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# Analysis of the Demand for Raw Ivory: Case Studies of Japan and Hong Kong

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by

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## ANALYSIS OF THE DEMAND FOR RAW IVORY CASE STUDIES OF HONG KONG AND JAPAN<sup>1</sup>

### 1. Introduction

This chapter examines the trends in total and net demand for unworked (raw) ivory of Japan and Hong Kong over the periods 1950-87 and 1962-87 respectively. This is done through the construction of two econometric models. The first is a relatively simple estimation of the income and price elasticities of demand at a national level. The second involves the construction of a more elaborate model, that attempts to calculate price elasticities while also including an 'asset demand' motivation for holding ivory, which is asserted by some authors as being significant (Douglas-Hamilton [1987]).

As Japan is a major consumer of raw ivory (Barbier [1989b]), calculating the income and price elasticities of demand is important for designing appropriate policies to limit demand, and thus controlling the global trade in raw ivory.<sup>2</sup> There are at least four policy relevant features of empirical estimates of demand elasticity. First, a low price-elasticity of demand would suggest that a tax on raw ivory imports would not be effective in significantly reducing end-use demand. Second, the asset-demand model should also indicate the extent to which unworked ivory is held as a store of value. Since interest rates could not be influenced by specific policies aimed at the ivory trade, a high interest-elasticity may limit the extent to which demand-control or supply control policies will influence trade. Third, if demand is price inelastic there are implications for the gains that would be made if "producers" - i.e. countries of export origin-cooperated to restrict the supply of ivory. Fourth, the measure of income-elasticity will show how sensitive ivory demand will be to economic growth in final consuming countries, and will thus enable a better idea to be obtained of how elephant population decline might be projected into the future.

As in the case of Japan, Hong Kong is a major importer of raw ivory (Barbier [1989a]). Calculating the income and price elasticities of demand by Hong Kong is important for designing appropriate policies to limit demand, and thus controlling the global trade in ivory. However, unlike Japan, Hong Kong is less of a final source of end-use demand than a major "entrepot" in the world ivory trade. A significant proportion of its imports of raw ivory are re-exported to other countries. The resulting net imports may be held as stockpiled inventories, to be exported later, or used as raw materials for its carving industry, which may also be eventually exported as worked ivory. Thus net imports do not necessarily indicate final end use consumption of ivory in Hong Kong.

Nevertheless, in order to determine whether any policy interventions are feasible at this entrepot stage in the world ivory trade, it is important to analyze the elasticities of demand and asset-demand motivation for importing ivory in trading countries such as Hong Kong. For example, a high price elasticity of demand would suggest that a tax on raw ivory imports into entrepot countries might be effective in controlling the world trade. The analysis should cover both gross imports, which include re-exported ivory, and net imports. At the very least, this should reveal whether policy interventions are more effective at the final end-use demand stage of the ivory trade rather than at the entrepot stage as represented by Hong Kong.

## 2. Analysis of Japan

### i. Background

Japan's end-use demand, or final consumption, of raw ivory remained fairly stable in the 1950s and early 60s, but then increased dramatically from the late 60s to the early 1980s (Figure 1 and Table 1).<sup>2</sup> For example, at its peak in 1983 raw ivory consumption was 15 times its level in 1950.

In the early 1980s, the relative importance of Hong Kong as the centre of the ivory trade was overtaken by Japan. A major reason cited is that, although in 1980 Japan accepted the control of imported tusks agreed under the Convention on International Trade in Endangered Species (CITES), up to 1985 Hong Kong's legislation has been more effective than Japan's in implementing CITES rules for raw ivory. As a result, illegitimate suppliers of ivory from Africa reduced their exports to Hong Kong, which subsequently became more reliant upon Japan as a source of supply (Caldwell [1984], [1987]). Thus, in the 1980s, re-exports to Hong Kong initially began absorbing a growing proportion of Japan's gross imports of raw ivory, however since 1984 the trade has experienced a steady decline back to pre-1983 levels (Table 1).

However, in 1985 Japan introduced an amendment to the Import Trade Control Order which implements the 'Japan Laws, Ordinances and Other Regulations Concerning Foreign Exchange and Foreign Trade'. This amendment eliminated the acceptability of country of origin certificates, and required the presentation of a valid CITES permits from the country of export or re-export. At the same time, the ivory importers self-imposed a further measure, namely to present all documents covering individual shipments to the CITES Secretariat for review before importation into Japan is allowed. If any discrepancies are noted, the Japanese dealers reject the transaction. Therefore, Japanese ivory transactions have been 'transparent' and subject to constant examination since 1985 (Milliken [1989]).

The new regulation began affecting raw ivory imports in the second half of 1985, and in 1986 gross imports fell to their lowest level in 20 years (Table 1). Thus, since its peak in

1983, Japan's consumption of raw ivory has fallen rapidly and although there has been a slight recovery in 1987, the 1988 trade will be less than 100 tonnes, a figure approximately 40 tonnes less than the 1987's trade. This is further evidence that imports of raw ivory to Japan remain substantially reduced. (Figure 1).

Given that Japan is a major end-use consumer of ivory, the main effect of the 1985 Japanese regulation has been to create a block at the importing end of the illegal trade route. This may have given rise to the diversion of illegal ivory to entrepots and importing consumers that have a less strict control on exports. An example of this is the subsequent large-scale stockpiling of illegal ivory in Macau, Singapore, and Dubai, destinations which largely rose and fell in the sequential order noted (Milliken [1989]).<sup>4</sup> When Japanese regulations took effect the illegal traffic from Africa became more 'transparent' (i.e. we became more aware of the tremendous volumes of ivory moving outside CITES channels). It remains to be documented to what extent, if at all, this trade represents an increase over previous years.

Before the new regulation in Japan, the Japanese import system unwittingly assisted the illegal trade: country of origin certificates were accepted in lieu of the required CITES documents, so that the 'act of smuggling' merely involved moving ivory into Japan openly with documentation which was not sanctioned under less strict import controls. This meant that large-scale 'smuggling' was unnecessary. Now, after the regulation, it is possible, although somewhat doubtful, that smuggling has increased. A modest growth in the trade between Japan and Hong Kong in cut and simply worked ivory has emerged, although this apparently halted in 1988 when imports dropped by about 15%. This trend may be to evade the regulations imposed on raw ivory by diverting trade into worked ivory, and consequently exploiting a loophole in CITES regulations. Thus these trends indicate a possible weakness in the existing CITES control system, which if they continue might make the whole system less tenable. On the other hand, ivory with proper permits is currently selling for several times the price of ivory without them (Caldwell [1987]). This could hopefully encourage producer countries in Africa to maintain a regular supply of legally traded ivory to importing countries that follow the CITES Convention.

Clearly, one key to regulating the world trade in ivory lies in controlling the demand for ivory by end-use consuming countries. But to understand the policy options available to these countries for asserting this control requires better analysis of their demand for ivory.

One policy option that should be explored is whether consumer countries such as Japan should employ a tax to reduce end-use demand. Real raw ivory prices - the per unit value of net imports of raw ivory deflated by the consumer price index - were significantly higher, but more volatile, in the 1970s and 80s compared to the 1950s and 60s (Figure 2). Over 1983-86, Japanese real raw ivory prices rose sharply but then fell back in 1987,

which may have contributed significantly to the trends in final consumption over 1983-87 discussed above. This suggests that, in recent years at least, Japanese consumption of raw ivory is sensitive to changes in its real price. Another view put forward is this could have been an artefact of better control. That is, the imposition of trade controls have cut off the supply of illegal ivory, and driven the price of legal ivory demanded higher and as a consequent the price of imported ivory has risen. Alternatively, the costs of harvesting ivory from African elephants, particularly for hunting the remaining populations concentrated in forest areas, may have risen in recent years. Any resulting contraction in the supply of ivory to the world trade would have resulted in higher real prices.

Finally, Table 1 indicates that, over the 1970-87 period for which data are available, the per unit value of Japanese net imports of raw ivory tends generally to exceed that of gross imports. This would suggest that Japanese re-exports of raw ivory tend to be of lower value than raw ivory retained for domestic consumption. This may be accounted for by Hong Kong tending to import smaller and inferior quality tusks than Japan. Ivory might therefore be a 'luxury' consumption good in Japan, which may make it more amenable to control by taxation. Both the income and price elasticities of demand for raw ivory should therefore be analyzed.

There is also a need to analyze whether investors are attracted to ivory as a store of wealth, especially in times of high inflation. For example, at the global level, the real value of ivory was six times higher in 1978 than in 1960, and at no time since 1973 has the real value been less than three times its average for the 1960s (Douglas-Hamilton [1987]). If there is a significant 'asset demand' for ivory in consuming and entrepot countries, then the returns to holding it should be greater than those obtained from an alternative asset. A proxy for the latter would be the real rate of interest in the importing country. Figure 3 compares for Japan the percentage change in real raw ivory prices to the real interest rate (both at 1980 prices). The real interest rate has fallen steadily since 1950, whereas the percentage change in real raw ivory prices has fluctuated significantly, particularly since 1970. If an 'asset demand' for raw ivory exists, it may be cyclical; i.e., only over certain years may the capital gains from holding ivory exceed those earned from other assets.

## ii. Demand Analysis

A simple method for estimating the elasticities of demand for ivory in Japan is based on a Cobb-Douglas model relating Japanese consumption of raw ivory to real raw ivory prices and real gross national product:

$$JCRI = A * (RJRIP)^b * (RJGNP)^c, \quad (1)$$

where

JCRI = Japanese consumption of raw ivory  
 RJRIP = real Japanese (net) import price of raw ivory  
 (1980 prices)  
 RJGNP = real Japanese gross national product (1980  
 prices).

Thus the coefficients b and c are the price and income elasticity of demand respectively.

Data on Japanese imports of raw ivory are from Japanese Customs import statistics and not from Japanese CITES data. This has been the procedure followed by past qualitative analysis of the Japanese trade in unworked ivory (Caldwell [1984], [1987]; Parker [1979], [1988]; WTMU [1983]).

A log-linear time series regression of (1) allows direct estimation of the coefficients of elasticity, b and c. Ordinary least squares regression revealed the presence of first-order serial correlation, which was corrected using the Cochrane-Orcutt procedure. In addition, results were improved by including a dummy variable for 1986 - the year of the substantial fall in Japanese net imports. This led to the following estimates (with t-statistics in parentheses):

$$C = 4.826 - 0.516P + 0.999Y - 1.419D \quad (2)$$

(1.23) (-1.73) (2.68) (-4.95)

period: 1952-87  $R^2 = .807$   $\text{adj } R^2 = .782$

S.E. = 0.324  $D-W = 1.97$   $F_{3,32} = 32.5$

where

C = natural logarithm of JRIC  
 P = natural logarithm of RJRIP  
 Y = natural logarithm of RJGNP  
 D = dummy variable for 1986.

The coefficients for Y and D are significant at the .02 and .01 confidence levels respectively (two-tailed test), and the coefficient for P is significant at the .10 level. As the estimate of the constant is close to 80% significant, it is also retained.

Thus the result of this simple regression is a price elasticity of demand for raw ivory in Japan of approximately one half. A 10% increase in the domestic price of raw ivory would therefore reduce the quantity demanded by about 5.2%. Similarly, the estimated income elasticity of demand of about unity implies that a 1% increase in Japanese real GNP results in a 1% rise in ivory demand.

Extending the analysis to examine an 'asset demand' motivation for holding raw ivory essentially involves including an



additional variable in (1) to account for the returns on alternative assets:

$$JCRI = A * (RJRIP)^b * (RJGNP)^c * (RJDR)^d, \quad (3)$$

where

$$RJDR = \text{real Japanese discount rates (\%).}^5$$

Thus an estimate of  $d$  would provide the interest-elasticity of demand for raw ivory. If an asset-demand relationship exists, then one would expect  $d$  to be negative; that is, as interest rates rise it is less attractive to hold ivory as a store of wealth.

In addition to regressing the log-linear version of (3), more robust versions including additional variables were also run, e.g., a dummy variable for 1986, lagged variables for RJRIP, RJGNP and RJDR, and new variables such as real and nominal yen/dollar exchange rates and the percentage change in real Japanese raw ivory prices. In the best regression of (3), none of these additional variables proved significant, except RJDR lagged one year and  $D$ . However, this version also displayed second-order serial correlation, which when corrected yielded the following estimates:

$$C = 4.901 - 0.702P + 1.147Y + 0.342R - 0.397R(-1) - 1.419D \quad (4)$$

(0.61) (-2.23) (1.90) (1.36) (-1.40) (-3.83)

period: 1954-87  $R^2 = .844$   $\text{adj } R^2 = .802$

S.E. = 0.315  $D-W = 1.90$   $F_{5, 29} = 20.1$

where

$R$  = natural logarithm of RJDR  
 $R(-1)$  = natural logarithm of RJDR, lagged one period.

The coefficients for  $P$  and  $D$  are significant at the .05 and .01 confidence levels respectively, and the coefficient for  $Y$  is significant at the .10 level. The coefficient for  $R$  is .85% significant, and that for  $R(-1)$  70% significant. However, the constant is less than 50% significant. Consequently, an additional version of the model was regressed with the constant omitted. This version displayed first-order serial correlation, which when corrected resulted in the following estimates:

$$C = - 0.718P + 1.530Y + 0.372R - 0.257R(-1) - 1.20D \quad (4')$$

(-2.39) (6.43) (1.55) (-1.10) (-4.03)

period: 1953-87  $R^2 = .816$   $\text{adj } R^2 = .784$

S.E. = 0.324  $D-W = 1.95$   $F_{5, 30} = 25.7$

The coefficients of  $Y$  and  $D$  are now both significant at the .01 confidence level, and the coefficient of  $P$  is easily significant

at the .05 level.  $R$  and  $R(-1)$  are again both 85% and 70% significant respectively.

Versions (4) and (4') both yield higher estimates of price and income elasticity of demand for raw ivory in Japan. Both versions seem to indicate a price elasticity of about 0.7. Income elasticity in (4) is estimated at around 1.1 but increases to over 1.5 in (4'). Thus the extended model indicates that the demand for raw ivory in Japan may be income-elastic, and although it is not price-elastic, there is a significant degree of price sensitivity.

Although the variables  $R$  and  $R(-1)$  are not strongly significant, it is nevertheless difficult to accept the hypothesis that there is no relationship between the level of real interest rates and consumption of ivory in Japan. Interest rate elasticity in the current period is estimated to be about 0.3 in (4) and 0.4 in (4'); however, the lagged interest rate elasticity is -0.4 and -0.3 respectively. This suggests that a higher level of real interest rates in the previous year will reduce consumption of raw ivory today as investors will have been attracted to other income-earning assets and thus in the immediate future invest less in ivory as a store of wealth. On the other hand, high current levels of real interest rates today may mean that investors expect future real rates to be lower and thus will switch to investing in ivory as an alternative asset.

However, the low estimated coefficients for  $R$  and  $R(-1)$  indicate that demand is fairly interest-inelastic. Coupled with the fact that these variables are not strongly significant, this suggests that further analysis of the 'asset demand' motivation for holding ivory may need to be undertaken using more sophisticated methods and models than the ones employed here.<sup>6</sup>

### iii. Conclusion

Simple estimation of the elasticities of Japanese end-use demand for raw ivory reveals a price elasticity of about one half and an income elasticity of approximately unity (see Table 2 which summarises elasticities). When an 'asset demand' motivation is included, price elasticity increases to over 0.7 and income elasticity rises to at least 1.15, and in the best model, to over 1.53. Intuitively this seems reasonable. If ivory is being held as a store of wealth, one would expect it to be more income-elastic (i.e., more of a luxury good), and one would also expect demand to become more sensitive to changes in real prices, as these now determine the returns on ivory as an asset.

Although the above models do seem to present reasonable evidence that such an 'asset demand' motivation for holding ivory in Japan does exist, further work is required before one can conclusively reject the hypothesis that no such motivation is at work. Equally important, if such a relationship does exist, more analysis is required before the actual mechanics and magnitude of the 'asset demand' for ivory can be satisfactorily revealed.

However, the elasticities estimated from the above models do indicate a number of important policy implications. First, as the demand for raw ivory in Japan seems to be significantly sensitive to real prices as well as income-elastic, there appears to be some scope for the use of import taxes as a means of discouraging domestic consumption. For example, assuming 0.7 price elasticity, a domestic tax on consumption that raised real ivory prices by 10% would reduce the 1987 level of consumption by 7.2 tonnes. Taxes that doubled the real price of raw ivory would reduce Japanese consumption by about 70%, which in 1987 would have meant a total net import level of 7,228 kg - about the level of gross imports in Japan in the early 1960s (Table 1).

As raw ivory demand in Japan appears to be fairly income elastic, it is essential to take measures to reduce consumption as real GNP in Japan continues to expand at around 4% per annum. This could increase ivory consumption by 6.1% each year - or an additional 6.3 tonnes based on 1987 levels. In addition, the high income elasticity of demand for ivory would suggest that any tax would be progressive. Thus one would anticipate that the higher income groups in Japan would bear proportionately more of the burden of taxation; particularly if there is a strong asset demand motivation for holding ivory.

Imposing high taxes on raw ivory consumption in Japan would not be effective without further tightening of CITES controls and other import legislation that has a bearing on ivory imports. In particular, any possible loopholes that may allow illegal ivory or ivory imports without proper documentation to enter Japan if it is only slightly worked or cut need to be closed. In turn it may also be necessary to impose taxes on all worked ivory permanently entering Japan. Moreover, a major advantage of combining taxes with existing and improved controls is to counteract any smuggling of raw ivory into Japan if this exists (Caldwell [1987]). A sales or value-added tax on ivory consumed within Japan would further discourage demand whether the raw ivory was legally imported or smuggled.

The ultimate aim of taxes and regulations on net imports of raw ivory into countries that are large end-use consumers such as Japan is to facilitate control of the global trade and thus hopefully help end the overexploitation of elephant populations in Africa. Unfortunately, stricter controls and the use of taxes by one or even a few consuming countries may reduce their domestic consumption of raw ivory significantly, but may not necessarily affect the global legal and illegal trade if this is diverted to new entrepots and end-use consumers who have less strict policies and controls. Already, there is evidence of such diversions taking place in response to the stronger controls already imposed by Japan and recent (1988) strengthening of regulations in Hong Kong. Moreover, there is the unknown factor of how a fall in demand in Japan will affect the trading price of raw ivory. On the other hand, if Japan is successful in reducing its domestic consumption of raw ivory substantially through the combination of taxes and regulations, increased pressure through

CITES and other organizations could be put on other consuming countries to follow suit. The demonstration of effective controls is preferable to ad hoc implementation of untried and possibly dubious controls.

Finally, a price-inelastic demand for ivory is one of the conditions favourable to the formation of an ivory producers' exporting cartel (IPEC). If the African exporters can form an IPEC and collude on price fixing and quota arrangements, the low price elasticity of demand for Japan - a major consuming country - suggests that revenues for the cartel can be raised by restricting exports of raw ivory.

### 3. Analysis of Hong Kong

#### i. Background

Hong Kong's total, or gross, imports of raw ivory increased steadily during the 1950s and 60s, grew dramatically in the mid-1970s, sustained these high levels in the early 1980s and then declined sharply after 1983 (Figure 4 and Table 3). The level of annual imports over 1985-87 - approximately 200 tonnes - is roughly the same as import levels in the early 1960s.

Trends in net imports have largely followed those of gross imports (Figure 4 and Table 4). The share of Hong Kong's re-exports of raw ivory in total imports by weight was roughly 20-25% in the early 1960s, dipped to under 20% in the late 60s and early 70s, and, with the exception of unusually strong performances in 1973-74 and 1983, has remained at roughly 25-30% ever since (Figure 4 and Table 5).

In recent years the pattern of Hong Kong's trade in raw ivory has undergone some important changes. In the early 1980s, the relative importance of Hong Kong as the centre of the ivory trade was overtaken by Japan. A major reason cited is that up to 1985 Hong Kong has been more effective than Japan in implementing legislation agreed under the Convention on International Trade in Endangered Species (CITES) (Caldwell [1984], [1987]). Two results have emerged:

First, since 1984 total imports of raw ivory into Hong Kong have fallen off dramatically (Figure 4 and Table 3). It is too early to tell whether this represents a success for CITES in permanently reducing the flow of ivory through Hong Kong, or whether the trade is temporarily adjusting - diverting ivory to the illegal trade or to entrepots and importing countries that have less strict controls than Hong Kong and now Japan.<sup>7</sup> In addition, a significant trade between Japan and Hong Kong in cut and simply worked ivory has emerged, which appears to be exploiting a loophole in CITES regulations (Caldwell [1987]).

Second, legitimate suppliers of ivory from Africa have reduced their exports to Hong Kong, which has subsequently become more

reliant on Japan and other non-African suppliers. Thus the long-term trend of Hong Kong importing less ivory direct from African suppliers and increasingly from the rest of the world - in particular Japan - seems to have accelerated in the 1980s (Table 6 and Figure 5).

An important policy option that needs to be explored is whether the key to regulating the world trade in raw ivory lies in controlling the demand for ivory by entrepot countries such as Hong Kong. In the case of Hong Kong, this demand consists not only of end-use domestic consumption of ivory - which may actually be quite small - but also of supplying its re-export trade and its export-oriented carving industry, as well as any stockpiling that is required to service both. The demand for ivory in Hong Kong and other entrepot countries therefore differs significantly from that in mainly end-use consuming countries, such as Japan. Analysis of the entrepot demand for ivory should reveal these differences.

Such an analysis should also reveal whether it is feasible for entrepot countries such as Hong Kong to employ a tax, either on gross or net imports, to reduce their demand for ivory. In Hong Kong, real raw ivory prices - the per unit value of total imports of raw ivory deflated by the consumer price index - rose sharply in the early 1970s and again in the late 70s, but fell in the early 1980s before returning recently to maximum levels. Prices for net imports have generally followed similar trends (Figure 6). With the exception of the recent 1983-87 period, it is not apparent that raw ivory imports are immediately responsive to changes in real prices, although some evidence for a lagged impact seems present (Figures 4 and 6). The latter would be consistent with stockpiling of ivory.

The analysis of Japan's end-use demand for ivory indicated that the per unit value of Japanese net imports of raw ivory tends generally to exceed that of gross imports (see section 2.ii.). This is consistent with a final consuming country that re-exports lower value raw ivory, retaining the higher valued ivory for domestic consumption. As Japan is now a major supplier of raw ivory to Hong Kong, presumably these exports are being used in the Hong Kong carving industry - perhaps to be re-exported to Japan as worked ivory. In contrast, in Hong Kong, over the period 1962-87 for which re-export data are available, the per unit value of total imports of raw ivory tends to exceed that of net imports (Tables 3 and 4). Thus, with a substantial re-export market in raw ivory and an export-oriented carving industry, Hong Kong appears to be exporting higher valued raw ivory and retaining the rest as raw material for its carvers. This again suggests that the responsiveness of both gross and net imports to price changes might be different for an entrepot as opposed to an end-use consumer of ivory.

The need to respond to export markets of raw ivory and to supply a domestic carving industry would call for some stockpiling of raw ivory inventories. Investors may also be further attracted to stockpiling ivory as a store of wealth, especially in times of

high inflation. For example, at the global level, the real value of ivory was six times higher in 1978 than in 1960, and at no time since 1973 has the real value been less than three times its average for the 1960s (Douglas-Hamilton [1987]). Thus both the real costs of holding ivory inventories as well as the motivation for holding ivory as a store of wealth would be negatively affected by the level of real interest rates in the economy. Figure 7 compares for Hong Kong the percentage change in real raw ivory prices for net imports to the real interest rate (both at 1979/80 prices). The real interest rate has fallen steadily since 1963, whereas the changes in prices have been generally more cyclical. This would suggest that if there is any impact of real interest rates on the stockpiling of ivory, it may be cyclical. Moreover, if stockpiling, including 'asset demand,' is a significant component of the total demand for ivory in Hong Kong, this would explain the considerable fluctuations in imports as indicated in Figure 4.

## ii. Demand Analysis

A simple method for estimating the elasticities of demand for ivory in Hong Kong is based on a Cobb-Douglas model relating imports of raw ivory to real raw ivory prices, real gross domestic product and the exchange rate (HK\$/US\$). This estimation should be carried out for both total and net raw ivory imports:

$$HKRI_i = A * (RHKRIP_i)^b * (RHKGDP)^c * (HKE)^d, \quad i = N, T, \quad (5)$$

where

HKRI <sub>i</sub>	=	Hong Kong imports of raw ivory, for net (N) and total (T) imports
RHKRIP <sub>i</sub>	=	real Hong Kong import prices of raw ivory (1979/80 prices), for net (N) and total (T) imports
RKGDGP	=	real Hong Kong gross domestic product (1979/80 prices).
HKE	=	HK\$/US\$ exchange rate*

Thus the coefficients b, c and d are the price, income and exchange rate elasticities of demand respectively.

Data on Hong Kong imports of raw ivory are from Hong Kong Customs import statistics and not from Hong Kong CITES data. This has been the procedure followed by past qualitative analysis of the Hong Kong trade in unworked ivory (Caldwell [1984], [1987]; Parker [1979], [1988]; WTMU [1983]).

A log-linear time series regression of (5) allows direct estimation of the coefficients of elasticity, b, c and d for both net and total imports. For net imports, ordinary least squares regression revealed the presence of second-order serial correlation, which was corrected using the Cochrane-Orcutt procedure. The results were improved by including lagged

independent variables and a dummy variable for 1984-85 - the years when raw ivory imports responded significantly to tougher Hong Kong CITES legislation (see section 3.i.). This led to the following estimates for net imports (with t-statistics in parentheses):

$$\begin{aligned}
 I = & 13.982 - 0.514P(-1) + 0.352P(-2) + 4.436Y - 3.519Y(-1) \\
 & (10.2) \quad (-5.15) \quad (2.87) \quad (7.39) \quad (-5.72) \\
 & - 0.857Y(-2) + 4.653E - 5.711E(-1) - 0.395D \quad (6) \\
 & (-1.61) \quad (4.99) \quad (-7.20) \quad (-3.0)
 \end{aligned}$$

period: 1966-87  $R^2 = 0.934$   $\text{adj } R^2 = .874$

S.E. = 0.149  $D-W = 2.22$   $F_{8,22} = 15.6$

where

I = natural logarithm of HKRIN  
 P(-1) = natural logarithm of RHKRIPN, lagged one period  
 P(-2) = natural logarithm of RHKRIPN, lagged two periods  
 Y = natural logarithm of RHKGDP  
 Y(-1) = natural logarithm of RHKGDP, lagged one period  
 Y(-2) = natural logarithm of RHKGDP, lagged two periods  
 E = natural logarithm of HKE  
 E(-1) = natural logarithm of HKE, lagged one period  
 D = dummy variable for 1984-85.

All coefficients are significant at the .01 confidence levels (two-tailed test), except the coefficient for Y(-1) which is over 85% significant.

The results of this regression suggest that real raw ivory prices have a lagged but not a current impact on net imports into Hong Kong. If real raw ivory prices in the previous year increased by 10%, then net imports in the current year would fall by 5.1%. On the other hand, a 10% increase in real raw ivory prices two years ago would actually increase today's net imports by 3.5%. The simplest explanation is that there is a lag effect of prices on demand. It takes time for a rise in real prices to reduce net imports of raw ivory. This would suggest a (lagged) price elasticity of demand of approximately one half. One reason for this lagged effect would be the presence of stockpiling - either to service the carving industry, supply future re-exports, or because of an 'asset demand' motivation. However, if the real price rise occurred sufficiently long ago (i.e., two years previously), the expectation is that today's prices might be substantially lower, thereby increasing net imports in the current period.

Regression (6) also indicates that net imports are highly income and exchange-rate elastic. A high income elasticity suggests that raw ivory is a luxury good. As the economy grows and national income increases, more raw ivory will be imported. The negative lagged effect on GDP suggests that, if in previous years real income increased, importers will anticipate real income to

be lower this year and reduce purchases accordingly. A high, positive exchange-rate elasticity may at first glance seem perverse; even though ivory imports are becoming more expensive in terms of Hong Kong dollars, net imports actually increase. But a substantial proportion of net imports may be servicing a domestic carving industry that is export-oriented, which would benefit from a higher exchange rate and thus require more raw ivory. However, if past exchange rates were increasing, one might expect future exchange rates to be falling. This is captured in regression (6) by the negative impact on current net imports of lagged exchange rates.

An income elasticity of 4.43 and exchange-rate elasticity of 4.65 seem extremely high and may be over-estimated by regression (6). One reason for this is that interest rates - the costs of stockpiling ivory or holding it as a store of wealth - are excluded from the model. This effect is therefore being picked up by the income and exchange rate variables. For example, the income elasticity measure may include the 'wealth effect' of holding ivory. Similarly, the exchange-rate elasticity may be obscuring the speculative demand for stockpiling: if the exchange rate is high but real interest rates are low or expected to be low, it may still be profitable to increase net imports of raw ivory to build up stocks. Including interest rates in the regression should therefore correct for these over-estimations (see regression (9) below).

A log-linear time series regression of (5) was also carried out for total imports of raw ivory into Hong Kong. The results were improved by correcting for first-order serial correlation and by including lagged independent variables:

$$\begin{aligned}
 I = & 14.283 + 0.421P - 0.549P(-1) + 1.088Y - 0.806Y(-1) \\
 & (12.50) \quad (1.67) \quad (-2.38) \quad (1.94) \quad (-1.46) \\
 & + 1.123E - 1.409E(-1) - 2.082E(-2) \qquad (7) \\
 & (1.39) \quad (-1.16) \quad (-2.22)
 \end{aligned}$$

period: 1964-87       $R^2 = .861$       adj  $R^2 = .787$

S.E. = 0.192      D-W = 2.04       $F_{7,24} = 11.6$

where

I      = natural logarithm of HKRIT  
P      = natural logarithm of RHKRIPT  
P(-1) = natural logarithm of RHKRIPT, lagged one period.

The coefficients of the constant term, P(-1) and E(-2) are all easily significant at the .05 confidence level, Y is easily significant at the .10 level, P at just around this level, and Y(-1) and E at the .20 level. E(-1) is close to 75% significant.

Total imports of raw ivory are positively affected by higher real current prices and negatively affected by prices lagged one year. As gross imports are not adjusted for annual re-exports of raw



ivory, and as Hong Kong tends to export its higher valued ivory imports, higher real import prices for raw ivory may actually be encouraging total imports to increase to supply the re-export trade. Higher prices in the previous year may discourage importing in the current year as it is anticipated that real prices will be lower.

Total imports of raw ivory appear to have an income elasticity of about unity, and if in previous years real income has risen, importers may assume that it will be lower in the current year and adjust purchases downward. If anything, the omission of interest rates in (7) may be biasing income elasticity downward rather than upwards. Hong Kong tends to re-export its higher valued raw ivory imports. As seen in the analysis of Japan, Hong Kong's main re-export market, higher valued raw ivory is a fairly income-elastic 'luxury good' (see section 2.ii.). Thus Hong Kong is effectively importing a luxury good - albeit to export it to final consuming countries. But one of the costs of importing and holding re-exportable raw ivory would be interest rates. If this variable is significant but excluded, its negative impacts on total imports would instead appear as a lower income elasticity of demand.

As expected, higher current exchange rates have a positive impact on total imports into Hong Kong. The re-export trade in raw ivory clearly benefits from higher exchange rates. If previous exchange rates were high, the expectation is that current rates would be lower and thus total imports reduced. The omission of interest rates from (7) may actually be under-estimating rather than over-estimating the exchange-rate effect. If higher real interest rates raise the cost of stockpiling, then less stocks might be held and more exported. This would make total imports more sensitive to exchange rate movements.

The above analysis for net and total imports of raw ivory suggests that model (5) should be extended to include an additional variable to account for the 'asset demand' motivation for holding raw ivory, as well as for the direct costs of stockpiling. As in the analysis of Japan, the variable chosen is real interest rates:

$$HKRI_i = A * (RHKRIP_i)^b * (RHKGDP)^c * (HKE)^d * (RHKLR)^e, \quad i = N, T, \quad (9)$$

where

$$RHKLR = \text{real Hong Kong lending rates (\%).}^9$$

An estimate of e for net and total imports would provide the interest-elasticity of demand for raw ivory. If an asset-demand relationship exists, then one would expect e to be negative; that is, as interest rates rise it is less attractive to hold ivory as a store of wealth. Similarly, a rise in interest rates would increase the direct costs of stockpiling raw ivory to supply the carving industry or future re-exports.

The regression of (9) for net imports displayed second-order serial correlation, which when corrected, yielded the following estimates:

$$\begin{aligned}
 I = & 7.723 + 0.479P - 0.199P(-2) + 0.398Y + 0.490R & (9) \\
 & (3.20) \quad (10.44) \quad (-4.13) \quad (2.82) \quad (2.43) \\
 & - 0.548R(-1) + 0.828R(-2) - 0.666E - 1.071E(-2) \\
 & (-3.15) \quad (3.77) \quad (-1.28) \quad (-1.43)
 \end{aligned}$$

period: 1966-87       $R^2 = .951$        $\text{adj } R^2 = .906$

S.E. = 0.129      D-W = 2.23       $F_{0,22} = 21.2$

where

P = natural logarithm of RHKRIPN  
R = natural logarithm of RHKLR  
R(-1) = natural logarithm of RHKLR, lagged one period  
R(-2) = natural logarithm of RHKLR, lagged two periods.

The coefficients of the constant, P, P(-2), Y, R, R(-1) and R(-2) are all significant at the .03 level or higher. E(-2) is over 80% significant, and E over 75%.

The inclusion of interest rates in (9) not only improves the explanatory power of the model but also reduces the over-estimation biases of (6). It is clear that current and past real interest rates have a strong impact on net imports, which suggests that a significant proportion is stockpiled or held as a store of value. The changes in the sign on the lagged interest rate variables indicate that net imports are responding to the cyclical pattern of the change in real interest rates over time. Thus a higher level of real interest rates in the previous year will reduce net imports of raw ivory today, either because investors will have been attracted to other income-earning assets and thus in the immediate future invest less in ivory as a store of wealth, or because higher real interest rates raise the cost of financing the next year's stockpiling of ivory. On the other hand, high current levels of interest rates today may mean that future rates are expected to be lower and thus ivory becomes more attractive as an alternative asset and stockpiling easier to finance.

The income-elasticity of demand estimated by (9) is significantly lower and inelastic. Given that net imports are probably much less significant for end-use domestic consumption but are more readily used in an export-oriented carving industry or stockpiled for future use by this industry or the re-export trade, then a low income elasticity is expected. That is, raw ivory retained in Hong Kong is not a luxury consumer good but more like an industrial raw material. Like most raw material commodities, it therefore displays a low income elasticity.

With interest rates now accounting for the speculative demand and direct costs of holding ivory, regression (9) now shows exchange rate elasticity to be negative, -0.67. If net imports are primarily used as raw material, then higher exchange rates would raise significantly the costs to the carving industry of using this input. Net imports of raw ivory would therefore fall.

Regression (9) also shows a positive price elasticity of demand for net imports. There are two possible explanations. One is that a rising net import price for raw ivory is actually a reflection of stronger demand, and higher prices, for worked ivory. Thus the carving industry is expanding and importing more raw ivory inputs. Eventually, higher prices will reduce net imports, but this lagged effect appears quite small - an elasticity of 0.2. The other explanation is that rising real prices may reflect the stockpiling of more higher valued net imports to meet future re-exports of raw ivory. If past prices were rising, future prices are expected to be lower and thus current stockpiling for re-export is discouraged.

Regressing (8) for total imports involved correcting for first-order serial correlation. This yielded the following estimates:

$$\begin{aligned}
 I = & 11.875 + 0.409P - 0.413P(-1) + 1.541Y - 1.200Y(-1) \\
 & (4.58) \quad (1.43) \quad (-1.71) \quad (2.22) \quad (-1.71) \\
 & - 0.471R + 0.720R(-1) + 2.102E - 4.216E(-1) \quad (10) \\
 & (-1.65) \quad (2.34) \quad (2.27) \quad (-3.96)
 \end{aligned}$$

period: 1964-87       $R^2 = 0.854$        $\text{adj } R^2 = 0.761$

S.E. = 0.203      D-W = 2.10       $F_{8,24} = 9.12$  .

The constant, Y, R(-1), E and E(-1) are all significant at .05 or higher. P(-1), Y(-1) and R are all significant at around .10, and P is over 80% significant.

Although equation (7) is a slightly better fit than (10), the interest rate appears to be a highly significant explanatory variable. Total imports seem to respond negatively to interest rates, with an elasticity of about one half. As a large proportion of Hong Kong's total imports may consist of higher valued ivory to be re-exported, higher real interest rates would discourage any 'asset demand' motivation for importing additional exportable ivory and holding on to it as a store of wealth. If past real interest rates were rising, however, the expectation would be that future real rates would be lower, which would be an incentive to import.

The estimates of price elasticity appear not to be significantly different from those estimated by regression (7) (see Table 7, which summarises elasticities). The same interpretation is assumed to apply to both. As expected, the inclusion of an interest-rate effect raises both the income and exchange-rate elasticities of total imports. The former rises to over 1.5, and

the latter to over 2. From the point of view of its export market, Hong Kong is importing a luxury good, which in turn is highly responsive to changes in the exchange rate which benefit exports.

### iii. Conclusion

Hong Kong is not only a key entrepot country in the world trade for raw ivory, but it also retains a substantial amount of raw ivory to supply its export-oriented worked ivory industry. The economic motivation for importing ivory is therefore extremely complex.

The above analysis of Hong Kong reveals the importance of distinguishing demand for net imports from demand for total imports. Net imports are total imports adjusted for any re-exports of raw ivory that year. The evidence suggests that Hong Kong re-exports its higher valued raw ivory while retaining lower valued ivory. It will consequently treat re-exportable ivory as a luxury good, whereas its net imports serve mainly as a raw material for its carving industry and thus are characteristically income-inelastic. This is supported by the demand analysis, which yielded an income elasticity of around 0.4 for net imports and over 1.5 for total imports.

The implication is that, as the Hong Kong economy continues to develop and grow, it will tend to expand its luxury good re-export market in raw ivory relative to its carving industry. As shown in Table 5 and Figure 4, this appears to have happened up to the mid-1980s. More recently, the effect of the CITES-inspired Hong Kong legislation, but perhaps more importantly the 1985 legislation in its main export market of Japan, appears to have dampened the Hong Kong re-export trade in raw ivory. It is too early to tell whether this will be a temporary downturn, however. Nevertheless, it does suggest that controlling and reducing the demand in final end-use countries might be an effective way of limiting the re-export markets of entrepot countries. In the short run, Hong Kong's export-oriented carving industry might be boosted by the diversion of some of the raw ivory re-export trade to the worked ivory trade. Over the long run, however, as Hong Kong continues to develop one would expect its carving industry to be transferred to lesser developed economies.

The complex motivation for Hong Kong's demand for raw ivory imports complicates the responsiveness of imports to changes in real prices. For total imports, higher real raw ivory prices may actually spur a booming re-export trade. It is therefore unclear as to whether a tax on gross ivory imports would reduce demand. In any case, regression (10) indicates that total imports are much more responsive to changes in interest rates and exchange rates. For example, despite an increase in real import prices, a rising exchange rate and falling real interest rates would cause imports to expand. For net imports the price response is more complicated still. Once again this response appears positive in the current period. This may be due to expanding supply in the

carving industry pulling in more net imports, or stockpiling of higher valued raw ivory for future re-export. As in the case with gross imports, however, the price responsiveness of net imports is overshadowed by the impacts of interest rates and the exchange rate.

The complicated response of raw ivory imports into Hong Kong to changes in real (net or gross) import prices suggests caution in the use of taxation to control imports. Although imports are more responsive to interest rates and the exchange rate, these variables cannot be used to control Hong Kong's raw ivory trade because they are essentially determined by world economic factors and overall macroeconomic policy. This leaves three options in the control of Hong Kong's entrepot ivory trade: 1) continued tightening of Hong Kong's CITES-agreed legislation; 2) getting Hong Kong to accept a ban on its ivory trade; and, 3) controlling trade through Hong Kong by reducing demand by the end-use consuming countries it supplies.

As discussed, although the first option is welcomed, in the long run it may divert Hong Kong's entrepot trade to other entrepot countries who have not adopted or have ignored CITES regulations. The estimated income elasticity for Hong Kong's net imports of raw ivory suggests that in the long run its carving industry might shift to a lesser developed country anyway. Certainly if Hong Kong were to ban its trade in raw and newly carved ivory, the shift of its trade to other locations would be expedited. Thus, unless CITES legislation is tightened up for all existing and potential entrepot countries, unilateral tightening by Hong Kong may not have that much of a long-term impact on reducing the world ivory trade. The similar conclusion must also apply, perhaps even more strongly, to a unilateral ban imposed by Hong Kong.

Reducing the end-use demand for raw and newly carved ivory, as well as ivory-based products, in final consuming countries could have a dramatic impact on controlling the trade not just through Hong Kong but through other existing and potential entrepots. As demonstrated in the demand analysis of Japan, effective policies for controlling final consumption demand can be devised. In the long run, this could be the most effective way of controlling world trade, including reducing the incentive for other entrepots to take up trade displaced from Hong Kong. Further analysis is required, however, of the nature of the entrepot through Hong Kong and similar countries to understand the implications of this and even the other two options on world trade.

First, more detailed disaggregate study and analysis is required of the net import demand of raw ivory into Hong Kong and its re-export trade. It is important to understand more clearly the trends over time determining the supply of raw ivory to the worked ivory industry and the stockpiling of ivory for future re-export, or for future use by the carving industry, or simply as a store of wealth. What proportion of the remaining raw ivory meets final consumer demand in Hong Kong or is smuggled abroad also needs to be determined. In the case of re-exports, more

detailed analysis needs to be conducted of the demand for exports from Hong Kong by its main foreign markets. In particular, the Hong Kong-Japanese trade in ivory needs further and continual analysis.

#### 4. Conclusion

Economic analysis of the demand for raw ivory by Japan and Hong Kong demonstrates that policy interventions to reduce the demand for raw ivory are possible at the final consuming country stage of trade, and perhaps to control entrepot trade in raw ivory. However reduction of demand is likely to be easiest at the end-use level of trade rather than at entrepot level of trade.

However the restrictions of this modelling exercise must be noted. This exercise is only an economic analysis of the demand for unworked ivory in individual countries, and does not look at the political and institutional feasibility of the options. That is, the demand analysis alone is insufficient to recommend a tax for Japan as an optimal policy, but rather just shows that a tax is a feasible option. Whether this policy option is actually adopted depends on two important considerations: a) Japanese politics and institutions, and b) whether a tax is an optimal policy for conserving elephants, given the time horizon for population decline.

With regard to point a), it is unlikely that a substantial tax on ivory imports in Japan would ever be politically acceptable - particularly a tax that would double the real price of imported raw ivory. As regard to point b), the recent public and media attention paid to the African elephant's decline - and the subsequent popular demand for a 'ban' on trade - may have already eliminated any serious discussion of a system of taxation as a viable policy option. Such a system, whether involving import taxes in consuming countries such as Japan and/or export taxes imposed by African nations, does take time to implement and operate effectively. We may in any case be ten years too late to adopt such a system to prevent the elephant's decline.

To obtain a more complete understanding of the responsiveness of ivory trade to economic incentives, there is a need to supplement the demand analysis of Japan and Hong Kong by extending the work to cover other major consumers and traders of raw ivory. This involves analysing the trends over time in demand for unworked ivory of such countries as USA, EEC, Taiwan, and China.

Finally, there is an urgent need to examine the inter-relationship between the raw and worked ivory trade. The trends in the worked ivory industry and their implications for the demand for ivory as a raw material need to be better determined. As indicated in the analysis of net imports into an entrepot such as Hong Kong, this inter-relationship is extremely significant. This would also require further analysis of the demand for worked ivory exports from Hong Kong in its main foreign markets, such as

the United States. Without such an analysis, only a part of the story of the entrepot trade in ivory can be learned, thus inhibiting our ability to choose the correct policy options for controlling the global trade in ivory and ivory products.

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## NOTES

1. We are deeply indebted to Richard Luxmore of the Wildlife Trade Monitoring Unit, Cambridge for providing customs data and to David W. Pearce for providing additional data. Data on Japanese and Hong Kong ivory trade prior to 1976-79 comes from Parker (1979). We are also grateful to David W. Pearce, Tim Swanson and Tom Milliken for comments and to Anil Markandya for reviewing the econometric models.

2. The price elasticity of demand indicates the responsiveness of quantity demanded to changes in price; it is the ratio of the percentage change in quantity demanded to the percentage change in price. If this ratio is significantly less than one, then demand is said to be price inelastic. If it is greater than one, then demand is price elastic. Similarly, the income and interest elasticities of demand measure the responsiveness of quantity demanded to changes in income and average interest rates respectively, i.e., the ratio of the percentage change in quantity demanded to percentage change in income (or average interest rates).

3. Consumption of raw ivory by Japan is equivalent to its net imports, i.e. gross imports less re-exports in the same year. Unfortunately, custom data on re-exports by Japan were only available from 1970 onwards (Table 5.1). As noted below, however, only in the 1980's have Japan's re-exports of raw ivory increased significantly (mainly to Hong Kong). Also note that for the 1984-87 period ivory waste and powder imports have been ignored.

4. Thus in recent years there has been a flourishing illegal trade, via Burundi to the United Arab Emirates, the emergence of Singapore and Dubai as important entrepots for ivory trading without CITES permits, and the emergence of Taiwan and the resurgence of China as important destinations of the trade (Parker, 1988).

5. A discount rate in this context is the generic term for the rate charged by central banks for lending to commercial banks and other financial institutions. It therefore forms the basis for the entire interest rate structure of the economy.

6. One possibility might be to assume that the value of ivory as an asset follows a "random walk", with drift, to allow for real interest rate effects. Essentially, all current information is incorporated in the current price, and the price only moves as new, random information is generated by the market. Then the only systematic effect is that of the real interest rate, which could be adjusted for risk.

7. In recent years there has been a flourishing illegal trade, via Burundi to the United Arab Emirates and probably on to India, the emergence of Singapore and Dubai as important entrepots for ivory trading without CITES permits, and the emergence of Taiwan and the resurgence of China, and possibly of India, as important destinations of the trade (Parker [1988]).

8. Both the nominal exchange rate and the rate deflated by the consumer price index were tried in all models.

9. The Hong Kong and Shanghai Banking Corporation's quoted best lending rate, which is one of the base rates for the entire interest rate structure of Hong Kong.

TABLE 1

## JAPAN - IMPORTS OF RAW IVORY

	(kg)	(\$)	(\$/kg)	(JY/\$)	(JY)	(JY/kg)
1950	28725	82597.29	2.88	360.00	29735024.4	1035.16
1951	86573	350793.50	4.05	360.00	126285660.0	1458.72
1952	72425	267052.94	3.69	360.00	96139058.4	1327.43
1953	118492	454046.21	3.83	360.00	163456635.6	1379.47
1954	69280	379419.44	5.48	360.00	136590998.4	1971.58
1955	55788	332019.44	5.95	360.00	119526998.4	2142.52
1956	66618	392577.78	5.89	360.00	141328000.8	2121.47
1957	67343	417761.11	6.20	360.00	150393999.6	2233.25
1958	67329	411727.76	6.12	360.00	148221993.6	2201.46
1959	71171	441844.44	6.21	360.00	159063998.4	2234.96
1960	70986	458566.64	6.46	360.00	165083990.4	2325.59
1961	64511	398983.33	6.18	360.00	143633998.8	2226.50
1962	79378	461399.99	5.81	360.00	166103996.4	2092.57
1963	86086	483919.43	5.62	360.00	174210994.8	2023.69
1964	120319	668519.44	5.56	360.00	240666998.4	2000.24
1965	52497	354305.53	6.75	360.00	127549990.8	2429.66
1966	83259	642924.98	7.72	360.00	231452992.8	2779.92
1967	120143	841866.66	7.01	360.00	303071997.6	2522.59
1968	115341	791399.98	6.86	360.00	284903992.8	2470.10
1969	155520	1013969.43	6.52	360.00	365028994.8	2347.15
1970	149415 a/	1567999.98	10.49	360.00	564479992.8	3777.93
1970	141411 b/	1459955.54	10.32	360.00	525583994.4	3716.71
1971	110241 a/	1787774.95	16.22	349.33	624523423.3	5665.07
1971	100738 b/	1719105.79	17.07	349.33	600535225.6	5961.36
1972	275497 a/	5452745.08	19.79	303.17	1653108725.9	6000.46
1972	274657 b/	5439799.51	19.81	303.17	1649184017.4	6004.52
1973	315640	15521003.34	49.17	271.70	4217056607.5	13360.34
1974	233716	10994649.76	47.04	292.08	3211317301.9	13740.25
1975	223793	11066089.35	49.45	296.79	3284304658.2	14675.64
1976	306786 a/	11266717.08	36.73	296.47	3340266026.9	10887.93
1976	303759 b/	11225957.88	36.96	296.47	3328181959.3	10956.65
1977	266888 a/	10501471.13	39.35	267.38	2807880074.4	10520.81
1977	262967 b/	10436619.57	39.69	267.38	2790540062.3	10611.75
1978	368377 a/	26305147.33	71.41	208.33	5480238150.8	14876.71
1978	359192 b/	26148551.89	72.80	208.33	5447614105.0	15166.30
1979	296864 a/	24867378.78	83.77	219.88	5467672025.9	18418.10
1979	279288 b/	24490309.20	87.69	219.88	5384734083.4	19280.22
1980	274019 a/	20911277.71	76.31	225.84	4722516061.0	17234.26
1980	239981 b/	20218371.89	84.25	225.84	4566027945.1	19026.62
1981	308231 a/	24381025.25	79.10	220.26	5364362012.3	17403.70
1981	286070 b/	23931956.52	83.66	220.26	5265556895.3	18406.53
1982	284846 a/	21744843.70	76.34	248.26	5398421865.1	18952.07
1982	257419 b/	21078801.92	81.89	248.26	5233068895.5	20328.99
1983	475666 a/	29934654.57	62.93	237.42	7106992890.7	14941.14
1983	424950 b/	28565615.37	67.22	237.42	6781959847.5	15959.43
1984	473782 a/	31995887.59	67.53	237.25	7590957779.0	16022.04
1984	384442 b/	29002407.51	75.44	237.25	6880760856.8	17898.04
1985	286529 a/	24356120.57	85.00	236.74	5766126925.9	20124.06
1985	206004 b/	20487363.13	99.45	236.74	4850227927.6	23544.33
1986	79122 a/	9176519.71	115.98	167.48	1536848008.4	19423.77
1986	28840 b/	6566475.78	227.69	167.48	1099727950.7	38132.03
1987	142984 a/	21553042.12	150.74	144.66	3117665030.3	21804.29
1987	103261 b/	19092495.26	184.90	144.66	2761744977.6	26745.28

a/ Total imports.

b/ Net imports (apparent consumption) = imports less exports

N.B. Imports under CCCN category 509.600 excluded for 1984-87.

TABLE 2

SUMMARY OF ELASTICITIES OF DEMAND  
FOR RAW IVORY BY JAPAN

	MODEL 1	MODEL 2	
	no interest rate variable, net imports.	with interest rate variable, net imports. with constant	without constant
=====			
PRICE			
ELASTICITY			
i.current yr.	-0.52	-0.70	-0.72
-----			
INCOME			
ELASTICITY			
i.current yr.	+1.00	+1.15	+1.53
-----			
INTEREST			
ELASTICITY			
i.current yr.	na	+0.34	+0.37
ii.lagged 1 yr.	na	-0.40	-0.26
-----			

TABLE 3

## HONG KONG - TOTAL IMPORTS OF RAW IVORY

	(kg)	(\$)	(\$/kg)	(HK\$/\$)	(HK\$)	(HK\$/kg)
1952	71386	284649	3.99	5.71	1626484	22.78
1953	107880	482061	4.47	5.71	2754497	25.53
1954	86440	372815	4.31	5.71	2130265	24.64
1955	93211	424536	4.55	5.71	2425799	26.02
1956	144653	693573	4.79	5.71	3963076	27.40
1957	126151	620165	4.92	5.71	3543623	28.09
1958	145058	750501	5.17	5.71	4288363	29.56
1959	220626	915231	4.15	5.71	5229630	23.70
1960	157751	874926	5.55	5.71	4999327	31.69
1961	115112	598501	5.20	5.71	3419835	29.71
1962	212804	1091675	5.13	5.71	6237831	29.31
1963	149544	808217	5.40	5.71	4618152	30.88
1964	243639	1373105	5.64	5.71	7845922	32.20
1965	276400	1885366	6.82	5.71	10772981	38.98
1966	234596	1473326	6.28	5.71	8418585	35.89
1967	223017	1205727	5.41	6.06	7307911	32.77
1968	329928	1698156	5.15	6.06	10292524	31.20
1969	299111	1642851	5.49	6.06	9957320	33.29
1970	267444	2095489	7.84	5.71	11954765	44.70
1971	260006	2394653	9.21	5.70	13649522	52.50
1972	261509	2624065	10.03	5.09	13356491	51.07
1973	597122	15159797	25.39	4.93	74737799	125.16
1974	464838	12608964	27.13	4.93	62162193	133.73
1975	512986	14521454	28.31	5.04	73188128	142.67
1976	720631	18405349	25.54	4.88	89782192	124.59
1977	477197	14020306	29.38	4.65	65210729	136.65
1978	610864	32243732	52.78	4.67	150671647	246.65
1979	474208	26797404	56.51	5.00	133987023	282.55
1980	494271	26929475	54.48	4.98	133977491	271.06
1981	577204	23865390	41.35	5.62	134075228	232.28
1982	510626	21089352	41.30	6.06	127814255	250.31
1983	638292	24600911	38.54	7.25	178267475	279.29
1984	381927	18535158	48.53	7.82	144906679	379.41
1985	238958	13487189	56.44	7.79	105074784	439.72
1986	181522	11167177	61.52	7.79	87000241	479.28
1987	225370	16717374	74.18	7.79	130240221	577.90

N.B. Values reported by customs for Singapore adjusted one decimal place over 1977-83

TABLE 4

## HONG KONG - NET IMPORTS OF RAW IVORY a/

	(kg)	(\$)	(\$/kg)	(HK\$/ \$)	(HK\$)	(HK\$/kg)
1952	71386	284649	3.99	5.71	1626484	22.78
1953	107880	482061	4.47	5.71	2754497	25.53
1954	86440	372815	4.31	5.71	2130265	24.64
1955	93211	424536	4.55	5.71	2425799	26.02
1956	144653	693573	4.79	5.71	3963076	27.40
1957	126151	620165	4.92	5.71	3543623	28.09
1958	145058	750501	5.17	5.71	4288363	29.56
1959	220626	915231	4.15	5.71	5229630	23.70
1960	157751	874926	5.55	5.71	4999327	31.69
1961	115112	598501	5.20	5.71	3419835	29.71
1962	174856	847120	4.84	5.71	4840445	27.68
1963	113409	576087	5.08	5.71	3291759	29.03
1964	167197	854745	5.11	5.71	4884014	29.21
1965	208009	1393897	6.70	5.71	7964729	38.29
1966	173363	1078989	6.22	5.71	6165345	35.56
1967	190526	963748	5.06	6.06	5841276	30.66
1968	275844	1309332	4.75	6.06	7935862	28.77
1969	262033	1390519	5.31	6.06	8427933	32.16
1970	234772	1750340	7.46	5.71	9985690	42.53
1971	213118	1737128	8.15	5.70	9901630	46.46
1972	197290	1492424	7.56	5.09	7596438	38.50
1973	339365	5751132	16.95	4.93	28353081	83.55
1974	213899	918767	4.30	4.93	4529521	21.18
1975	372363	8110191	21.78	5.04	40875363	109.77
1976	492812	6231505	12.64	4.88	30397586	61.68
1977	346504	8571942	24.74	4.65	39869497	115.06
1978	424289	19361171	45.63	4.67	90472763	213.23
1979	366025	17706453	48.37	5.00	88532264	241.87
1980	376164	18365069	48.82	4.98	91368504	242.90
1981	427336	12890937	30.17	5.62	72420995	169.47
1982	322194	8570200	26.60	6.06	51940605	161.21
1983	442763	12363000	27.92	7.25	89586957	202.34
1984	270287	12028684	44.50	7.82	94039477	347.92
1985	109373	3534569	32.32	7.79	27536805	251.77
1986	129163	6651418	51.50	7.79	51819274	401.19
1987	150414	7900399	52.52	7.79	61549723	409.20

a/ Net imports (apparent consumption) = imports less exports.  
N.B. Values reported by customs for Singapore adjusted one decimal place over 1977-83 for imports, and 1976-83 for exports

TABLE 5

## HONG KONG - SHARE OF TOTAL IMPORTS OF RAW IVORY

	Re-exports		Net Imports	
	(kg)	(HK\$)	(kg)	(HK\$)
1962	17.83%	22.40%	82.17%	77.60%
1963	24.16%	28.72%	75.84%	71.28%
1964	31.38%	37.75%	68.62%	62.25%
1965	24.74%	26.07%	75.26%	73.93%
1966	26.10%	26.77%	73.90%	73.23%
1967	14.57%	20.07%	85.43%	79.93%
1968	16.39%	22.90%	83.61%	77.10%
1969	12.40%	15.36%	87.60%	84.64%
1970	12.22%	16.47%	87.78%	83.53%
1971	18.03%	27.46%	81.97%	72.54%
1972	24.56%	43.13%	75.44%	56.87%
1973	43.17%	62.06%	56.83%	37.94%
1974	53.98%	92.71%	46.02%	7.29%
1975	27.41%	44.15%	72.59%	55.85%
1976	31.61%	66.14%	68.39%	33.86%
1977	27.39%	38.86%	72.61%	61.14%
1978	30.54%	39.95%	69.46%	60.05%
1979	22.81%	33.92%	77.19%	66.08%
1980	23.90%	31.80%	76.10%	68.20%
1981	25.96%	45.98%	74.04%	54.02%
1982	36.90%	59.36%	63.10%	40.64%
1983	30.63%	49.75%	69.37%	50.25%
1984	29.23%	35.10%	70.77%	64.90%
1985	54.23%	73.79%	45.77%	26.21%
1986	28.84%	40.44%	71.16%	59.56%
1987	33.26%	52.74%	66.74%	47.26%

TABLE 6

## HONG KONG - IMPORTS OF RAW IVORY FROM AFRICA

	(kg)	(\$)	(\$/kg)	(HK\$/\$)	(HK\$)	(HK\$/kg)
1952	69990	278279	3.98	5.71	1590086	22.72
1953	101007	446648	4.42	5.71	2552147	25.27
1954	83162	357743	4.30	5.71	2044144	24.58
1955	79918	360440	4.51	5.71	2059554	25.77
1956	112927	536685	4.75	5.71	3066618	27.16
1957	93476	440711	4.71	5.71	2518223	26.94
1958	121210	618785	5.11	5.71	3535737	29.17
1959	121301	578023	4.76	5.71	3302823	27.23
1960	129331	705421	5.45	5.71	4030776	31.17
1961	108531	562588	5.18	5.71	3214628	29.62
1962	170410	868258	5.10	5.71	4961226	29.11
1963	122823	662153	5.39	5.71	3783542	30.80
1964	218197	1226979	5.62	5.71	7010958	32.13
1965	232684	1585142	6.81	5.71	9057501	38.93
1966	195208	1223837	6.27	5.71	6993005	35.82
1967	189349	986612	5.21	6.06	5979855	31.58
1968	232010	1129556	4.87	6.06	6846239	29.51
1969	275346	1502299	5.46	6.06	9105434	33.07
1970	236151	1833895	7.76	5.71	10462371	44.30
1971	223943	2038490	9.10	5.70	11619393	51.89
1972	216384	2141461	9.90	5.09	10900036	50.37
1973	476604	11885008	24.94	4.93	58593089	122.94
1974	269078	6571308	24.42	4.93	32396548	120.40
1975	339432	7527609	22.17	5.04	37939149	111.77
1976	543955	14470163	26.60	4.88	70586160	129.80
1977	320951	9180524	28.60	4.65	42700112	133.00
1978	260817	12483700	47.90	4.67	58335047	223.70
1979	194920	10916313	56.00	5.00	54581563	280.00
1980	246913	11239226	45.50	4.98	55916548	226.50
1981	168130	4114144	24.50	5.61	23113169	137.50
1982	153351	4264768	27.81	6.06	25847084	168.55
1983	199596	5527681	27.69	7.25	40055660	200.68
1984	29170	1466446	50.27	7.82	11464577	393.03
1985	41679	2011143	48.20	7.79	15688231	375.90
1986	110714	7429193	67.10	7.79	57878687	522.78
1987	42163	3280966	77.80	7.79	25561056	606.20



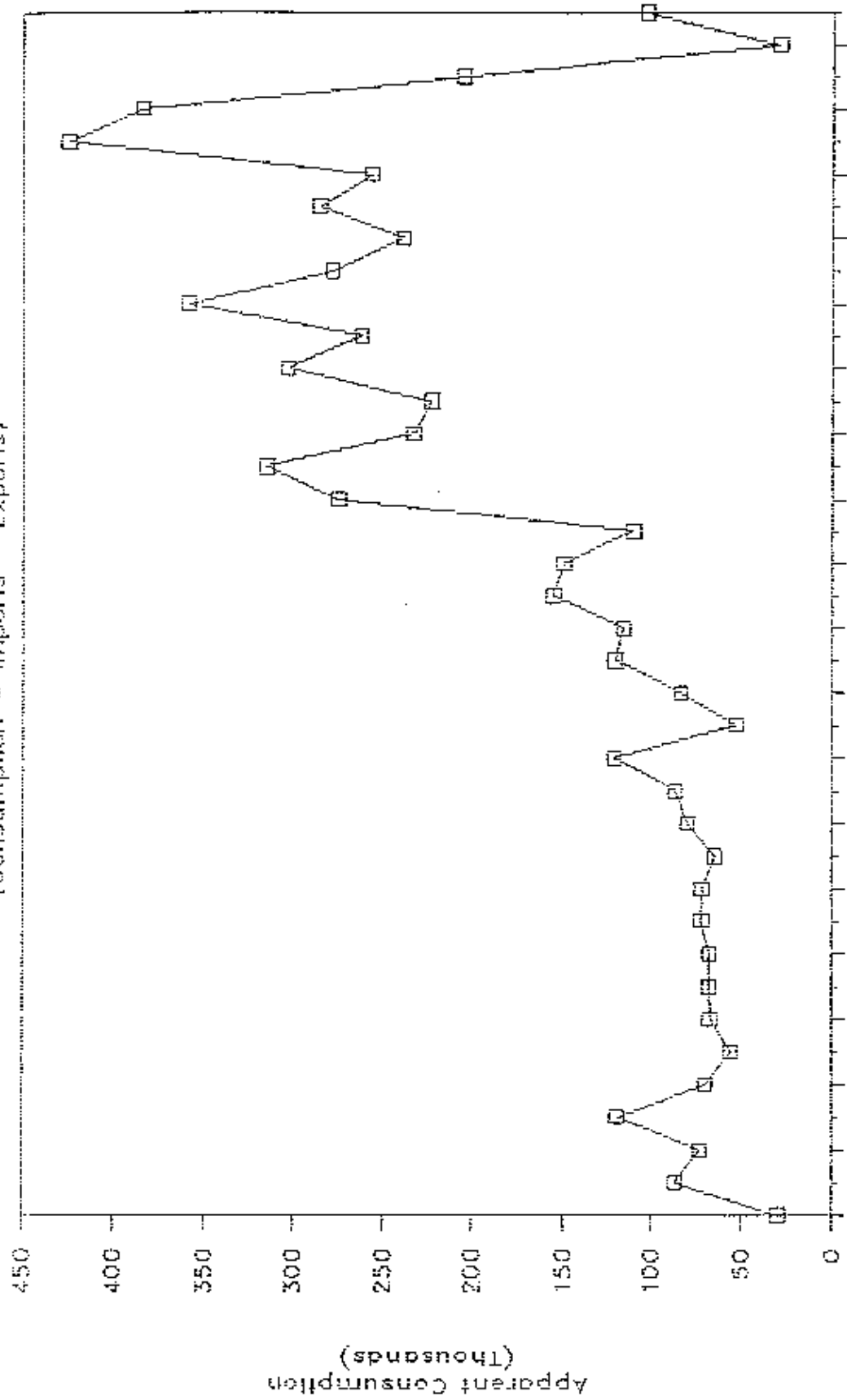
TABLE 7

SUMMARY OF ELASTICITIES OF DEMAND  
FOR RAW IVORY BY HONG KONG

	MODEL 1		MODEL 2	
	no interest rate variable.		with interest rate variable.	
	Net Imports	Gross Imports	Net Imports	Gross Imports
=====				
PRICE				
ELASTICITY				
i. current price.	na	+0.42	+0.48	+0.41
ii. lagged 1 yr.	-0.51	-0.55	-0.20	-0.41
iii. lagged 2 yrs.	+0.35	na	na	na
-----				
INCOME				
ELASTICITY				
i. current yr.	+4.43	+1.08	+0.40	+1.54
ii. lagged 1 yr.	-3.52	-0.81	na	-1.20
iii. lagged 2 yrs.	-0.86	na	na	na
-----				
EXCHANGE				
RATE				
ELASTICITY				
i. current yr.	+4.7	+1.12	-0.67	+2.10
ii. lagged 1 yr.	-5.7	-1.41	-1.07	-4.22
iii. lagged 2 yrs.	na	-2.08	na	na
-----				
INTEREST				
ELASTICITY				
i. current yr.	na	na	+0.49	-0.47
ii. lagged 1 yr.	na	na	-0.55	+0.72
iii. lagged 2 yrs.	na	na	+0.83	na
-----				

# Japan - Consumption of Raw Ivory

[Consumption = Imports - Exports]



1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986

FIGURE 1

# JAPAN - REAL RAW IVORY PRICES

(1980 P)

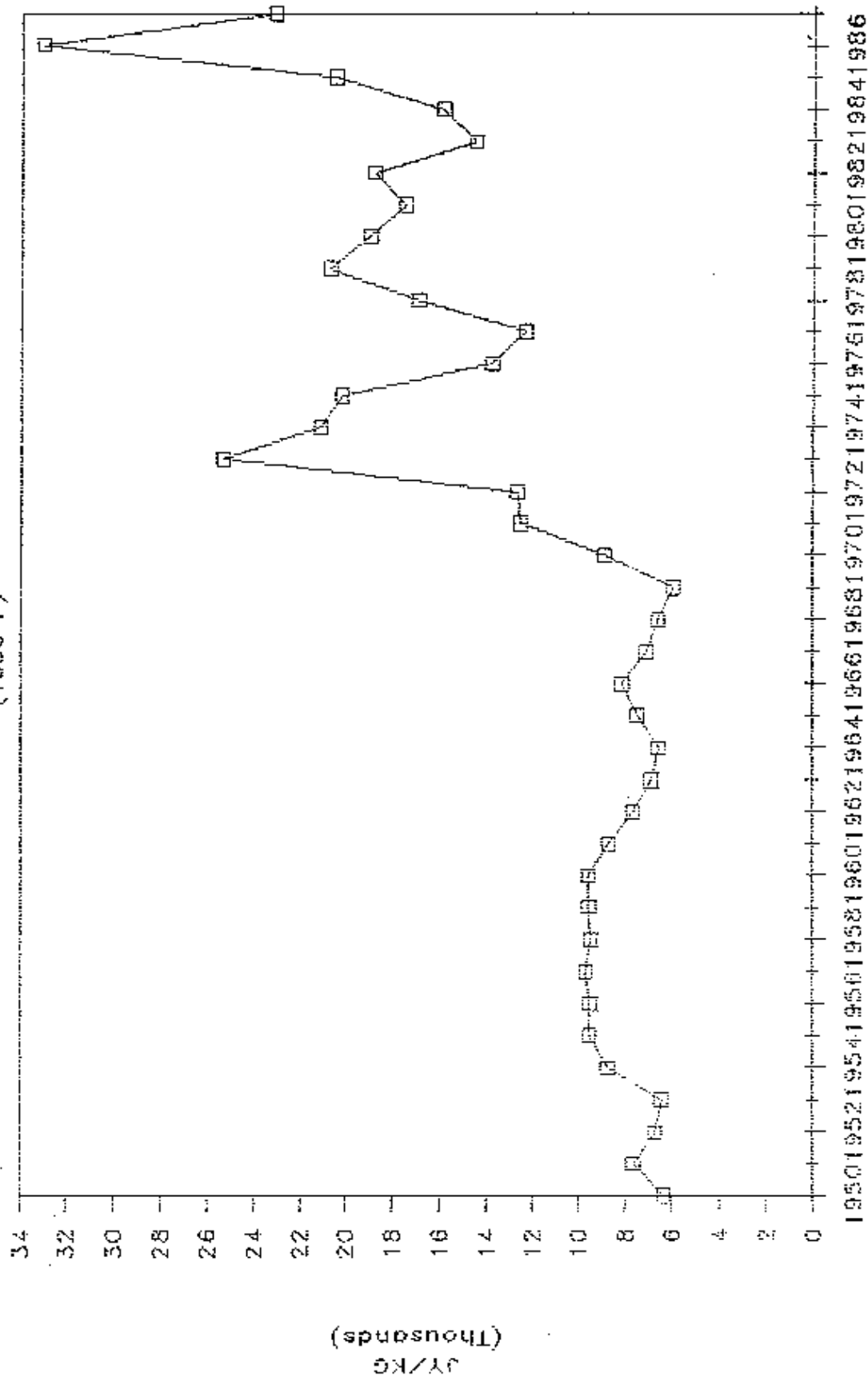


FIGURE 2

Japan -- Percentage Change in Real Raw Ivory Prices (PCJRIP)  
 and Real Discount Rates (RJDR), 1951-87 (1980 P)

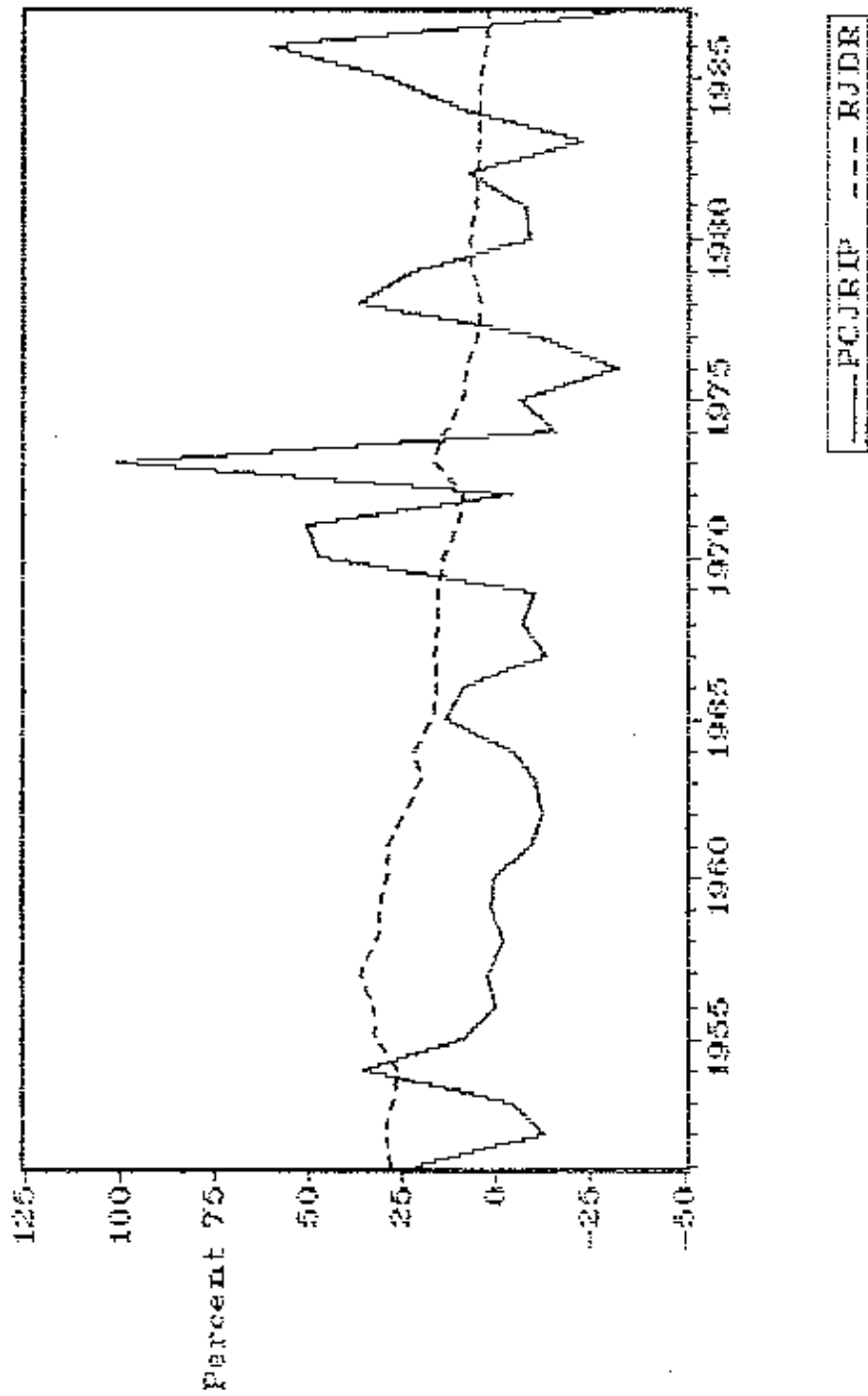
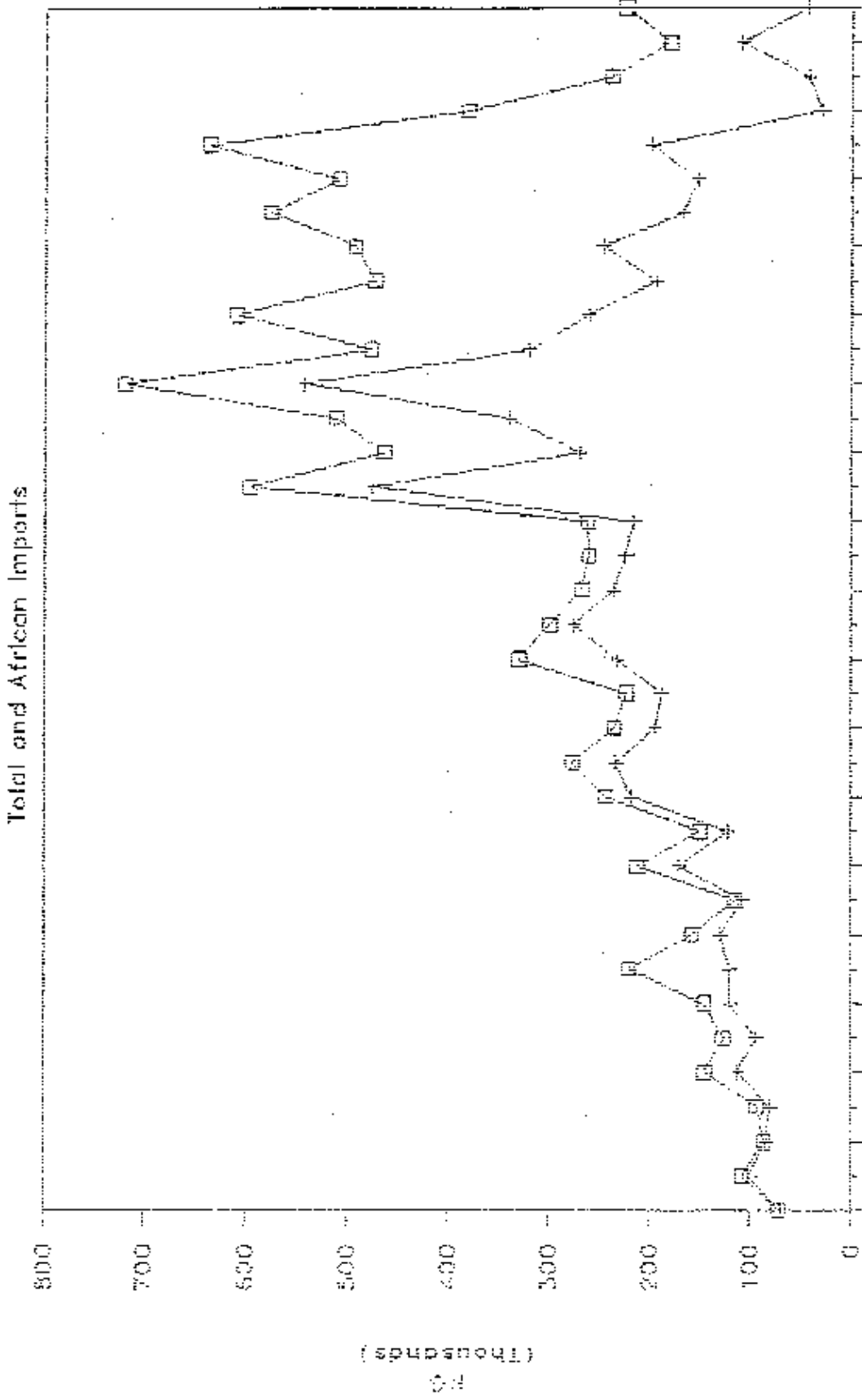


FIGURE 4

# Hong Kong - Imports of Raw Ivory



1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986

— Total imports      + Imports from Africa

# Hong Kong - Real Raw Ivory Prices

(1979/80 P)

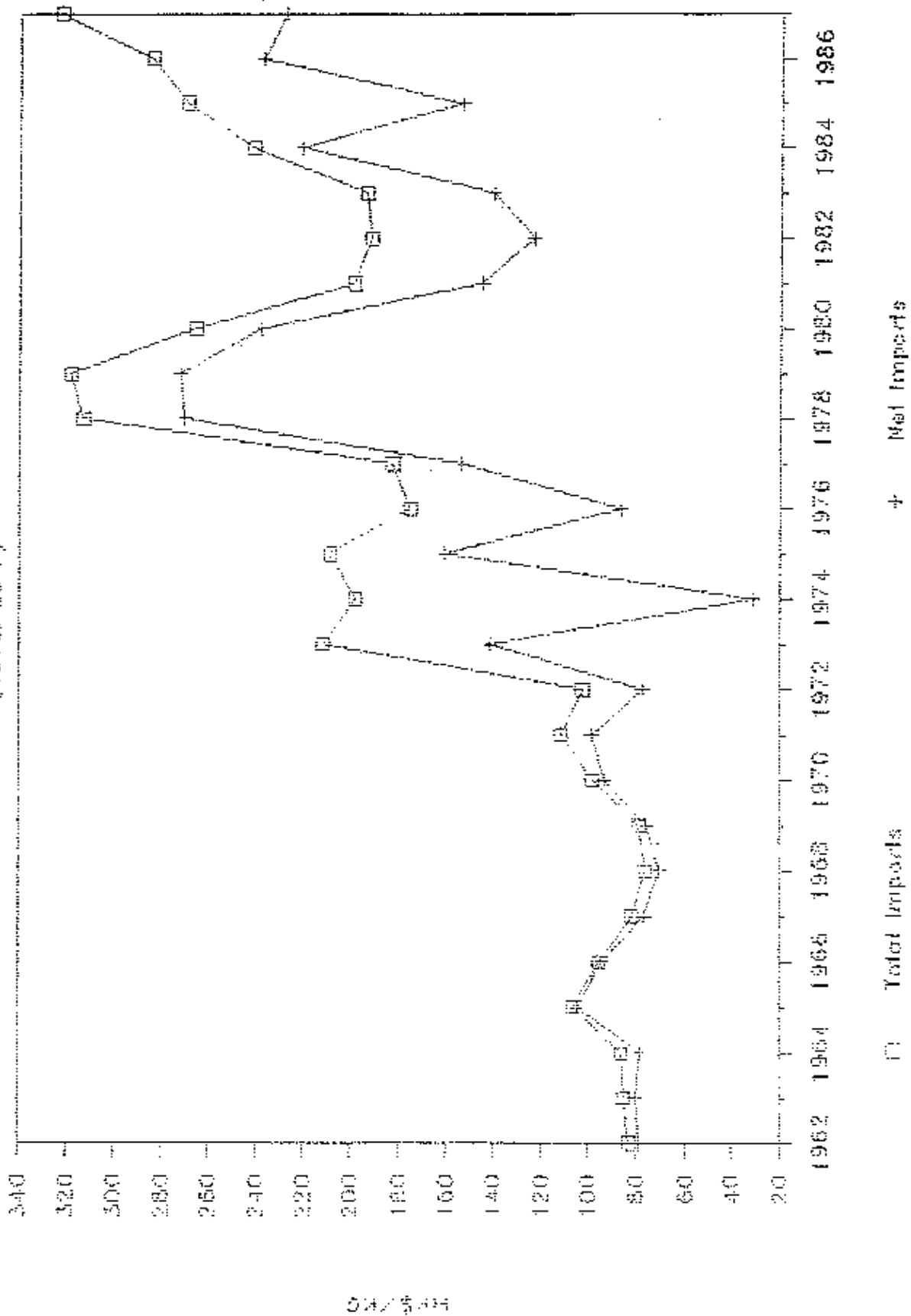


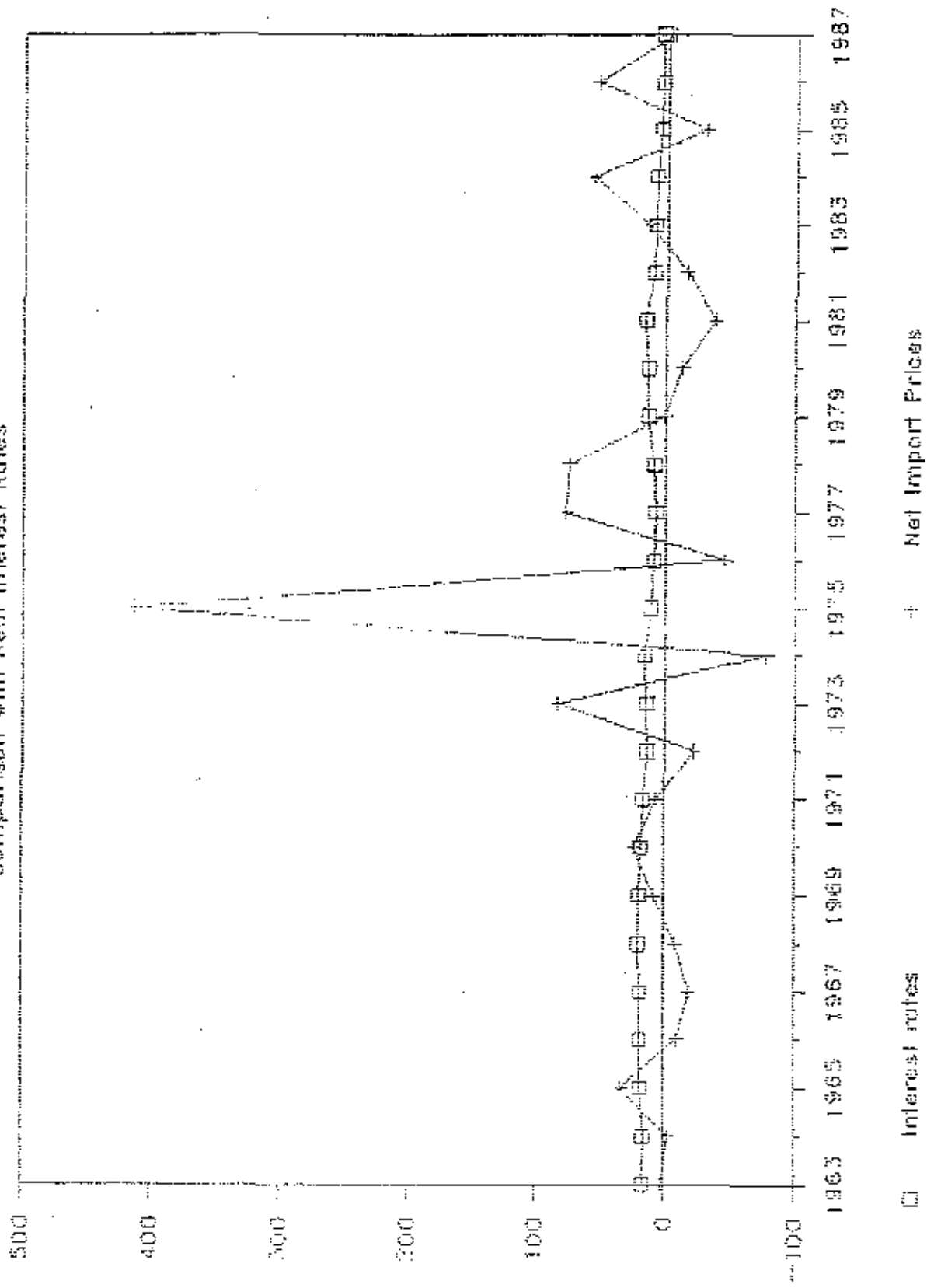
FIGURE 5

04/544

FIGURE 6

# Hong Kong - Change in Real Ivory Prices

Comparison with Real Interest Rates



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