CHAPTER SEVEN

TARIFF LIBERALISATION AND PRICE COMPETITIVENESS - AN ECONOMETRIC ANALYSIS[1]

7.1 Introduction

In chapter six the importance of distinguishing between the price of imports and the price of import substitutes is distinguished. The former is the price of imports at the border, whereas the price of import substitutes refers to the price charged by the domestic industry for similar goods. The distinction is important since importers may be highly concentrated with a result that tariff liberalisation may not necessarily put downward pressure on domestic prices. In this chapter an econometric analysis is undertaken of:

- the relationship between tariff changes and import prices, and
- the relationship between tariff changes and the price of import substitutes.

Sections 7.2 and 7.3 highlight some theoretical considerations pertinent to the analysis at hand. Section 7.4 outlines the methodology used in the econometric analysis. The econometric results are presented in section 7.5 while section 7.6 concludes.

7.2 Changes in Import prices

Empirical evidence suggests that macroeconomic conditions influence tariff policy (Bohara and Kaempfer, 1992; Das and Das, 1994; Hall, Kao, and Nelson, 1998; Henriques and Sadorsky, 1994; Krol, 1996; Thornton and Molyneux, 1997). The usual explanation is that political pressure for protection is strongly correlated with economic performance - protection rises with unemployment and decreases with economic growth (Sherman, 2002: 1). However, Irwin (1998) has shown that much of the variation in U.S. tariffs has

[1] I am greatly indebted to Professor Suzanne McCoskey of the US Naval Academy for valuable comments and assistance relating to the econometric tests used in this chapter. In addition Greg Farrel of the South African Reserve Bank provided valuable comments on an earlier draft of this chapter.

been due to changes in import prices rather than policy changes.[2] These results highlight the possibility that the link between macroeconomic fluctuations and tariffs identified in many studies may be due to price changes rather than from political pressure induced policy changes (Sherman, 2002).

Fluctuations in the prices of traded goods have attracted much attention in the empirical literature in recent times. The pass-through relationship between exchange rate fluctuations and traded goods' prices has been one of the focal areas of this attention. The consensus in the empirical work to date is that pass-through effects from exchange rate fluctuations to traded goods' prices tend to be incomplete – the so called “incomplete pass-through” phenomenon. This result has been particularly robust for import prices. Import prices do not fall (increase) by as much as the currency appreciates (depreciates) (Woo, 1984; Dornbusch, 1987; Krugman, 1987; Gagnon and Knetter, 1992; Menon, 1995b, 1999; Goldberg and Knetter, 1997).

The pass-through effects of changes in tariffs on import prices have also attracted some attention in the economic literature (albeit more limited than exchange rate fluctuations). Svedberg (1979) and Brander and Spencer (1984) argue that under monopoly conditions, a lowering of tariffs may be less than fully passed through to import prices. In addition, there may be a “terms of trade” justification for import protection, which is due to imperfect competition in the exporting country rather than to the traditional large import country case (Feenstra, 1989)[3].

In general, the empirical work has found that there is less than complete pass-through effects of exchange rate and tariff changes to import prices. Models of imperfect competition have been used to explain the incomplete pass-through effects. "Pricing to market” behaviour on the part of foreign suppliers may

[2] The *ad-valorem* effect of specific (per-unit) duties fell as import prices rose. With specific duties in the tariff schedule, average tariff rates changed with changes in import prices even though there was no explicit change in the tariff policy.

[3] Feenstra (1989) is the seminal contribution on tariff pass-through to import prices. This paper analyses the effect on US prices of tariffs and exchange rates on Japanese cars, trucks and motorcycles. The increase in US tariffs led to a decrease in Japanese export prices to the US, thus implying a terms-of-trade gain for the US.

account for destination currency prices not fully responding to changes in the nominal exchange rate and tariff rates. The ability of exporters to discriminate across markets ("price to market") depends on the type of the good (substitutability of the good) and the industry structure (degree of competition or strategic intervention in the market) (Goldberg and Knetter, 1997).[4]

One of the main justifications for a policy of tariff liberalisation is the impact it is meant to have on competitiveness. Tariff changes are seen as affecting competitiveness through their impact on import prices. The conventional argument is that, *ceteris paribus*, tariff liberalisation is expected to result in a reduction of prices.[5]

The relationship between tariffs and prices can be represented as in figure 7. As far as import prices are concerned, it is important to distinguish between final goods imports and intermediate goods imports. For simplicity, it is assumed that there is complete pass-through of tariff changes into import prices. In other words, the full reduction (increase) in tariffs is passed on to import prices.[6] Firstly, considering the case of intermediate imports, a reduction in tariffs will lead to a reduction in the prices of imported intermediate goods. This in turn reduces production costs, which in turn, will lead directly to improved price competitiveness, both in the domestic and international market.[7] Secondly, a reduction in tariffs will lead to a reduction in the prices of final imported goods. Under conditions of perfect competition, this should place downward pressure on the price of import competing products. The reduction in the prices faced by producers of import competing goods will promote efficiency gains in domestic production and/or force a reallocation of resources. Tariff liberalisation on both inputs and outputs has a positive impact on price competitiveness.

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[4] There is some controversy on the determinants of exporters mark-up in the long-run. See Goldberg and Knetter (1997) for a good summary of the issues. In general, it is assumed that the competitiveness in the market will be one of the more important determinants of the rate of mark-up (Hung et al, 1993, Hooper and Mann, 1989).

[5] The extent to which tariff liberalisation improves competitiveness depends on the extent of the pass-through effects of tariff changes to import prices.

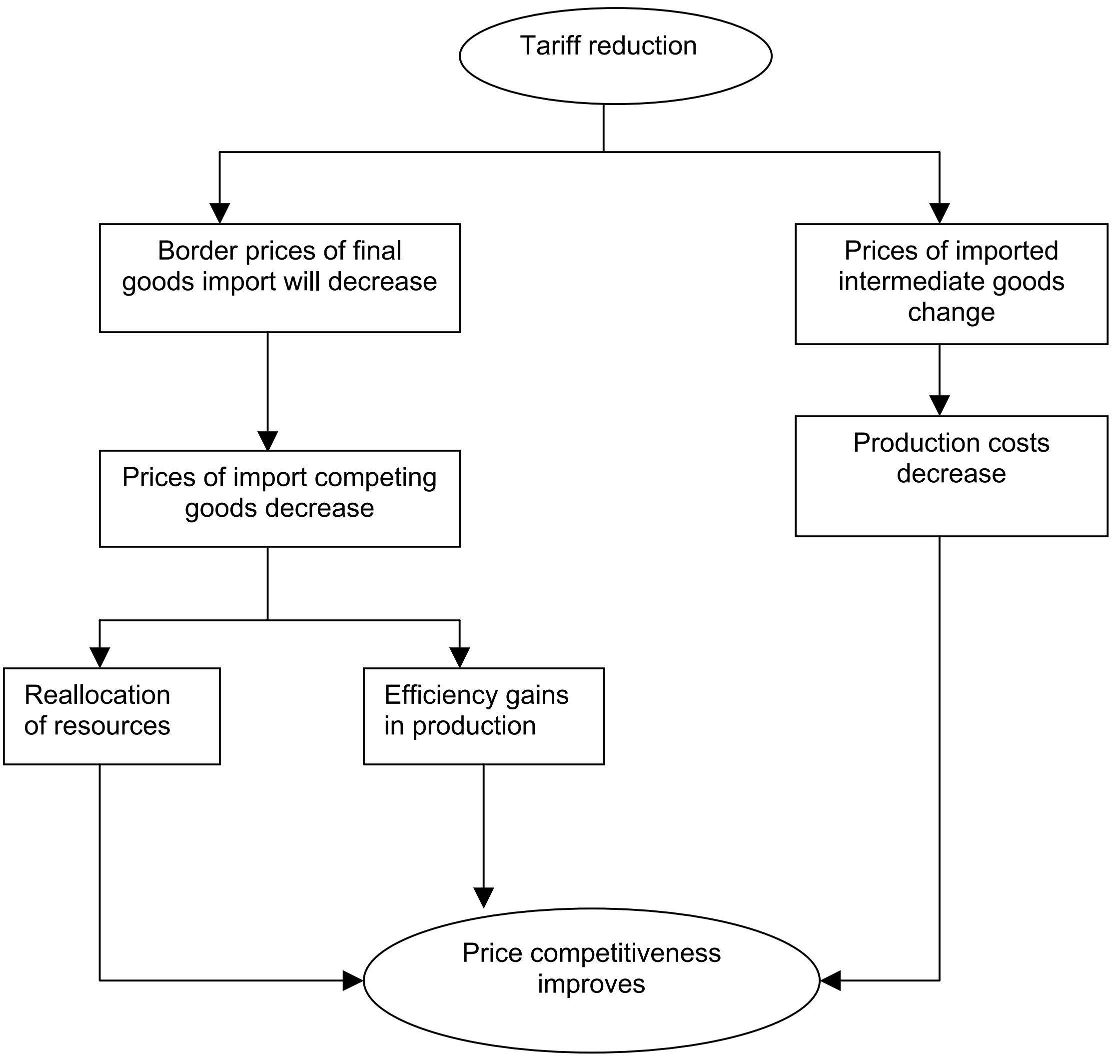
[6] The different pass-through effects are elaborated upon later on in this chapter.

[7] In this case, the impact on production costs will depend on the share of intermediate inputs in production costs.

From figure 7 it is apparent that the impact of tariff liberalisation on competitiveness depends on the various pass-through effects of tariff changes to import prices. In summary, South Africa's manufacturing liberalisation policy will be appraised by considering:

- Firstly, the pass through effects from tariff changes to import prices at the border.
- Secondly, the impact of border import prices on the price of importables, and finally,
- The impact of tariff liberalisation on input costs.

Figure 7: The effect of a tariff reduction on import prices



7.3 The relationship between tariff changes and the prices of imports, importables and input costs.

In this section, the models that will inform the empirical analysis of South Africa's tariff liberalisation policy during the 1990s are set out.

7.3.1 Relationship between tariff changes and import prices[8]

Starting from the purchasing power parity doctrine with no transport, distribution costs and tariffs, one gets:

$$P = P^w E \qquad (26)$$

where P = import prices in domestic currency (P_t) in time period t,

P^w = world price in time period *t* in foreign currency, and

E = exchange rate quoted as Rands per unit of foreign currency.

The implication is therefore that the same traded good will sell at the same price when expressed in a common currency in different destinations. However, if one now assumes the existence of tariffs, then equation (26) translates into

$$P = P^w E(1+T) \qquad (27)$$

where T = tariff rate.

The long-run relationship can be estimated from a log-linear transformation of equation (27) which allows for a constant (α_1):

$$LP = \alpha_1 + \overset{(+)}{\alpha_2} LP^w + \overset{(+)}{\alpha_3} LE + \overset{(+)}{\alpha_4} L(1+T) + \varepsilon \qquad (28)$$

where ε is the stochastic error term, and α_2 is the elasticity measure for foreign prices. In addition, α_3 and α_4 are the conventional pass through estimates for exchange rate and tariff changes to import prices.[9] The expected signs of the coefficients are reflected above the variables in

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[8] Domestic import prices refer to the price of imports at the border.

[9] See Feenstra (1989) for a similar specification.

equation (28). Under the small country assumption with perfect competition, importers would be price takers and world price (P^w), exchange rate (E) and tariff changes $(1+T)$ should be fully absorbed into domestic import prices $(\alpha_2 = \alpha_3 = \alpha_4 = 1)$. However, where the coefficients are less than unity ($0 \leq \alpha_2, \alpha_3, \alpha_4 \leq 1$), this implies that foreign exporters hold some degree of market power and can therefore independently influence domestic currency prices. If α_4 is less than unity (α_4<1), this implies that the full effects of the tariff change have not been passed on to prices.

As far as the tariff factor $(1+T)$ is concerned, a rise (decrease) in tariffs is expected to lead to an increase (decline) in the domestic price of imports (P). The rate of influence depends on the magnitude of the coefficient α_4. *Ceteris paribus*, tariff liberalisation having the desired effect of improving competitiveness would entail α_4 being significant and close to 1.[10]

7.3.2 Impact of import prices on the prices of import substitutes

As mentioned earlier, it is necessary to test the impact of import prices at the border on the price of importables (i.e. the price charged by domestic industry). Drawing on the theory of industrial organisation and a simple mark up model, results in domestic or importables prices (P_d) being a constant mark-up $(1+m)$ over unit costs (*u*).[11] Mark-up models are beneficial in the sense that it can be used under conditions of imperfect competition (Eichner, 1973; Lovoie, 1996) and have been extensively used in the empirical literature to analyse price competitiveness (see Hooper and Mann (1989); Athukorala, 1991; Swift , 1998). [12] A simple mark-up model can be represented as:

$$P_d = (1+m)*(u) \qquad (29)$$

[10] However, as pointed out in the previous section, this would also depend on the extent to which the border price of imports influences the price of import competing domestic production (prices charged by domestic industry).

[11] See Hooper and Mann (1989); Athukorala (1991); Swift (1998) for applications of mark-up models within the context of evaluating price competitiveness.

[12] Under conditions of perfect competition price equals marginal cost. However, under conditions of imperfect competition and a downward sloping demand good, price will exceed marginal cost.

Both the mark-up and unit costs are expected to be positively correlated with domestic prices - increases (decreases) in their levels would cause domestic prices to increase (decrease). Stated differently, price competitiveness is influenced by two factors, namely, the extent of the mark-up and the level of unit costs.

Assuming that the mark-up $(1+m)$ is influenced by the magnitude of price and quantity competition from abroad as well as movements in the domestic aggregate price level in general (Chand and Sen, 1998). It is to be expected that the price of imports in domestic currency $(P\ )$ would be positively correlated with the mark-up coefficient (Athukorala and Menon, 1994). In addition, an increase in imports as a share of domestic demand (I) is expected to exert downward pressure on the level of mark-up.[13] Further, the aggregate price level (c) is expected to be positively correlated with the level of mark-up .[14]

Algebraically this can be expressed as :

$$(1+m) = f(P\ , I, c) \text{ ....(30)}$$

Substituting for $(P\ )$ from (27) gives:

$$(1+m) = f[P^{w}E(1+t), I, c] \text{ ....(31)}$$

Substituting for $(1+m)$ in equation (29) and considering a log transformation that allows for a constant (β_0) gives:

$$\begin{array}{l} \qquad\qquad (+) \qquad\quad (+) \qquad\quad (+) \qquad\qquad\quad (+) \qquad (+) \qquad (-) \\ LP_d = \beta_0 + \beta_1 LP_t^w + \beta_2 LE + \beta_3\ L(1+t) + \beta_4 Lc + \beta_5 Lu + \beta_6 LI + \varepsilon_t \text{ ....(32)} \end{array}$$

Equation (32) reflects the main determinants of the domestic price of import substitutes. β_1 captures the influence of foreign prices on domestic prices.

[13] In terms of the terminology used earlier, the world (import) prices in domestic prices is given by the border price of imports.

[14] The movement in the price level is taken to reflect domestic economic conditions. Domestic producers are likely to increase prices if the general price level increases.

The elasticity measures for changes in exchange rates and tariff rates are represented by β_2 and β_3 respectively.[15] Ideally, one should also include a measure of industry concentration in the specification of equation (31) but a suitable measure or a proxy is not available on a time series basis. However, some inferences can be drawn from β_2 since it gives an indication of the extent of import parity pricing prevalent in the economy.[16] Import parity pricing behaviour could be an indication that some form of monopoly practice is prevalent. β_4 captures the effect of domestic economic conditions on prices. Finally, β_5 and β_6 reflect the influence of unit costs and import quantity on the price of importables. The expected signs are reflected above the coefficients.

7.3.3 Impact of tariffs on input costs

It should be noted that β_2 and β_3 in equation 31 capture the "indirect effects" of exchange and tariff influences on domestic prices.[17] The "direct effects" of exchange rate and tariff changes influence domestic prices through their impact on imported input costs.[18] Imported inputs form part of unit costs *(u).* The cost variable *(u)* comprises domestic input costs (u_d) and imported input costs (u_i). This is given by:

$$u = u_d + u_i \quad \text{......(33)}$$

$$u = u_d + [P^{wi} * E * (1+t)] \quad \text{......(34)}$$

where $u_i = P^{wi} * E * (1+t_i)$

P^{wi} = world price of imported inputs

t_i = tariff on inputs

Considering a log transformation of 34 gives:

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15 In this case, β_3 captures the effect of the tariff on the price of import substitutes whilst in equation 28, α_4 captures the effect on the price of imports at the border.

16 A high value of β_2, for example, would indicate high pass-through effects for exchange rate changes which in essence means that the price of import substitutes is greatly influenced by exchange rate changes.

17 In a theoretical sense, the change in output tariff is expected to lead to reduced import prices, X-efficiency effects and finally, to reduced prices. It is for this reason that the effect of output tariffs are termed "indirect" effects.

18 Since the change in input tariffs impact directly on production costs, it is referred to as "direct" effects.

$$\begin{matrix} & + & + & + & + \\ Lu = \gamma_0 & +\gamma_1 Lu_d & +\gamma_2 LP^{wi} & +\gamma_3 LE & +\gamma_4 L(1+t_i) + \varepsilon_t \end{matrix} \qquad (35)$$

where the coefficients γ_1 γ_2, γ_3 and γ_4 measure the effect of changes in domestic input costs, world prices, exchange rates and tariffs on unit costs respectively.

7.4 Data and methodology used in the analysis

Before reporting the results, the data and methodology used in the econometric tests is briefly explained.

7.4.1 Data used in estimation

The period of analysis extends from 1990 to 2001. Due to data constraints relating to suitable proxies for world prices, 25 manufacturing industries were considered in the analysis (see table 14).[19]

Table 14: Manufacturing industries considered in analysis

Industries	SIC (version 5)
Food	301-304
Beverages	305
Tobacco	306
Textiles	311-312
Wearing apparel	313-315
Leather and leather products	316
Footwear	317
Wood and wood products	321-322
Paper and paper products	323
Printing, publishing and recorded media	324-326
Basic chemicals	334
Rubber products	337
Plastic products	338
Glass and glass products	341
Non-metallic minerals	342
Basic iron and steel	351
Basic non-ferrous metals	352
Metal products excluding machinery	353-355
Machinery and equipment	356-359
Electrical machinery and apparatus	361-366

[19] These 25 sectors were the major contributors to manufacturing GDP, accounting for 86 percent (87 percent) of GDP in 2001(1990).

Table 16: Manufacturing industries considered in analysis (continued)

Professional and scientific equipment	374-376
Motor vehicles, parts and accessories	381-383
Other transport equipment	384-387
Furniture	391
Other manufacturing	392-393

Source: TIPS database

The exchange rate is the nominal effective exchange rate expressed as the number of domestic currency units per foreign currency and was obtained from the South African Reserve Bank.[20] The world price (P^w) was proxied by the US producer price index (PPI) of the relevant sector and was sourced from the Bureau of Labour Statistics. Import prices (P_i) were sourced from the standard industrialisation classification database housed at TIPS.[21] The price of import substitutes (P_d) is given by the GDP deflator of the respective industries. The US producer price index of the relevant sector (P^w) was used as a proxy for the world price of imported inputs (P^{wi}).[22] In addition, t and t_i represent the tariff collected on output and inputs.[23] Unit cost (u) is derived

[20] An increase in the index depicts a depreciation. The four currency NEER was used since manufacturing imports are predominantly invoiced in these currencies.

[21] Unless otherwise stated all data were sourced from the standard industrial classification database housed at TIPS. P_t is based on the PPI for imported commodities.

[22] The implicit assumption here is that world intermediate input prices increased at the same rate as those for world final goods prices. Given the structure of the US economy this was considered not an unrealistic assumption.

[23] t_i was derived from the effective rate of protection (ERP) formula. Considering a linear relationship between inputs and outputs with a_{ij} the input-output coefficient for the i^{th} input used in the production of the j^{th} output. In addition if the nominal tariff level on *j* is given by t_j, nominal tariff on input *b* by t_b and the share of inputs *b* in the costs of j without tariffs by $\sum_b a_{bj}$, then the effective rate of protection (ERP) is given by:

$$ERP = \frac{t_j - \sum_b a_{bj} t_i}{1 - \sum_b a_{bj}}$$

From the above equation the tariff on inputs (t_i) for *j* is given by:

$$t_i = \frac{\sum_b a_{bj} t_b}{1 - \sum_b a_{bj}}$$

by considering total intermediate input costs as a ratio of industry GDP at constant prices (Chand and Sen, 1998).[24] Foreign competitive pressure (I) is proxied by the import penetration ratio (i.e. imports as a share of domestic demand). The GDP deflator for the manufacturing sector was used as a proxy for general price level (c).

7.4.2 Methodology

In this study, panel data estimations for the manufacturing sector are undertaken. The application of estimation methods, which exploit panel data techniques, has increased in prominence in both the theoretical and empirical economic literature. This popularity is in part due to the increased availability of data of this type, as well as, the potential of panel data studies to answer questions not possible either from a cross-section or within a pure time series context.[25]

It is important to investigate the stochastic properties of the data in order to ensure that correct inferences are made. The use of panel unit root and cointegration tests enables one to determine the long-run impact of tariff liberalisation on price competitiveness. The analysis of unit roots and cointegration in panel data has now become standard practice following the seminal contributions by Levin and Lin (1992, 1993) and Quah (1994).[26] In the sections that follow, the tests that were used are first outlined after which the results of the tests are reported.

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[24] The data is at constant 1995 prices. Similarly, domestic input costs (u_d) and imported intermediate costs (u_i) are proxied by the ratio of domestic input costs and imported input costs as a ratio of industry GDP at constant prices respectively.

[25] In the South African context, it is acknowledged by the customs authorities that trade data preceding 1992 (and especially pre-1990s) is not very reliable. The unreliability is due to poor customs records, as well as, a significant proportion of South Africa's trade being unclassified during the sanctions era. The short period since 1990 thus increases the attractiveness of panel estimations of South Africa's trade relations or patterns.

[26] These developments have followed similar advancements in time series analysis. Given that the variables may be non-stationary, levels regressions may give rise to the familiar spurious regression problem. In the context of I(1) variables, modelling in levels is justified if the level variables are able to form a cointegrating vector.

7.4.2.1 Unit root test

Im, Persaran and Shin (1997) have developed an Augmented Dickey-Fuller (ADF) type unit root test that increased the power of univariate unit root tests by exploiting the panel structure of the data.[27] The test is valid in the presence of heterogeneous cross sectional units for the null of non-stationarity. The Im, Persaran and Shin (IPS) test is based on the ADF test[28]:

$$\Delta y_t = \alpha + \delta_t + \rho y_{t-1} + \sum_{j=1}^{p} y_j \Delta y_{t-j} + \upsilon_t \quad (36)^{29}$$

where ρ denotes the number of lags.

The basic issue with panel data is how to combine information on stationarity or non-stationarity for each individual cross-section into a conclusion about the panel as a whole (McCoskey and Kao, 1999: 675). Assuming that the cross-sections are independent, the IPS test combines information by averaging the individual ADF t-statistics and is given by the following equation:

$$\Psi_{\bar{t}} = \frac{\sqrt{N}(\bar{t}_{N,T} - E[\bar{t}_{N,T}(p,0)]}{\sqrt{Var(\bar{t}_{N,T})}} \Rightarrow N(0,1), \quad (37)$$

where $\Rightarrow$ denotes convergence in distribution, $\bar{t}_{N,T} = (1/N)\sum_{i=1}^{N} t_i$, t_i is the t-statistic for the OLS estimate of p in equation 36 for the *i*th unit of the cross-section, and $E[\bar{t}_{N,T}(p,0)]$ is taken under the null hypothesis $\rho_i = 0$ for all *i* and with the choice of $\rho = (\rho_1, \rho_2, \ldots, \rho_i, \ldots, \rho_N)'$ of the lag-length vector for the regressions unit by unit in equation 3. $\Psi_{\bar{t}}$ can be compared to critical values for a one-sided N(0,1) distribution. The moments of $\bar{t}_{N,T}$ depend on the

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[27] Im et al (1997) modified the simple panel root tests developed by Levin and Lin (1992, 1993). Maddala and Wu (1999) have addressed some of the shortcomings in these tests by addressing the issue of unbalanced panels and choice of lag lengths in the ADF regressions. However, since a balanced panel is available, these concerns do not apply and the Im et al (1997) tests are used.

[28] See McCoskey and Kao (1999) and Baltagi (2001) for a more detailed exposition of the test.

[29] In the empirical analysis it is assumed that the individual series do not contain a trend. In this case the equation is given by: $\Delta y_t = \alpha + \rho y_{t-1} + \sum_{j=1}^{p} y_j \Delta y_{t-j} + \upsilon_t$.

number of time series observations and the appropriate lag order (ρ_i) for each cross-section.

Under the null hypothesis of a unit root this statistic has a standard normal distribution and is valid in the presence of heterogeneity across industries as well as residual serial correlation across time periods.[30] As it is a one-sided test, a statistic less than –1.645 rejects the null of non-stationarity at the 5 percent level.[31] Results for IPS unit root tests for all the variables used in the analysis are contained in Table 15.

Table 15: Unit Root tests

Description of variables	**Variable**	**IPS**
Log(Import prices)	LP_i	9.697
Log(prices of import substitutes)	LP_d	-3.962*
Log(World Prices)	LP^w	-2.115*
Log(Tariff factor-final goods)	$L(1+t)$	-2.103*
Log(Exchange rate)	LE	20.587
Log(Unit Cost-total)	LU	-2.697*
Log(Imports as a share of domestic demand)	LI	-1.157
Log(Price of Importables)	LP_d	-3.962*
Log(Domestic economic conditions)	LC	-5.240*
Log(Unit Cost-domestic)	LU_d	-1.731*
Log(Tariff on inputs)	$L(1+t_i)$	0.207

Notes: *significant at the 5% level (critical value is -1.645) and the sample period 1990 to 2001.

Source: Own calculations.

The variables import prices (LP_i), exchange rate (LE), share of imports (LI) and tariff on inputs [$L(1+t_i)$] are all I(1) while all the other variables are stationary.

[30] Under the alternative of stationarity, the statistic diverges to negative infinity.
[31] It was assumed that none of the individual series in the model contains a trend, i.e. in terms of equation 11, δ_t=0.

7.4.2.2 Cointegration tests

Rejection of the null of nonstationarity implies that cointegration tests for panel data have to be undertaken. Following the methodology proposed in McCoskey and Kao (2001) cointegration tests were undertaken. However, it is important to ensure that the regressors themselves are not cointegrated (McCoskey and Kao,1999).[32] If cointegration exists between the dependent and independent variables (but not among the independent variables), then an error correction model (ECM) should be estimated. An advantage of the ECM is that it incorporates an error correction term (ECT) that reflects the dynamics leading to the long-run equilibrium position. In the ECM, the cointegrating vectors give the long-run relationship while the coefficient of the ECT depicts the short-run adjustments to the long run equilibrium position. If the data are not cointegrated then, the panel VECM reduces to a VAR in first differences.

The test results for cointegration amongst the variables used in equations (28), (32), (35) are reflected in table (16).[33]

Table 16: Cointegration test results

Equation	Variables	ADF	PP
Equation 28	LP, LE, LP^w, L(1+T)	-5.884	-7.964
	LE, LP^w, L(1+T)	2.662	4.447
Equation 32	LP_d, LE, LP^w, L(1+T), Lc, Lu, Ll	6.519	-10.668
Equation 35	Lu, Lu_d, LP^w, LE, $L(1+t_i)$	7.368	-7.102

Notes: A value less than the one sided critical value of 1.645 rejects the null of no cointegration at the 5% level of significance.
Source: Own calculations

7.4.2.3: Fixed effects and poolability

Test results for the joint significance of the fixed effects and poolability tests are reported in Table 17. The joint significance of the fixed effects was tested by the following *F-test* described by Baltagi (2001: 14):

$$F_0 = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT-N-K)} \overset{Ho}{\sim} F_{N-1,N(T-1)-K} \qquad \text{..............................(38)}$$

[32] If the regressors are cointegrated then this would require that the model be re-specified.

The restricted sums of squares (RRSS) was obtained from the OLS on the pooled model and the unrestricted residual sums of squares (URSS) was obtained from the LSDV regression, where K is the number of regressors, N is the number of cross sections and T is the number of years. The null of no individual effects was rejected at the 5 percent level of significance for all the equations.

The following test statistic described by Baltagi (2001: 53) was applied to test for poolability of slopes allowing for varying intercepts under the assumption that $\mu \sim N(0,s^2 I_{NT})$[34]:

$$F_{obs} = \frac{(e'e - e'_1e_1 - e'_2e_2 - \cdots - e'_N e_N)(N - I)K'}{(e'_1e_1 + e'_2e_2 + \cdots + e'_N e_N)/N(T - K')} \qquad \text{.................................(39)}$$

Under H_o, F_{obs} is distributed as F((N - 1)K′, N(T - K′)). Hence the critical region for this test is defined as:

$$\{Fobs > F((N-1)K', NT - NK'; \alpha_o)\} \qquad \text{...(40)}$$

where α_0 denotes the level of significance of the test, K is the number of regressors, N is the number of cross sections and T is the number of years.

The URSS was obtained from summing the RRSS from the 25 individual industry OLS regressions, while the RRSS was obtained from the LSDV model. With the exception of equation (28), the null of poolability was rejected at the 5 percent (but not at the 1 percent) level of significance for equation (26) (see table 17 below).[35]

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33 The significance of these results are explained when the results of the model are presented in the sections that follow.

34 In this case, H_0 represents the null of poolability (i.e. all slopes are the same across cross sections).

35 However, this is not considered to be a major problem, since it is quite common to estimate pooled models even though the null of poolability is rejected (Baltagi and Griffin, 1997: 308).

Table 17: Tests for Poolability and Fixed Effects

Poolability test		Fixed effects test	
Equation	**Test statistic**	**Equation**	**Test statistic**
Equation no 28	1.46	Equation no 28	4.95
Equation no 32	0.69	Equation no 32	3.98
Equation no 35	1.29	Equation no 35	6.13
Critical value		Critical value	
(1%)	1.48	(1%)	1.89
(5%)	1.32	(5%)	1.57
10%)	1.24	(10%)	1.42

Source: own calculations.

7.5 Estimation Results

As pointed out earlier, estimates will be done of the effect of tariff changes on:

7.3.4 final good imports at the border,

7.3.5 prices of importable goods, and

7.3.6 input costs.

All the equations were estimated by the fixed effects (FE) least squares or least squares dummy variables (LSDV) method by making use of the *EVIEWS* software package.[36]

7.5.1 Tariff changes and import prices at the border

In this case, equation (28) provides the required estimates. Given that some of the variables are non-stationary (see table 15), tests for cointegration amongst the variables were undertaken. The results of the cointegration tests are reported in table 16. Firstly, in terms of the entire model, the null of no cointegration was rejected.[37] Having confirmed the existence of cointegration, an error correction model (ECM) is estimated.

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[36] An advantage of using fixed effects estimation is that it allows for intrinsic differences, for example, in the growth of mark-ups (say, due to technological progress or changes in the elasticity of demand) across industries (Chand and Sen, 1998: 8).

[37] Tests for cointegration amongst the regressors were also undertaken and it was found that the null of no cointegration could not be rejected. However, since there was only one I(1) variable (LE) amongst the regressors there was really no need to test for cointegration amongst the regressors. However, the test serves to reinforce the results of no cointegration amongst the regressors.

The methodology employed here is similar to that used in Gagnon and Knetter (1995).[38] The Engle and Yoo (1991) three-step technique includes an additional step to the Engle and Granger (1987) two-step estimation technique. The three-step procedure addresses two specific shortcomings associated with the two-step Engle and Granger estimation procedure, namely:

- The static regression gives consistent (but not fully efficient) estimates of the cointegrating vector, and
- Since the distribution of the estimators of the cointegrating vector provided by the static regression is generally not normal, no inference can be made about the significance of the parameters.

In summary, the three step Engle and Yoo estimation technique involves:

- Step 1 estimates the long-run equation in levels.

  $$LP_{it} = \alpha_1 + \alpha_2 LP_{it}^{w} + \alpha_3 LE_t + \alpha_4 L(1+t_t) + \varepsilon_t$$

  where ε_t is the residual.

- Step 2 estimates an error correction model that takes the form of a dynamic model using the residuals from the long-run equation in step 1 to impose the long-run constraints. This is given by:

  $$\Delta LP_{it} = \beta_1 LP_{it}^{w} + \beta_2 \Delta LE_t + \beta_3 L(1+t_t) + \beta_4 \Delta LP_{i(t-1)} + \beta_5 LP_{i(t-1)}^{w} + \beta_6 \Delta LE_{t-1} + \beta_7 L[1+t_{(t-1)}] + \beta_8 \varepsilon_{t-1} + \mu_t$$

- Step 3 regresses the residuals (μ_t) obtained in step 2 against the regressors ($LP_{it}^{w}, LE_t, L(1+t_t)$) multiplied by the inverse of the coefficient of the residual (-β_8) obtained under step 2. This is given by:

  $$\mu_t = \lambda_1(-\beta_8 LP_{it}^{w}) + \lambda_2(-\beta_8 LE_t) + \lambda_3[-\beta_8 L(1+t_t)] + \upsilon_t$$

  The corrected estimates are calculated as follows:

  - Exchange rate $(\omega_1) = \lambda_2 + \alpha_3$

[38] Gagnon and Knetter (1995) use the Engle and Yoo three step technique to obtain long-run estimates for mark-up adjustment and exchange rate fluctuations for automobile export prices for the USA, Germany and Japan.

- Tariff rate $(\omega_2) = \lambda_3 + \alpha_4$
- World price $(\omega_3) = \lambda_1 + \alpha_2$

The standard errors for the corrected estimates $(\omega_1, \omega_2, \omega_3)$ are given by the standard errors under step three for $\lambda_2, \lambda_3, \lambda_1$ respectively.

The LSDV regression results for equation (28) using the Engle-Yoo three-step procedure are reported in table 18. The first step long-run estimates show that all the coefficients are significant and have the correct signs. In addition, the F-statistic does not raise any concerns about the overall specification of the model while the adjusted R^2 statistic shows that the variables account for approximately 89 percent of the variation in import prices. In the second step, an error correction model (ECM) is estimated that incorporates the lagged dependent and independent variables. The ECM facilitates an investigation of both long-run and short-run dynamic relationships. The coefficient of the error correction term (ECT) measures the short-run adjustments towards the long-run equilibrium position. The coefficient has a value of -0,23 and is highly significant. This suggests that import prices adjust to correct about 23 percent of any disequilibrium in the long-run relationship each year.

Finally, the adjusted coefficients and t-statistics are reflected under step 3. It is these statistics that are of primary importance. All the coefficients have the expected signs and they are all significant. The results indicate that in the long run, the pass-through effect of tariff changes to import prices is around 85 percent, implying that with a 10 percent reduction (increase) in tariffs, import prices decrease (increase) by 8.5 percent. Similarly, approximately 88 percent of world price changes are passed onto domestic currency import prices. The pass-through effect of exchange rate changes is slightly lower at 67 percent.[39]

[39] Given that oil imports are excluded from this estimation it is not surprising that the pass-through effect of exchange rate changes (0.67 percent) for manufacturing imports is slightly lower than those obtained in other recent studies. Nell (2000) obtains an estimate of 0.82 using quarterly data, while Rangasamy and Farrell (2002) obtain an estimate of 0.78 using monthly data for total imports.

Table 18 : Pass-through effects to import prices using the Engle and Yoo three step procedure

Variable	Coefficient	Std. Error	t-Statistic
STEP 1 **Long run equation**			
Dependent variable $L(P_i)$			
L(E)	0.954	0.026	36.499**
$L(P^w)$	0.241	0.110	2.200**
L(1+T)	0.941	0.247	3.810**
R-squared Adjusted R-squared F-statistic Prob(F-statistic)	0.896 0.886 86.684 0.0		
STEP 2 **Error Correction Model**	**Coefficient**	**Std. Error**	**t-Statistic**
Dependent variable: $\Delta L(P_i)$			
ΔL(E)	0.112	0.054	2.074**
$L(P^w)$	0.264	0.067	3.940**
L(1+T)	0.631	0.200	3.154**
ECT	-0.228	0.037	-6.058**
$\Delta L[(P_i)(-1)]$	0.328	0.071	4.607**
Δ (LE(-1))	-0.315	0.121	-2.593**
L(1+T(-1))	-0.669	0.201	-3.323**
R-squared Adjusted R-squared F-statistic Prob(F-statistic)	0.581 0.493 4.328 0.0		
STEP 3 **Adjusted coefficients**	**Coefficient**	**Std. Error**	**t-Statistic**
Dependent variable $L(P_i)$			
L(E)	0.676	0.059	11.517**
$L(P^w)$	0.878	0.250	3.508**
L(1+T)	0.847	0.335	2.526**

Notes: 1. Δ represents the first-difference operator and (-1) indicates a one period lag
2. Industry-specific fixed effects are not reported
3. ** indicates significant at the 5 percent level

Source: Own calculations.

The significance of this result is that the major proportion (around 85 percent) of tariff changes had filtered through to import prices during the 1990s. In the case of South Africa, this means that the major part of the tariff reduction during the 1990s has been passed onto import prices. The question of relevance, however, is whether the reduced import prices had any influence on the prices charged by domestic industry. This is the focus of the next section.

7.5.2 Tariff changes and prices of import substitutes

In order to ascertain the impact of tariff changes on the prices of import substitutes, equation (31) is estimated which is given by:

$$LP_d = \beta_0 + \beta_1 LP_t^w + \beta_2 LE + \beta_3 \ L(1+T) + \beta_4 Lc + \beta_5 Lu + \beta_6 LI + \varepsilon_t$$

Once again, tests for cointegration were conducted but it was found that in terms of the ADF test, the null of no cointegration could not be rejected, but in terms of the Phillips-Perron test the null was rejected (see table 16). Proceeding to estimate an error correction model, it is found that the error term is insignificant which prompts the acceptance of the results of the ADF test of no cointegration.[40] In this case the I(1) variables are differenced and estimated using OLS which gave the results depicted in table 19.

Table 19: Pass-through effects of tariff changes to prices of domestic industry

Variable	Coefficient	Std. Error	t-Statistic
Dependent variable: $L(P_d)$			
ΔLI	-0.042	0.040	-1.041
LU	0.457	0.029	15.789**
ΔLE	1.046	0.160	6.555**
LP^w	0.660	0.093	7.125**
$L(1+T)$	0.234	0.239	0.981
ΔLC	1.209	0.243	4.979**
R-squared	0.840		
Adjusted R-squared	0.820		
F-statistic	42.571		
Prob(F-statistic)	0.0		

Notes: 1. Δ represents the first-difference operator and (-1) indicates a one period lag
2. Industry-specific fixed effects are not reported
3. ** indicates significant at the 5 percent level

Source: own calculations.

Both R^2 and adjusted R^2 suggest that the identified variables account for over 80 percent of the variation in import prices. All the variables also have

[40] Monte Carlo simulations have shown that the Phillips-Perron nonparametric tests may be less reliable than the ADF tests when there is a predominance of negative autocorrelations in first-differences (Maddala and Kim, 1998: 81).

the expected signs. In the case of the price of import competing goods (P_d), the import tariff variable is now insignificant implying that tariff changes have not exerted any direct influence on the prices charged by domestic industries. It should be noted that the tariff changes referred to in this case refer to the tariff on final goods. What this implies is that pricing behaviour of domestic producers has not been influenced by the tariff liberalisation on final goods. In addition, it is also interesting to note that the rate of growth in import volumes (ΔLI) do not influence the prices charged by domestic producers.[41] In other words, rising imports have not forced domestic producers to reduce prices. This result is somewhat surprising and suggests the possibility that:

- There could be deliberate collusion between importers and domestic producers.[42]
- Alternatively, importers may have increased their profit margins with a result that there was not much increase in (price) competition from imports in the domestic market arising from tariff liberalization.
- It could also be the case that distribution (transport) costs may play a significant role in the retail price of import goods. In this case, it could be that the tariff liberalisation effects were outweighed by increased transport costs. This aspect warrants further research particularly in the light of recent international evidence that transport costs play an important role in the price of tradables.

The coefficient of the exchange rate implies that the rate of change (i.e. appreciation or depreciation) in the exchange rate is completely passed onto domestic prices. In other words, a 10 percent increase in the rate of depreciation (appreciation) results in a 10 percent increase (decrease) in importables prices. This suggests that domestic prices are highly sensitive to exchange rate changes. About 66 percent of world price changes are passed onto the prices of domestic products. In addition, the rate of increase in the

[41] Since the first difference in logarithms is approximately the percentage change in the variable then, dlog(I) refers to the rate of growth in import penetration. The econometric results suggest that the increase in the rate of growth in import penetration during the 1990s has not significantly influenced the prices charged by domestic industry.

[42] It could be the case that high prices are maintained in order to protect the interests of both domestic producers and importers.

general price level (ΔLU) is also a significant determinant of prices charged by domestic industry. This indicates that domestic producers increase their prices as the aggregate price level increases.

For every 10 percent increase in unit costs, domestic prices increases by 4.6 percent. However, as pointed out earlier, tariffs on inputs also influence unit costs. The next section focuses on an estimation of the impact of tariff changes on imported inputs.

7.5.3 Tariff changes and input costs

The estimating equation is given by equation (35) above, namely:

$$Lu = \alpha_0 + \alpha_1 Lu_d + \alpha_2 LP^{wi} + \alpha_3 LE + \alpha_4 L(1+T_i)$$

where T_i = tariff on inputs

In terms of the ADF test the null of no cointegration could not be rejected (see table 7.2). The results are reflected in table 20 below.

Table 20: Tariffs and input costs

Variable	Coefficient	Std. Error	t-Statistic
Dependent variable: Lu			
ΔLE	1.744	0.313	5.569**
LP^{w}	1.184	0.165	7.194**
$\Delta L(1+T_i)$	1.174	0.581	2.015**
LU_d	0.349	0.050	7.025**
R-squared	0.582		
Adjusted R-squared	0.538		
F-statistic	13.455		
Prob(F-statistic)	0		

** indicates significant at the 5 percent level

Source: Own calculations.

The econometric results indicate that imported input costs have been strongly influenced by changes in world prices, exchange rates and tariff rates. Every 10 percent increase in the rate of tariff liberalisation results in a 12 percent decrease in unit costs. This suggests that tariff liberalisation did have the intended effects of reducing input costs and improving competitiveness. The exchange rate coefficient implies that a 10 percent increase in the rate of change in the exchange rate resulted in a 17 percent change in input costs. The high pass-through effects of exchange rate changes may be due to expectations about the exchange rate volatility being an important factor in international trade contract pricing.[43] There is also complete pass-through from world prices to domestic input costs. On the other hand, domestic input costs have subdued effects on total input costs with every 10 percent increase (decrease) in domestic input costs resulting in a 4 percent increase (decrease) in total input costs.

Just over 50 percent of the variation in unit costs is captured by the variables. This is on the low side and could be due to the proxy variables used in the estimation not being ideal. In addition, intuition suggests that it is likely that domestic producers have benefited from the tariff liberalisation on imported inputs. This is especially the case given that the producers would have, in all probability, imported the inputs they needed themselves, and hence, would have directly benefited from the tariff liberalisation on inputs. This in effect would have translated into tariff liberalization having resulted in reduced input costs.

7.6 Conclusion

Tariff liberalisation is expected to result in lower prices of import substituting goods, which in turn promotes improved competitiveness. This is due to increased competitive pressures emanating from reduced import prices and reduced input costs. The econometric results in this chapter indicate that tariff liberalisation on intermediate goods did lead to reduced input costs. On the other hand, while tariff liberalisation did lead to a reduction in final goods import prices, it did not increase competitive pressures on domestic industry. In other words, the tradition argument of tariff liberalisation providing the "cold

[43] The exchange rate coefficients for imported intermediate goods (1.74) is higher than that for final importables goods (1.10). One possible explanation could be related to the time lags involved in the trade contracts for these goods. It is possible that there may be a longer time lag between the order and delivery for intermediate goods than in the case for final goods,

winds of competition" necessary for efficiency gains in production has not been fully realized within the South African manufacturing sector during the 1990s.

The next chapter analyses whether manufacturing production manifested any characteristics of improved competitiveness during the 1990s.

and hence expectations surrounding the exchange rate volatility could result in a higher coefficient for imported intermediate inputs.