In many practical situations \( \log P \) will be approximately proportional to any appropriately defined price index, for example, \( \log P = \sum w_k \log p_k \). The index \( P \) can be calculated directly before estimation so that (13) becomes straightforward to estimate.

Parameter \( \gamma_{ij} \) measures the change in the \( i \)th budget share following a unit proportional change in \( p_j \) with \( x/P \) held constant. Parameter \( \beta \) defines whether goods are luxuries (\( \beta > 0 \)) or necessities (\( \beta < 0 \)). Adding up requires:

\[
\sum_k \alpha_k = 1, \quad \sum_k \beta_k = 0, \quad \sum_k \gamma_{kj} = 0.
\]

Homogeneity is satisfied only and only if for all \( j \):

\[
\sum_k \gamma_{jk} = 0,
\]

while symmetry is satisfied provided \( \gamma_{ij} = \gamma_{ji} \). Unrestricted estimation of equation (13) will automatically satisfy the adding up constraint (one equation to be left out from estimation) so that the NIDS offers opportunity to test homogeneity and symmetry. Apart from expression \( P \), the model can be estimated equation by equation using ordinary least squares. The income elasticity (\( e_i \)) and the uncompensated and compensated price elasticities (\( e_{ii}, e_{ij}, e_{ij}', e_{ij}'' \)) are given by:

\[
\begin{align*}
e_i &= 1 + \beta_i w_i; \\
e_{ii} &= \gamma_i / w_i - \beta_i - 1; \\
e_{ij} &= \gamma_j / w_i - \beta_i w_i / w_j; \\
e_{ij}' &= \gamma_j / w_i + w_i - 1; \\
e_{ij}'' &= \gamma_j / w_i + w_j
\end{align*}
\]

Expenditure \( x \) is the sum of gross investment and private consumption at constant prices obtained from the National Accounts (unlike consumption, investment is not disaggregated for the private sector and government). As the price of nontradables \( p_n \) we will use the nontradable part of the consumer price index, CPI,\(^{21}\) and the domestic ex factory price is the price of importables \( p_r \). To calculate \( w_i \) we use the sum of manufacturing value added and the total value of manufactured imports as proxy for the value of importables,\(^{22}\) which implies

\(^{21}\)Low income index of consumer prices (Nairobi), except for two categories: (i) clothing and footwear, and (ii) furniture, furnishing, house equipment and household operation.

\(^{22}\)Includes imports under SITC 5-8 and the equivalent categories of domestic manufacturing as the breakdown of imports into government and household consumption extends up to 1988 only.
Table 4:  
The Nearly Ideal Demand System for Kenya. Importables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>t-value</th>
<th>HCSE</th>
<th>PartR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.5134</td>
<td>0.7386</td>
<td>-3.403</td>
<td>0.5678</td>
<td>0.4527</td>
</tr>
<tr>
<td>LogPm</td>
<td>0.3680</td>
<td>0.0877</td>
<td>4.198</td>
<td>0.0872</td>
<td>0.5573</td>
</tr>
<tr>
<td>LogPn</td>
<td>-0.6952</td>
<td>0.1182</td>
<td>-5.881</td>
<td>0.1053</td>
<td>0.7119</td>
</tr>
<tr>
<td>Logx-LogP</td>
<td>0.7713</td>
<td>0.1858</td>
<td>4.150</td>
<td>0.1406</td>
<td>0.5516</td>
</tr>
</tbody>
</table>

R²=0.829569  F(3,14)=22.715 [0.0000]  Œ=0.0234911  DW=1.98
Information Criteria: SC=-7.1113

Notes: HCSE=heteroscedastic consistent standard error. t-values are calculated on the basis of the unadjusted t-statistic. The F-statistic is against the null that all coefficients = 0.

\[ e_x = 3.39 \quad e_a = -0.632 \quad e_u = -3.77 \quad e_{\phi} = 0.462 \quad e_{\phi} = -0.0182 \]

that tradables are consumed by the private sector, except for investment. This is a plausible assumption for Kenya.

The first step is to estimate price index \( P \) and insert it into equation (13). We will use Stone’s approximation for \( P \) as defined above, i.e. \( \log P = \sum w_i \log p_i \). As there are, by assumption, only two composite consumer goods in the Kenyan economy (importables and nontradables), it is sufficient to estimate equation (13) for importables alone. In other words, the budget share of importables \( w_i \) is regressed (using ordinary least squares) against logarithms of real expenditure \( x/P \) and prices \( p_i \) and \( p_n \) (using PC Give version 7 by Doornik and Hendry 1992). A summary of the estimation results appears in Table 4 above.

The model tracks the data well during 1973-90, producing significant t and F statistics. The coefficients are stable and the first order (negative) autocorrelation is small. As can be expected from a well-behaved model, parameter \( \beta_i \) indicates that importables are a luxury good (\( \beta > 0 \)). The expenditure elasticity \( e_x \) (all elasticities are evaluated at the mean), however, seems to be far too high, although Blundell, Pashardes and Weber (1989), for example, who use the UK micro-data, obtain expenditure elasticities slightly above 3 for the lowest income group. In all other UK income groups the elasticities are much lower. Prichett (1987) estimates import demand functions using data from some fifty developing countries and finds
a fairly narrow range of estimates for income elasticity, with a median of 1.2. The range of (own-) price elasticities was found to be from -0.8 to -1.0.

Another problem of the NIDS estimation is caused by $\gamma_n < 0$ which implies that importables and nontradables are complements instead of substitutes as one would expect at this level of aggregation. In addition to a wrong sign, the uncompensated cross-price elasticity has an implausibly high absolute value, which is clearly out line of some other studies (Deaton and Muellbauer 1980a; Blundell, Pashardes and Weber 1989). The uncompensated own-price elasticity has a correct sign, although its absolute value is on the low side. Lastly, the compensated price elasticities have opposite signs to what one would expect. Their small absolute values indicate that the demand for importables is price-inelastic. In sum, on the basis of the estimated demand system, and assuming that the data for expenditure and price of nontradables are unbiased, there seems to be a bias in the Kenyan domestic price deflator. More specifically, either the value of output data, the quantity index for manufacturing, or both can be the ultimate source of this bias.

**D. Derivation of hypothetical index**

Let us next assume plausible expenditure and price elasticities and derive a hypothetical domestic price series from the demand equation for importables. As the NIDS equation for importables is sensitive to the choice of the constant, we will use the Linear Expenditure System instead, as it does not require similar specification of a constant. Following Stone's approach, a general linear formulation of Marshallian demand could be adopted and adding up, homogeneity and symmetry restrictions be imposed. The Linear Expenditure System (LES) for the two goods consumed domestically would then be:

22 Adam (1991) estimates a demand system of five assets for Kenya. Some of his price elasticities also have a high absolute value.

24 Using the Kenyan import price index as an alternative price for importables, its coefficient w.r.t. the budget share is not statistically significant.
\[ p_i q_i = p_i \gamma_i + \beta_i (x - p_i \gamma_i) \]

\[ p_n q_n = p_n \gamma_n + \beta_n (x - p_n \gamma_n) \]

where \( x \) denotes the total expenditure, \( p_i \) is the price of importables, \( p_n \) the price of nontradables, \( q_i \) and \( q_n \) are the quantities of importables and nontradables, respectively, and \( \beta \) is the marginal propensity to consume so that \( \Sigma \beta_k = 1 \) (\( k = i, n \)). Parameters \( \gamma_k \) (\( k = i, n \)) are usually interpreted as subsistence quantities for which there is no substitution. The residual, \( (x - \Sigma p_k) \), is allocated between the goods in fixed proportions \( \beta_k \) (Deaton and Muellbauer 1980b). Note that the system is not linear with respect to parameters \( \beta, \gamma_i \) and \( \gamma_n \) which makes the LES more complicated to estimate than the NIDS.

The logarithmic derivatives of Marshallian demands give the total expenditure elasticities \( e_k \) (\( k = i, n \)) and (uncompensated) price elasticities \( e_{il} \) (\( k, l = i, n \)):

\[ e_k = \beta_k / w_k ; \quad e_{ik} = \gamma_k (1 - \beta_k) / q_k - 1 ; \quad e_{il} = - \beta_i p_i \gamma_i / p_q q_k \]

Given the quantity index for importables \( q_i \) (weighted average of the quantity index for domestic manufactured goods and imports) and total private expenditure \( x \), we can solve for a hypothetical domestic price deflator \( p_i \) from equations (16)-(17) by assuming plausible values for elasticities, and that the subsistence quantity for importables is zero (\( \gamma_i = 0 \)). Figure 9 depicts the base case (as in Figure 1) and an alternative implicit tariff index, using a hypothetical domestic price deflator. The domestic deflator is derived by assuming that \( e_i = 1.265 \) (valued at the mean) and \( e_{il} = -1 \). The latter elasticity follows because we assume \( \gamma_i = 0 \). The hypothetical implicit tariff index is not very sensitive to the choice of \( e_i \).

The hypothetical domestic deflator yields a very different implicit tariff index compared to the base case. Variations, for example, are less pronounced. The alternative index indicates that Kenyan trade policy was most protectionist in the early-1970s and during 1981-84. The first liberalization episode seems to have occurred in 1974, instead of 1973 as our earlier evidence showed. The second episode was the coffee boom in 1976-78. Tightening
of trade policy in 1979 is picked up by the hypothetical index. The exogenous reform in 1980 is also shown, as well as its reversal from 1981 onwards. Instead of liberalization, the 1982 reform of import schedules is shown as a tightening of import controls. The hypothetical index also picks up the mini coffee boom in 1986 (by that time recession had also ended). The most recent episode is also shown (1988-89). It was (modestly) reversed in 1990. In sum, the general trend of the hypothetical implicit tariff index, obtained by using plausible elasticities to derive the domestic deflator (instead of using the domestic ex factory price series) seems, in the light of other evidence of Kenyan trade policy, much more credible than the base case.

As we saw above, the hypothetical index concurs well with the narrative of changes in trade policy (Section 2.2). Unlike the index of import compression (IIIR), our hypothetical index indicates a slightly higher level of protection in the 1970s than in the 1980s. Further, it shows that trade policy was more liberal during the latter half of 1980s than in the first half. This is again in contrast with the IIIR. The hypothetical index also seems to contradict the two snapshots of the actual level of protection in 1985 and 1988, which indicate tightening of policy. As discussed earlier, the deviation between the two snapshots may result from the choice of goods in the samples and from that of international prices rather than from a change in import controls.

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24. The average reading of the hypothetical implicit tariff index is 90.2 for the 1970s, while that for the 1980s is 86.1 (1982=100).

25. The average index reading for 1980-84 is 92.1, while that for 1985-89 is 80.1 (1982=100).
Summarizing, it is quite likely that the domestic producer price, used for constructing the implicit tariff index, contains a bias. This is clearly indicated by the elasticities obtained from the estimation of an aggregate demand system for Kenya as well as by application of alternative domestic price deflators. Recall that the domestic deflator was derived by using the value of manufacturing output and the quantity index for manufacturing. As there was no clear indication that the output data would contain a bias, it is therefore possible that the quantity index for domestic manufacturing is the source of bias. In addition, there is some evidence that falling domestic prices of importables relative to their world prices may, at least to some extent, be due to increased domestic output and relaxation of the foreign exchange constraint. As the latter has been only temporary, its effect on the implicit tariff must also have been temporary.

VI. Reliability of Import Price Indices

Kenyan Department of Customs and Excise reports the (ci/f) import price index annually at one-digit Standard International Trade Classification (SITC) level.\(^{27}\) If the index had a bias which remained constant over time, it would not distort the implicit tariff index. There is, however, no reason to believe that the bias - if any - would remain constant as incentive for misreporting imports is likely to change over time. In general, the import price index can be biased either upwards or downwards, i.e. import are either overinvoiced to evade capital controls, or underinvoiced in order to minimize payment of import duties. We are mostly concerned about the possibility of increasing overinvoicing over time which may produce the observed downward bias in the implicit tariff index of trade policy (Figure 1). In this section we will examine what evidence is available to confirm or reject this hypothesis.

Overinvoicing of imports (and under-invoicing of exports) can be a profitable activity for two groups of economic agents: Kenyan residents who wish to obtain foreign savings, and foreign-owned firms. If the former group is dominant, changes in the magnitude of

\(^{27}\) Figure 1 uses the Kenyan import price indices for SITC 5-8 (weighted by shares in domestic manufacturing) as the average world price. Import categories for crude materials (SITC2) and animal and vegetable oils and fats (SITC4) do not have an equivalent in domestic manufacturing and are therefore left out. Beverages and Tobacco (SITC1) and mineral fuels (SITC3) are also left out from the weighted import price index.
over invoicing are likely to be positively correlated with the black market premium. If the premium is higher than the prevailing tariff rate, it is more profitable to over invoice imports than to buy foreign currencies in the black market. When the premium falls below the tariff, over invoicing is no longer a profitable activity from the individual's point of view. Multinational companies can reduce corporate taxes by removing their profits through transfer pricing to the country where the tax rate is lowest. If the company wants to evade all taxes, over invoicing of imported inputs is a means to conceal profits. In the latter case, there must be a given level of tariffs which makes tax evasion by over invoicing unprofitable, i.e. when the excess tariffs exceed the gains derived from non-payment of taxes. There is an additional incentive to over invoice imported inputs if the subsidiary is partly owned by Kenyans as the latter will share the burden of zero-profit or a loss but the main company will take the entire benefit from over invoicing. According to a World Bank study (1975), the prevailing tariff structure in Kenya in the early-1970s made transfer pricing only a marginal activity, whereas the incentive to evade taxes by over invoicing was found to be fairly substantial.

Quantitative import restrictions and foreign exchange controls tend to breed other controls. There is a particular need to control over invoicing in order to protect external reserves. Pre-shipment inspections of the quantity, quality and price of imports has been carried out for the Central Bank of Kenya since 1972 by private companies in the exporting countries (mainly industrialized market economies). Allocation of foreign exchange to imports has since then required a Clean Report of Findings by the inspecting company. Live animals, fresh fruits and vegetables, crude oil, donors, and the Kenya government are among those exempted from inspection.

It is very difficult to determine the extent to which Kenyan importers are able to over invoice their imports in reality. On the one hand, the Maxwell Stamp report (1989) assumes that over invoicing is so wide-spread that the import price index is useless for calculation of the implicit tariff. On the other hand, a report by the United States International Trade Commission (1987), which analyzes pre-shipment inspection programmes of 25 developing countries, including Kenya, at the request of US exporters, does not at all suggest that any kind of over invoicing is taking place. Over invoicing would actually require that the Kenyan importer collude with both the (US or other developed countries) exporter and the surveillance company (based in the US or other developed countries) responsible for inspection. Therefore over invoicing of imports seems to be a more difficult way of capital
flight that under invoicing exports, as the latter are not subject to such a comprehensive system of inspection. If we assume that the pre-shipment inspection is able to prevent any major capital flight through imports so that there is no distorting effect in the import price index, it is still possible that the value of imports is mis reported as the Customs does not require the Clean Report of Findings for the clearance of imports. Instead of over invoicing, the incentive there is to under report imports to minimize the payment of duties.

Yeats (1990b) assesses the general accuracy of African trade statistics by comparing the reported export values, plus a transport and insurance cost factor (based on freight and insurance charges actually paid on African exports to the United States), with partner countries' declared import values in 1982-83. Although this study does not shed any light on the magnitude of possible over invoicing of imports from the OECD to African countries as means of evading controls on holdings of foreign assets, it tells a devastating story about the quality of some other African trade data. The results show that in intra-African trade the average discrepancy between matched export and import values is more than 60 percent. Reported exports at fob prices frequently exceed matched reported cif imports, suggesting that smuggling is widespread, or that importers are under invoicing to avoid high tariffs or quotas. Over invoicing of exports is less likely as export subsidies are not widely used in Africa. A large part of smuggled goods may not be reported at either end of transactions so that the found discrepancy points even more strongly to under invoicing of imports. This inference is further strengthened by the fact that differences in official and parallel market exchange rates were found not to be significantly correlated with discrepancies in trade values.

Large discrepancies were also found when comparing exports from African countries to the matched imports reported by the OECD. For example, export quantities that fall under international commodity agreements tend to be under reported, presumably to evade both quotas and foreign exchange controls. In high-value low-volume goods, such as precious stones, reported imports far exceed exports, suggesting that smuggling occurs on a large scale. Substantial differences were also found in some of the reported unit values, suggesting that exporters are under invoicing, or do not receive the full value for their goods. Kenya seems to have under reported the value of her exports to the OECD (the difference between imports from Kenya reported by her trading partners and exports reported by Kenyans was 28 percent) and, to a lesser extent, to other African countries (12 percent). Intra-African imports seem to

46
have been underreported. In addition to misreporting, Kenyan trade data may suffer from inaccurate recording of trade flows which are in transit to other countries in the region.

There may be other reasons than overinvoicing for the relatively high import prices recorded in African trade statistics, such as high concentration of import supply on a small number of firms, a small size of export markets, tied foreign aid (donors and the government are exempted from pre-shipment inspection), or corruption involved in import contracts. Analysing import unit values for 1962-87, Yeats (1990a) shows in another study that twenty African former French colonies paid a price premium of 20-30 percent on average over other (developed or developing country) importers for iron and steel imports from France. The study also finds that similar premia were paid by former Belgian, British and Portuguese colonies in Africa for iron and steel imports from their former rulers. Kenya is included in the study of the former British colonies. Another striking result was the extreme variance of average premia paid among countries in any one period and by any one country over time.28

Annual data on the quantity and value of French, British etc. exports of five-digit SITC iron and steel products were used in order to ensure good quality data and as homogeneous products as possible. Even if product or quality differences existed, one would expect that poorer countries would import poorer-quality, lower-price products. A correlation analysis confirmed that market structure and (somewhat less) market size are strongly and significantly correlated with relative prices. Yeats cites other studies that have found similar overpayment by African countries for other imports than iron and steel.

Therefore, it is quite possible that Kenyan import prices really are considerably higher than, for example, the UK import prices used by Maxwell Stamp Associates (1989) as proxy for the world price, and yet there is no major problem of over invoicing. Variance in excess payment for imports observed by Yeats (1990a) may explain at least part of the decline in the implicit tariff over a given period, but only further research can confirm this inference.

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28 Only the former French colonies were studied in detail.
Finally, let us construct an alternative implicit tariff using the average UK import unit value (United Kingdom). It is depicted in Figure 10 together with the base case. The UK import unit value produces almost an equivalent decline in the implicit tariff index between 1976-81 as the Kenyan import price index. During 1983-86 instead the UK data indicates much less pronounced liberalization than the Kenyan index. In other words, in the 1970s it does not matter very much which of the two world prices we use, whereas in 1983-86 it indeed seems to make a difference. The attempted coup d’État in August 1982, for instance, might have created an unprecedented incentive to over invoicing and capital flight in those categories of imports and importers exempted from pre-shipment inspection in the exporting country.

VII. Conclusions

Our choice for the quantitative measure of trade policy for Kenya, the average implicit tariff index, which was calculated as the ratio of the domestic ex factory price index and the import price index, has a strongly declining trend. It implies that substantial trade liberalization has taken place in Kenya since the late-1960s. When we compare the index with other available information on protection in Kenya, we have reason to believe that the index has a bias. First, it does not concur with the snapshots of the actual levels of protection (i.e. nominal and effective rate of protection, NRP and ERP) in Kenya available for years 1968, 1985 and 1988.