog } L_{it} + \beta \log K_{it} + \gamma \log M_{it} + v_{it}$$

or

$$q_{it} = a + u_i + \lambda t + al_{it} + \beta\, k_{it} + \gamma\, m_{it} + v_{it} - - - - \quad (4)$$

where

$q_{it} = \log Q_{it}$; $l_{it} = \log L_{it}$; $k_{it} = \log K_{it}$; $m_{it} = \log M_{it}$

Choice of Estimator

There arises a problem of corre-lation between the regressors and the unobserved firm and time effects. If the unobserved effects u_i and ët are known to the firms, then they are likely to affect the firm's choice of inputs. This violates the assumption of the linear model of uncorrelatedness of regressors with the error term, making OLS estimation inconsistent. If u_i is interpreted as managerial efficiency and ët as a productivity or a policy shock, it is reasonable to assume that the realisation of these is known to managers and affect their choice of inputs.

The most common way of removing the plant and time specific effects is to use the 'dummy variable' or 'within' estimator. This implies the use of firm and time dummies in the regression equation or a regression on transformed variables. The transformed variable is given by

$$\overline{q}_{it} = \overline{q}_{it} - \overline{q}_i - \overline{q}_i + \overline{q}.$$

where

$\overline{q}_i = (I/T)^*, \Sigma q_{it}$

$\overline{q}_i = (I/N)^*, \Sigma q_{it}$

$\overline{q}_i = (I/NT)^*, \Sigma\Sigma q_{it}$

where i=1,2---N and t=1,2,---T

Since the 'effects' are swept out of the equation in this way, OLS estimation of the parameters from the transformed equation is consistent.

If the 'effects' are treated as random rather than fixed then for samples with large N and small T the GLS random effects estimator is more efficient than the within estimator. But the GLS estimator is inconsistent in the case of correlation effects. The choice of the model depends, therefore, on the existence of effects and correlation between effects and regressors. A Housman test is conducted to test whether the effects and regressors are correlated to determine whether a fixed effects or a random effects specification is preferred.

Estimation Method

OLS estimation of equation (4) provides the estimates of a + u_i, λ, á, β and γ

where

$$\lambda = \frac{\partial q_{it}}{\partial t}$$

since q_{it}=log Q_{it}, λ can be inter-preted as the rate of growth of output, with all inputs fixed, i.e. it is the rate of growth of output not explained by the growth of inputs which is nothing but the rate of growth of productivity.

$$\alpha = \frac{\partial q_{it}}{\partial l_{it}} = \frac{\partial \log Q_{it}}{\partial \log L_{it}} = \frac{\Delta Q_{it}}{\Delta L_{it}} * \frac{L_{it}}{Q_{it}}$$

Therefore, a can be interpreted as the elasticity of output with respect to labour i.e. percentage growth of output per one percent change in labour

employed. Similarly, β and γ can be interpreted as the elasticity of output with respect to capital and materials, respectively.

If we introduce a dummy variable such that D=1 for 1992 to 1996

= 0 otherwise

and consider the following regre-ssion

$q_{it}=a + u_i + \lambda t + \delta Dt + al_{it} + \beta k_{it} + \gamma m_{it} + v_{it}$

OLS estimate of δ provides an indicator of the effect of policy reforms after 1991 on the rate of growth of output.

Rate of growth of output for 1985-91 = λ

Rate of growth of output for 1992-96 = $\lambda + \delta$

Source of Data and Creation of Variables

The analysis for the Chemicals and Chemical products sector is done considering 34 compa-nies of the sector. The data for these companies is taken from Stock Exchange Official Directory which provides income statement and balance sheet data for the companies. The variables used for the analysis are generated from there.

Output : The data set contains observations for the net sales of the companies and the inventories for various years. The value of total output is obtained as the sum of net sales and the change in inventories. The index numbers of wholesale prices for the sector concerned are used to deflate the value of output obtained above to generate the real output variable (Q_{it}).

Capital : The balance sheet data provides information on net fixed assets held by the company. This is deflated by the capital formation index obtained from the NAS to obtain the real capital stock (K_{it}).

Labour : The income statement of the companies provides information on the wages and salaries paid by the companies for each year. An average wage indicator is obtained form the ASI (Total wage bill/number of workers). The labour employed by each company is then obtained by deflating the wages and salaries by the average wage indicator of the whole sector.

Material Inputs : The income state-ment of the companies provides information on the stocks consumed and direct manufacturing expenses. These are added together to obtain the value of materials consumed and then deflated by the index of industrial raw materials provided by the RBI to obtain the real value of the raw materials consumed.

V. RESULTS OBTAINED

For the equation: $q_{it}=a + u_i + \lambda_1 \delta d + al_{it} + \beta k_{it} + \gamma m_{it} + v_{it}$

The fixed effects, random effects and the Housman test results for 34 companies and 385 observations are given in Table 1.

Table 1: Fixed effects (within) regression (R^2 =0.68)

Output	Coefficient	Standard error	t
Trend	.02601	.00948	2.743
Dummy	-.01913	.00566	-3.382
Labour	.3161	.04672	6.765
Capital	-.01373	.019022	-0.722
Material inputs	.6747	.05049	13.362
Constant	.66799	.29539	2.261

The F-test for insignificance of all u_is show negative results i.e. all the u_is are independently and jointly significant (Table 2).

Table 2 : Random effects GLS regression

Output	Coefficient	Standard error	z
Trend	.02006	.008799	2.28
Dummy	-.01766	.0058021	-3.05
Labour	.11996	.0260074	4.61
Capital	.03392	.0144102	2.35
Material inputs	.79648	.0268558	29.66
Constant	.89279	.1581813	5.64

The random effects model assumes that the correlation between u_is and X is zero so we test with the help of a Housman test whether this assumption is correct. If the assumption is correct then the two models would provide nearly the same results.

The test shows significant difference between the results of the two models. Therefore, we would only consider the results of the fixed effect model which does not make any restrictive assumption.

From the results of the Fixed Effects model, we notice that the rate of growth of productivity declines in the 1990s after the reforms since the coefficient of the dummy variable is equal to – 0.01913 (which is negative). For understanding the reason for such a decline in productivity, let us consider some behaviour of the output for the whole sector. The rate of growth of output showed a decline from the 1980s (around 9 percent) to 1990s (around 4.9 percent). So we see a slow down in the rate of growth of output which can occur due to two reasons: shift of resources away from the sector, or decline in the productivity of the resources used.

VI. CONCLUSION

The results obtained indicate the following main points:

- There is a decline in the productivity growth rate in the

1990s after the reforms. The decline is by 1.9 percent and is significant.

- The elasticity of output with respect to labour is .3161 (and is significant), with respect to capital is -.01373 (insignificant) and with respect to raw materials is .6747 (significant). Raw materials seem to be the most significant component in the Chemicals industry since output is most sensitive to a change in material inputs.

If the rate of growth of output is declining due to a decline in productivity then it indicates that increased liberalisation is leading to a negative effect on productivity. One of the possible explanations can be that the indigenous producers do not get the right incentive to lower their costs (lowering of costs can be brought about by either better utilisation of resources or by an increase in productivity). This can be due to the following reasons:

- The (import) tariff rates remain invariably high so that the price of the imported goods remain high. As a result, the domestic producers can do away with lower productivity since they do not find the incentive to lower their per unit costs. Due to this the increased competition effect that is expected to arise with increased liberalisation cannot operate.
- The transport costs remain very high which again does not allow the true effect of competition to come in.
- The exchange rate also has to be appropriate, since with a devalued rupee the price of imports becomes very high which does not let the competition effect to operate.

Also due to the above reasons the exports cannot be increased since the per unit costs remain high and the indigenous producers cannot compete in foreign markets.

And if the output growth is declining due to a shift in resources away from the sector then the government would have to provide greater incentives for the producers to invest in the sector concerned. For the complete effect of liberalisation to be felt the government would have to see to it that the policy environment provides the right signals to the producers for lowering costs and the right incentives for improving produc-tivity. Then only would the link between liberalisation and productivity operate.

Appendix

List of Sample Companies

1	Astra IDL Ltd.
2	Atul Ltd.
3	Bharat Petroleum Corporation Ltd.
4	Cipla Ltd.
5	Cochin Refineries Ltd.
6	Colour-Chem Ltd.
7	Coromandel Fertilisers Ltd.
8	Cynamid India Ltd
9	Deepak Fertilisers & Petrochemicals Corpn. Ltd.
10	Excel Industries Ltd.
11	Fulford India Ltd.
12	Gujarat Alkalies and Chemicals Ltd.
13	Gujarat Narmada Valley Fertilisers Co. Ltd.
14	Gujarat State Fertilisers & Chemicals Ltd.
15	ICI India Ltd.
16	Indian Deystuff Industries Ltd.
17	Indian Oil Corporation Ltd.
18	Nagarjuna Fertilisers & Chemicals Ltd.
19	Ranbaxy Laboratories Ltd.
20	Reckitt & Colman of India Ltd.
21	Searle India Ltd.
22	Tata Chemicals Ltd.
23	Traspek Industries Ltd.
24	United Phosphorous Ltd.
25	Vam Organic Chemicals Ltd.
26	Zandu Pharmaceuticals Ltd.
27	Zuari Agro Chemicals Ltd.
28	Parke Davis
29	Glaxo India Ltd.
30	HLL
31	Procter & Gamble India Ltd.
32	Burroughs Wellcome India Ltd.
33	Alembic Chemical Works Ltd.
34	Pfizer Ltd.

References

Balakrishnan, P, K.Pushpangadan and M.Suresh Babu (2000), "Trade Liberalisation and Productivity Growth in Manufacturing: Evidence from Firm Level Panel Data", ***Economic and Political Weekly,*** October 7, 3679-3682.

Greene, W.H. (1993): ***Econometric Analysis,*** Second Edn., New York: Macmillan Publishing Company.

Hall, R.E. (1988), "The Relation Between Price and Marginal Cost in US Industry", ***Journal of Political Economy,*** 96, 921-47.

Krueger, A.O. (1998): "Why Trade Liberalisation is Good For growth?", ***Economic Journal,*** 108 (September), 1513-1522.

NAS (2000), ***National Accounts Statistics*** 1992 and 1998, Central Statistical Organisation, Government of India , New Delhi.

Reserve Bank of India(2000), ***Handbook of Statistics on the Indian Economy.***

Srivastava, Vivek (1996), ***Liberalisation, Productivity and Competition: A Panel Study of Indian Manufacturing,*** OUP, Delhi.

Srivastava, Vivek (1999): "Estimating the impact of liberalisation in India on Productivity, Efficiency and Competition: An approach", ***APO Productivity Journal,*** 49-71.

Srivastava, Vivek (2001), ***The Impact of India's Economic Reforms on Industrial Productivity, Efficiency and Competitiveness: A Panel Study of Indian Companies,*** Vol I, mimeo.

Stock Exchange Official Directory, 1985 to 1996.