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Export Performance in South Pacific Countries with Inadequate Endowments of Natural Resources: Cook Islands, Kiribati, Niue and Tuvalu, 1960 to 1999

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Abstract

Stochastic dominance analysis was used to assess export performance in four South Pacific island countries with very limited natural resources: Cook Islands; Kiribati; Niue; and Tuvalu. Total export values declined significantly over the study period in all four countries, brought about by a significant decline in the value of agricultural exports while non-agricultural exports showed only small increases.

Results seem to confirm the view that these countries have insufficient natural resource endowments for sustainable economic development without outside support. The fisheries sector holds the key to whether the economies under study (bar Niue) can transform themselves into productive ones by exploiting further the fishery resources within their EEZs to develop domestic fishing industries.

Key words: export performance; Cook Islands; Kiribati; Niue; stochastic dominance; Tuvalu.

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1. Overview of Analysis

The question that we attempt to answer in this study is whether developing South Pacific island countries with what Mellor (1997a) described as inadequate endowments of natural resources were successful in improving commodity export performance over the final four decades of the twentieth century. Commodity export performance is analysed for four independent (or self-governing) developing South Pacific island countries: Cook Islands, Kiribati, Niue and Tuvalu. The period of analysis of export performance, from 1960 to 1999, was dictated largely by the availability of data for a full period of four decades from the 1960s to the 1990s.

Stochastic dominance analysis was used to assess export performance across the four decades, which allowed a simultaneous assessment using two key criteria: the mean value of commodity exports and variability around the mean. Two analytical procedures were followed in its application. First, cumulative distribution functions were calculated and graphed for comparison between decades. This approach was useful where first-degree stochastic dominance or clear second-degree stochastic dominance prevailed. Where stochastic dominance was not immediately apparent, a more advanced analytical procedure was needed.

The RISKROOT program devised by McCarl (1996), based on the more advanced analytical procedure of stochastic dominance with respect to a function (Hardaker, Huirne and Anderson 1997, pp. 149-150) suited this purpose. RISKROOT was applied to two sets of data: the raw export values and trend-corrected export values within each decade. The latter approach assumes that participants in the export sector are only averse to variability around the trend in values whereas the former approach assumes they are averse to all variability. Results are reported for the approach using the raw export values, as the sets of results differ only in the extent of dominance, and then only in a few circumstances.

Measures of absolute risk aversion were estimated assuming participants in the export sector have a normal relative risk-aversion coefficient of unity. This coefficient was divided by an estimate of the wealth of the participants to derive the absolute risk aversion coefficient that could then be compared with the break-even risk aversion coefficient (BRAC) estimated in the RISKROOT program. Because the risk-aversion coefficients are estimated by a crude approximation, we decided to adopt a conservative approach and include a buffer zone 100 per cent each side of the estimates of the coefficients. If the BRAC were to fall within this zone, the values were considered too close to each other to make an informed assessment of which decade is superior in export performance.

The data used are values of total domestic commodity exports, and disaggregated values of agricultural and non-agricultural exports. All series were converted into US dollars using the pertinent annual average exchange rate to enable comparisons across countries. The series are expressed in real terms in 1999 prices, using the world export unit value index published by the International Monetary Fund (IMF) (2002) as a deflator. Values taken from reference sources other than those published by national statistics departments and central banks that were published in nominal local currency terms are also converted to 1999 US dollars.

Agricultural exports are taken to include raw and processed agricultural products because it proved impossible to separate the value added by processors from that by agricultural producers of the raw material outputs. Gross export values were used instead of net value added. The latter series would have given a better picture of changes in export profitability but could not be used because cost data were almost universally unavailable.

Data were confined to annual observations because more time-disaggregated data were not available for the full study period. In general, national statistical agencies were the chief data sources. Resort was also made to export value statistics published the National Centre for Development Studies (NCDS 1995), ADB (2002) and various editions of the Pacific Islands Yearbook (Carter 1981). The principal national sources were: Cook Islands Office of Statistics (2002); Kiribati Statistics Office (1989); Government of Kiribati (1994); and Statistics Unit (1993).

Copra export statistics for Kiribati in the 1960s were combined with those for Tuvalu as part of the British colony of Gilbert and Ellice Islands. The export values for Tuvalu were subtracted from the combined statistics for the 1960s according to shares of export volumes.

The following discussion of export performance is based on the results reported for each of the four countries under study. Graphic representation of stochastic dominance between decades is presented while the RISKROOT outputs for stochastic dominance are also provided in summary form. As a supplementary measure, linear trends in values over the full study period are also reported for total, agricultural and non-agricultural exports.

2. Analysis of Commodity Export Performance: Cook Islands

Trends in export values in Cook Islands over the study period are reported in Table 1. Results of the stochastic dominance analysis for total exports are presented in graphical form in Figure 1 and for RISKROOT analysis in Appendix 1. Comparable results for agricultural exports are presented in Figure 2 and Appendix 2, and for non-agricultural exports in Figure 3 and Appendix 3.

Table 1

Linear Trends in Total, Agricultural and Non-Agricultural Export Values, 1960 to 1999

Country	Trend coefficients in values (*t*-ratios) and annual percentage changes					
	Total exports		Agricultural exports		Non-agricultural exports	
	US$000	%	US$000	%	US$000	%
Cook Islands	-204.4 (-8.31)	-3.5	-225.9 (-12.69)	-8.5	21.5 (1.62)	1.3
Kiribati	-731.0 (-3.43)	-6.4	-102.9 (-3.43)	-3.1	-628.1 (-3.08)	-8.6
Niue	-12.2 (-4.87)	-4.2	-4.8 (-2.22)	-2.6	-7.4 (-5.67)	-8.3
Tuvalu	-0.7 (-0.11)	-2.0	-8.1 (-4.87)	-12.1	7.3 (1.18)	17.3

2.1 Overall trend

Total export values declined significantly over the study period by 3.5 per cent per annum (see Table 1). The annual decline of US$204.4 k, significant at less than 1 per cent significance level, was brought about predominantly by an annual average decline in agricultural export values of US$225.9 k, also significant at less than 1 per cent

significance level. The annual average percentage decline in agricultural exports was high, at 8.5 per cent. Non-agricultural exports showed a small annual average annual increase of US$21.5 k, significant at 11 per cent level of significance.

Clear stochastic dominance is present for both total and agricultural export values, with first-degree dominance exhibited in all results. The 1960s are stochastically dominant across all decades, the 1970s dominate the 1980s and 1990s, and the 1980s are dominant over the 1990s. A progressive worsening of commodity export performance is evident in these results.

The picture is less clear for non-agricultural exports. The stochastically dominant decade is the 1990s, with the 1980s dominant only where greater instability is preferred (which is not considered to be a rational response). There is little to separate the 1960s and 1970s. The latter is dominant above the BRAC of 0.0015 in Appendix 3. Therefore, given an estimated absolute risk aversion coefficient of 0.00004, the 1960s are found to dominate the 1970s. The 1980s stochastically dominate the 1960s and also dominate the 1970s with first-degree dominance.

Separate detailed descriptions are now given of trends in agricultural exports and non-agricultural exports.

2.2 Agricultural exports

2.2.1 1960s and 1970s

The explanation of the result showing that the 1960s decade dominates the 1970s for agricultural exports begins with the establishment of citrus and pineapple processing by Island Foods Ltd, a subsidiary of a New Zealand corporation, W. Gregg and Co. Syed and Mataio (1993:71) reported that the citrus industry was already well established by the beginning of the study period:

> The original aim was to process citrus produced from the [citrus replanting scheme], but full utilisation of the factory required a summer crop. Pineapple seemed ideal and an extension programme to expand pineapple production was initiated. The fruit-processing plant gave new impetus to pineapple production.
>
> (Syed and Mataio 1993:72)

Citrus exports were fairly consistent throughout the 1960s, averaging just over US$1 million annually. Fruit juice exports expanded impressively at an average annual rate of US$0.46 million. Development of the fruit industry in this decade was attributable to the intensity of production of a variety of fruits and vegetables with high returns to the limited land resource, suitable access to the New Zealand market and the ready availability of adequate quarantine, transport, communications and other export

marketing infrastructure for the efficient transfer of fresh and processed produce (Fleming 1996:18). The establishment of a processed fruit export industry was seen as a way to exploit small areas of rich soils complemented by a favourable climate that enabled year-round crop production.

The second element of the explanation why the 1960s dominated the 1970s is the government support provided for the new industry that enabled its rapid growth in the 1960s. Domestically, the government promoted the export of processed fruit by five major initiatives: (a) citrus planting and replanting schemes; (b) extension of banana plots; (c) extension of pineapple areas; (d) improved grading, loading and handling facilities; and (e) subsidised inputs and loans (Ward and Proctor 1980:375-376, Syed and Mataio 1993:72-73). In addition, the New Zealand government assisted the industry through technical and financial support, subsidised shipping and the provision of a protected and assured market (Agricultural Planning Unit 1993:29).

The third part of the explanation concerns the withdrawal of much of the above support, which was a major factor in the decline of processed fruit exports from the 1970s onwards. The value of exports of canned fruit had reached US$6.87 million by 1970, by which time citrus exports accounted for around 40 per cent of total exports (Peters 1973:9). Tomato exports, which were important in the early 1960s, peaked at US$1.02 million in 1965 and declined quickly thereafter. They had disappeared by 1970 and only very small volumes were exported during the 1970s.

Domestic price support, under the price support scheme implemented in 1978 to replace input subsidies, was clearly unsustainable (Syed and Mataio 1993:119). Nor was it sufficient to offset the withdrawal of the input subsidies (Agricultural Planning Unit 1993:30). Gregg and Co. sold the fruit-processing factory to the government in November 1978 (Agricultural Planning Unit 1993:30), chiefly because it was having chronic difficulties in obtaining regular and adequate supplies of raw materials. These difficulties were mainly a function of poor management, labour shortages, ageing trees and high-cost inputs (Fairbairn 1985:401).

The final point, made forcefully by the Agricultural Planning Unit (1993:12-14), is that the structure of the economy was changing. Export agriculture was increasingly being viewed as a less profitable option than agricultural activity to supply an enlarged domestic market, brought about by growing demand from the expanding tourist industry and other non-agricultural pursuits. Booming sectors such as tourism, government and migration/remittances eroded comparative advantage in agricultural export production, especially in the competition it provided for labour. This resulted in the export of small volumes of canned fruit exports by world standards with a wage structure that was high relative to competing developing countries in Asia (Fairbairn 1985:175, Mataio 1991:51). Most agricultural producers are now part-time farmers (Syed and Mataio 1993:65-114).

Other factors were also at work impairing the performance of both processed and fresh fruit exports:

- Commitments to foreign buyers of processed fruit exports were not being met (Syed and Mataio 1993:101), a result of supply inadequacies that helped cause the downfall of fruit juice exports (Sevele 1980:7) as well as increased domestic demand (Agricultural Planning Unit 1993:11).
- By 1980, agricultural production was being harmed by soil degradation (Ward and Proctor 1980:375) causing land productivity to decline, especially on sloping lands growing pineapples (Syed and Mataio 1993:61). The limited agricultural land resources were also being reduced by urban and tourist development (Syed and Mataio 1993:61, Agricultural Planning Unit 1993:19).
- The land tenure system discouraged long-term investment by producers of export crops (Agricultural Planning Unit 1993:14, Syed and Mataio 1993:93-98), especially for perennial crops such as citrus (Agricultural Planning Unit 1993:36).
- Government involvement in servicing the export crop industries was proving unsatisfactory by the mid-1970s (Agricultural Planning Unit 1993:30, Syed and Mataio 1993:88-89).
- The banana industry suffered from three problems common to Polynesian countries, namely quality deficiencies, the difficulties of transporting a fragile product and relatively high production costs (Syed and Mataio 1993:95).
- Increased prices of imported inputs following the energy crisis from 1971 reduced the profitability of producing pineapples, citrus fruit and bananas, which were intensive users of purchased inputs (Agricultural Planning Unit 1993:33).
- Climatic constraints played a role with some fresh produce exports (ESCAP 1992:4).

Exports to New Zealand of numerous types of fresh fruits and vegetables, such as avocados, beans, capsicums, zucchini, eggplants and mangoes, commenced in the early 1970s and had reached US$0.27 million by 1979 (Fairbairn 1985:405). They partly offset the decline in citrus, pineapple and banana exports but many waned over the second half of the 1970s (Fleming 1996:19). Values of root crop exports increased during the 1970s but they were quite small.

2.2.2 1980s

The factors impeding export performance in the 1970s continued into this decade, leading the 1980s to be stochastically dominated in the first degree by both the 1960s and 1970s. The fruit processing factory was re-equipped and reorganised in 1982, resulting in a

marked decrease in the value of exports in that year (Fairbairn 1985:401), but this initiative failed to stem the secular decline in processed fruit exports. Other commercial agricultural opportunities began to be exploited, notably papaya (pawpaw), vegetables and root crops, which began to achieve higher returns than traditional agricultural exports. Although the values of these exports failed to match those achieved by fruit exports in the 1960s, export values of all fruit and vegetables reached respectable levels of US$1.52 million in 1982, US$1.44 million in 1985 and US$1.48 million in 1988. Values averaged US$1.20 million in the 1980s, almost treble those of US$0.45 million in the second half of the 1970s. A major event leading to the stochastic dominance of the 1970s over the 1980s was the loss of preferential treatment for exporters to the protected and assured New Zealand market in the mid-1980s (Syed and Mataio 1993:99).

A notable success story in the 1980s was the export of papaya, which rose steadily from negligible export volumes prior to 1976 to peak at US$1.48 million in 1988. This successful development by the private sector (ADB 1995:99) was chiefly a corollary of the growth of the tourist industry that provided 'backloading capacity into the Auckland market' (McGregor 1990:6).

The copra industry, which had contributed significantly if capriciously to agricultural export earnings in the 1960s and 1970s, did a reasonable imitation of Icarus in the 1980s. After export receipts soared in the world oils market boom of 1985 to US$0.68 million, one-half of all agricultural exports in that year, the industry collapsed along with world prices to the extent that no exports occurred after 1987 (Agricultural Planning Unit 1993:6). Chilli exports developed modestly from 1983, reaching their highest value in 1988, but then waned due to limited marketing opportunities and labour shortages in what is a labour-intensive industry with relatively low returns to labour (Fleming 1996:21).

The substantial decline in the coefficient of variation of agricultural export values, observed in the 1980s, continued into the 1990s. This decline resulted from a change in export transactions whereby prices were fixed by negotiation with buyers in New Zealand rather than be subject to volatile world markets (Fairbairn 1985:404).

2.2.3 1990s

Agricultural export performance in the 1990s was disappointing, not helped by the 'serious fiscal and economic situation which had reached crisis point in the country in early 1996' (Mellor 1997b:17). By 1991, values of the principal export, papaya, had almost halved from their peak value. A lack of emergence of alternative fresh produce exports during the 1990s nevertheless meant that papaya remains the major agricultural export even though values declined by an average annual value of US$76 k to finish at US$178 k in 1999.

Taro exports briefly expanded in the wake of the infestation of taro leaf blight in Samoa in 1993, reaching a maximum export value of US$90 k in 1996 before disappearing by 1999. Exports of *maire*, an ornamental crop used to make neck leis for the Hawaiian market, were prominent in the first half of the decade, reaching US$95 k in 1993. As for papaya and taro, *maire* exports fell away in the second half of the decade, valued at just US$19 k in 1999.

The Agricultural Planning Unit (1993:37) expressed fears that the ability to engage in agricultural exporting might be severely restricted if exports were to fall below a critical mass. The low level of agricultural export activity at the end of the study period suggests that threshold might not be too far away. As a stark demonstration of the extent of the fall-off in fruit production, the erstwhile pineapple export industry reached a stage by mid-decade when pineapples were undersupplied in the domestic market (ADB 1995:99).

Non-agricultural exports

There is little to choose in stochastic dominance between the 1960s and 1970s for non-agricultural exports, with the 1960s slightly favoured by a BRAC of 0.0015 in Appendix 3 higher than the estimated absolute risk aversion coefficient of 0.0005. Mean annual export values declined significantly in the 1970s and the coefficient of variation declined slightly. Clothing and, to a much smaller extent, shell exports contributed most to non-agricultural export earnings in the 1960s. Clothing exports averaged US$1.83 million per annum during this first decade, declining slightly in the 1970s when they averaged US$1.56 million.

An absence of mineral and energy resources, and belated development of marine and forest resources that are still of uncertain promise, has meant that the scope for increasing non-agricultural exports has been narrow. The value of clothing and footwear exports in the 1980s continued at around the same level as in the 1970s before jumping sharply to a peak of US$4.7 million in 1987, contributing 70 per cent of total exports in that year. This trend explains the stochastic dominance of the 1980s over the 1960s and 1970s. But the typical constraints faced by manufacturers in small economies materialised in the late 1980s and 1990s in a global environment of trade liberalisation (Agricultural Planning Unit 1993:6). Clothing and footwear exports had declined to US$0.32 million in 1989 and fell further to only US$16 k by 1993 before recovering modestly in 1994 and finishing at US$149 k at the end of the study period.

The dominant export trend in the 1990s concerned black pearl exports from production in the lagoons of the northern atolls. Pearl culture commenced in 1973 on a small scale in Manihiki lagoon. Pearl exports contributed to the expansion of non-agricultural exports in the late 1980s following an impetus to its development in 1982 when management of the industry was taken over by the island council and a private farmer (ADB 1985:111).

Small-scale pearl farming began in 1987 and a large pearl farm commenced operating in 1989 (ADB 1995:112). Having reached a nadir of US$0.99 million in 1996, down from US$1.62 million in 1992, pearl and pearl shell exports grew rapidly in the second half of the 1990s and accounted for the stochastic dominance of the 1990s over the 1980s for non-agricultural exports. Their value reached US$2.83 million in 1999, contributing 79 per cent of total exports, and statistics in the post-study period indicate a further massive increase in export values, which more than trebled in 2000 to account for 92 per cent of total exports. Despite its impressive recent performance, the World Bank (1995:68) expressed reservations about the long-term viability of the pearl industry, observing that it had 'been plagued by poor quality, overstocking and poor technology development'. ADB (1995:114-115) highlighted the difficulties encountered in meeting the rigorous seeding quality requirements and the problems of theft of shell, political interference and non-compliance with the ban on harvesting wild shells. MFEM (2002:15) suspects that the industry is vulnerable to natural and man-made disasters, with the implication that the current overwhelming reliance on this single export makes the external trade balance susceptible to sudden adverse movement. On the positive side, Hunt (2001a:23) outlined the recent introduction of individual catch quotas into traditional fisheries management processes as a means of ensuring sustainable catches in future.

3. Analysis of Commodity Export Performance: Kiribati

Trends in export values in Kiribati over the study period are reported in Table 1. Results of the stochastic dominance analysis for total exports are presented in graphical form in Figure 4 and for RISKROOT analysis in Appendix 4. Comparable results for agricultural exports are presented in Figure 5 and Appendix 5, and for non-agricultural exports in Figure 6 and Appendix 6.

Given the dominant influence of phosphate export earnings in the first two decades of the study period, the cessation of phosphate mining in 1979 means any comparison between the first two and last two decades of total and non-agricultural exports is not very meaningful. For this reason, the first and last two decades are recorded and discussed separately for these categories in Figures 4(a) and 4(b) and Appendices 4(a) and 4(b), respectively.

3.1 Overall trend

Non-agricultural exports grew by an average of 11.4 per cent per year during the first two decades of the study period. The 1970s stochastically dominate the 1960s for total and non-agricultural exports, due to their much higher phosphate export values. A comparison between the 1980s and 1990s reveals that average non-agricultural export values grew by US$52.1 k per year over the final two decades, and values in the 1990s

stochastically dominate those in the 1980s in the first degree. Total exports in the 1990s narrowly dominate those in the 1980s in a higher degree, where the estimated risk aversion coefficient of 0.00026 is above the BRAC of 0.00005 in Appendix 4. Even though the mean total export figure in the 1990s is slightly below that for the 1980s, the substantially lower standard deviation is enough to outweigh this effect.

Agricultural exports declined over the study period by 3.1 per cent (US$102.9 k) per annum, significant at less than 1 per cent significance level. The 1960s stochastically dominate all other decades for agricultural exports, with the next most dominant decade the 1970s. It is a close-run competition for stochastic dominance in agricultural export values between the 1980s and the 1990s with the latter decade prevailing, given an estimated absolute risk-aversion coefficient of 0.0004 below the BRAC of 0.007 reported in Appendix 5.

3.2 Agricultural exports

Kiribati possesses a very narrow agricultural base, dominated by giant swamp taro in the domestic market and coconut production for domestic consumption and export as copra. Four factors explain this reliance on one agricultural export: exceptionally limiting agricultural land resources; high population growth rate; internal and international transport constraints; and a macroeconomic environment that is not conducive to the development of export industries. In respect of the fourth point, Kiribati exhibits strong MIRAB (migration, remittances, aid and bureaucracy (Bertram and Watters 1985)) characteristics of rents earned from aid and a trust fund, low propensity to save, remittances and the licensing of foreign fishing vessels, a large public sector, and a poorly developed private sector (World Bank 1991:157-169, Fleming and Hardaker 1995:100-101).

3.2.1 1960s and 1970s

As the sole agricultural export (and virtually the only commercial agricultural crop), copra became the major export in Kiribati following the cessation of phosphate mining in 1979, contributing around 90 per cent of domestic export revenue in 1980. The value of copra exports averaged US$5.38 million in the 1960s. It declined by an annual average of US$38.4 k during that decade before levelling off at a lower mean annual value of US$4.72 million during the 1970s. The downward trend might have been restrained but values certainly did not stabilise. The coefficient of variation increased markedly from 0.31 in the 1960s to 0.71 in the 1970s as export prices fluctuated with the increasingly volatile world market conditions in the latter decade.

3.2.2 1980s

Kiribati achieved its independence in 1979, and so the 1980s was the first decade as an independent nation. During this decade, the contribution by copra to export values in relative terms fluctuated on a downward trend with the emergence of various fish exports and lower export values that averaged 57 per cent of the values attained in the previous decade. Annual export values continued to be erratic due to export price volatility and the vagaries of the climate (World Bank 1991:157). They were particularly low between 1985 and 1987 due to the combined influences of low world prices and drought (World Bank 1991:165).

3.2.3 1990s

Copra exports held up remarkably well during the 1990s compared with other South Pacific countries, with a mean export value of US$2.31 million and coefficient of variation of 0.57 compared with US$2.70 million and 0.72 in the 1980s. A mid-decade world price recovery, instigated by a cyclone that severely reduced production in the world's major producing country, the Philippines, resulted in an export value of US$3.6 million in 1995, the highest figure since the previous world oils market boom a decade earlier. Export values remained close to US$3 million in the final two years of the study period, and the proportion of exports contributed by copra remained above 50 per cent. A major factor behind this encouraging performance was the provision of government subsidies to maintain a remunerative producer price (ADB 1998:100).

Copra export remains the only commercial agricultural activity, despite its low profitability, owing to its suitable attributes for the agricultural environment in Kiribati. All the same, its export performance in the 1990s—and 1980s—still lagged well behind the 1960s and 1970s. The mean value of copra exports in the 1960s of US$5.38 million was double that in the 1980s and 1990s, and the mean value of US$4.72 million in the 1970s was not far behind the 1960s value. A declining trend in copra export price and falling productivity with ageing palms were the main two causes of this trend. The forecast a decade ago by the World Bank (1991:169) of limited prospects for growth in the copra industry has been confirmed, and the best scenario for the industry is probably to hold its current position.

3.3 Non-agricultural exports

3.3.1 1960s and 1970s

Non-agricultural exports were almost wholly derived from phosphate in the first two decades of the study period. Mean phosphate export values almost trebled from US$13.6 million in the 1960s to US$36.5 million in the 1970s.

3.3.2 1980s

Non-agricultural exports excluding phosphate increased during the 1980s following the establishment by the government of a commercial pole-and-line fishing corporation, Te Mautari Ltd, in 1981 to export bulk frozen tuna (World Bank 1991:165, Fairbairn 1992:22). Up to this point, Kiribati had relied solely on licence fees from foreign fishing vessels exploiting the rich tuna resources to earn foreign revenue in its EEZ, the largest among the countries under study (ADB 1998:103).

Fish exports grew from US$0.5 million in 1982 to US$1.9 million in 1989, almost wholly contributed by Te Mautari Ltd (World Bank 1991:165). This growth was briefly interrupted by a rapid decline in volume in 1987 due to bad weather (World Bank 1991:165). The establishment in 1987 of the Marine Export Division of the Ministry of Natural Resources to export quality chilled fish from the island of Kiritimati failed due to problems with air service links, lack of quality control, and other managerial, marketing and financial constraints (World Bank 1991:166).

3.3.3 1990s

The operations of Te Mautari Ltd were suspended in 1991 because of financial, management and technical problems (World Bank 1991:165, Fairbairn 1992:22), causing a precipitous decline in fish exports in the early 1990s. The corporation has not been a financial success, bedevilled by variability in tuna stocks and difficulties in obtaining reliable bait supply (ADB 1998:111). At the time of the trouble experienced by Te Mautari Ltd, a private fishing company, Teikabuti Fishing TFC Ltd, began catching fish for export but at low values (Savins 2001:16). Fish exports were valued at only US$0.18 million in 1991, not much more than one-tenth the value two years previously.

Fish exports were given a boost following the establishment of a joint-venture fishing operation with a Japanese partner in 1994 that entailed the purchase of a purse seiner, although its performance has not been particularly impressive (Savins 2001:19). It did result in a marked recovery in fish exports, which reached a value of US$0.68 million in 1998. Overall, the mean export value of non-agricultural exports in the 1990s was US$1.45 million, and the coefficient of variation was slightly lower than in the 1980s. This result was sufficient for the 1990s to be stochastically dominant over the 1980s, when the mean export value was US$1.13 million.

The decline in fish exports in the early 1990s was offset by a concurrent private-sector diversification of the marine resources sector (ADB 1998:104) that led to increased exports of other marine products. Seaweed production was taken up enthusiastically by villagers in the outer islands who have few other cash-earning opportunities (ADB 2000a:178). Seaweed export value increased from a low level in the 1980s to peak at US$0.44 million in 1991. Shark fin export value also increased over the 1980s, reaching

its maximum level four years later than seaweed exports at US$0.37 million in 1995. Pet fish exports commenced in 1991 and reached US$0.46 million by 1995, while bêche de mer exports commenced two years later in 1993 and peaked at US$0.47 million in 1994.

Concern has been expressed about the sustainability of catch levels of shark fin, pet fish and bêche de mer in light of their export growth in recent years. ADB (1998:104) asserted that 'current harvesting rates are exceeding sustainable levels, and future exports are likely to decline from present levels'. Teiwaki (1988:41), cited by Hunt (2001a:20), recounted the transition from a strict traditional management regime to open access fisheries under which problems of overfishing could only be resolved by intervention by island councils according to Hunt (2001a:21). While the World Bank (1995:69) viewed the future of the seaweed industry favourably, it did point out that Kiribati would face strong competition from countries such as the Philippines and Indonesia. One positive sign is that these competing countries have been experiencing declining yields caused by water pollution (ADB 2000a:178).

4. Analysis of Commodity Export Performance: Niue

Trends in export values in Niue over the whole study period are presented in Table 1. Results of the stochastic dominance analysis for total exports are presented in graphical form in Figure 7 and for RISKROOT analysis in Appendix 7. Comparable results for agricultural exports are presented in Figure 8 and Appendix 8, and for non-agricultural exports in Figure 9 and Appendix 9.

4.1 Overall trend

Total export values in Niue regressed by 4.2 per cent (US$12.2 k) per annum over the study period (see Table 1). The decline was significant at less than 1 per cent significance level. Both agricultural and non-agricultural exports contributed to this decline, with the former decreasing annually by 2.6 per cent (US$4.8 k, significant at 4 per cent significance level), and the latter by 8.3 per cent (US$7.4 k, significant at less than 1 per cent significance level).

Although the estimated risk-aversion coefficient of 0.0020 was fractionally below the BRAC of 0.0021 reported in Appendix 7, slightly favouring the 1960s, stochastic dominance for the value of total exports between the 1960s and 1970s was too close to call. A decline in mean value from US$522 k to US$503 k from the 1960s to the 1970s was offset by a fall in the coefficient of variation from 0.41 to 0.32. This result means that these two decades share overall dominance. The 1970s dominated the 1960s for agricultural exports, with the mean annual value increasing from US$303 k to US$391 k and the coefficient of variation declining from 0.53 to 0.14. But the opposite trend

eventuated for non-agricultural exports. The mean annual values declined from US$220 k to US$148 k and the coefficient of variation increased from 0.39 to 1.17.

The largest decline in agricultural and non-agricultural exports occurred between the 1970s and 1980s, which meant that the 1960s and 1970s stochastically dominated the 1980s in the first degree. The mean annual values in the 1980s were less than half those in the 1970s for both categories.

There was little to choose between the 1980s and 1990s for total and agricultural exports. For total exports, the 1980s were slightly stochastically dominant, with an estimated risk-aversion coefficient of 0.0004 lying below a BRAC of 0.0025 reported in Appendix 7. In the case of agricultural exports, the 1990s were slightly stochastically dominant, with an estimated risk-aversion coefficient of 0.0005 lying above a BRAC of 0.0001 reported in Appendix 8. Mean values for the decades were virtually the same while the coefficient of variation was lower in the 1990s. Annual non-agricultural export values continued to decline in the final decade of the study period and had a higher coefficient of variation, making the 1980s stochastically dominant over the 1990s in the second degree.

4.2 Agricultural exports

Niue has been remarkably active in exporting a variety of agricultural products given its extremely small economy and negligible agricultural research capacity. But export values have been trending downwards since the early 1980s. The only export to move against this trend has been taro. Declining agricultural export performance can be attributed to many factors: difficulty in satisfying the increasingly exacting conditions in export markets and defending niche export markets; strong MIRAB characteristics that cause relatively high wages and a large bureaucracy; a high exchange rate by South Pacific standards, given the New Zealand dollar is the official currency; limited international transport facilities and services given the remote location; climatic abnormalities; crop maintenance shortcomings; and pests and diseases (Fleming 1996:49-50, Fairbairn 1997).

Four traditional agricultural products dominated agricultural and total exports in the 1960s. Copra was for long the major traditional export and was the most significant export in the first decade of the study period. Its pre-eminent position as an export industry was more pronounced than is apparent from the statistics because of the devastating effects on copra output and exports in 1960 and 1969 of cyclones in 1959 and 1968, respectively (Tudor 1963, 1972). As in other Polynesian countries, the second important traditional export industry was banana production, with exports sold to the New Zealand market. Like copra, the 1960s were to be the last period when bananas were to be an important export. The effects of cyclones virtually wiped out exports in 1960 and 1969, and banana exports had ceased to be of value by the early 1970s (Tudor 1972). The other two exports were handicrafts and sweet potatoes, which were irregularly exported

to New Zealand in the 1960s. Sweet potato exports ceased in the early 1970s but handicraft exports continued at relatively low values (Tudor 1972).

A number of high-value export industries emerged in the 1970s. Copra was still the second most valuable agricultural export in 1979, at US$102 k (Raad 1980), but its export had ceased altogether in 1984 as producers found a more profitable outlet for their nuts with the rapid emergence of a coconut cream industry and, to a much smaller extent, the export of green nuts to New Zealand from 1983. The value of coconut cream exports was US$329 k at their peak in 1983, but the industry was short-lived. It had collapsed by 1988 following closure of the processing plant because of 'the high cost of labour, technical and management problems, lack of information given to coconut farmers … , shipping problems and lack of interest by the authorities to revive the coconut industry at the right time' (Varnakulasingam 1991:3). A shortage of coconuts in the wake of a drought also contributed to the collapse (Fleming 1996:51).

The passionfruit and lime export industries existed for quite long periods in the 1970s and 1980s, having significant impacts on agricultural export performance in those decades. Passionfruit exports actually commenced in 1965 but it was not until the 1970s that substantial exports were achieved. The export value was at its maximum in 1979 at US$205 k (Raad 1980) when 220 listed growers had planted about 54 hectares (Government of Niue 1979). The industry had disappeared by 1986 following quite a steep decline in exports after 1979. The fatal blow was delivered by cyclone damage (Fairbairn 1998:56) but industry failure was more deep-rooted. It was brought about chiefly by production problems in that planting materials were poorly selected, pests and diseases became rife, and unsatisfactory pollination procedures were followed. Also, management deficiencies occurred in processing and marketing, and there were low returns to producers caused by an amalgam of high processing and marketing costs and low export prices (Fleming 1996:54).

The lime industry, the existence of which spanned the period from 1973 to 1988, peaked twice at US$36 k in 1979 and US$23 k in 1984. There were 225 growers producing limes on 62 hectares and exporting 76 900 kg of lime products in 1979 (Government of Niue 1979:39, Raad 1980:18). The lime industry had three important production advantages over passionfruit: no pollination requirements, easier maintenance and lower labour intensity. On the other hand, there were three major disadvantages of a long gestation period before producers received returns from their investment, greater susceptibility to cyclone damage, especially by the first Cyclone Ofa in 1985, and a lack of economically sustainable export outlets for either limes or lime juice and oil, given transport constraints and dubious profitability in processing (GRM International 1994).

Papaya purée was exported between 1977 and 1983, but it reached only modest values and had little effect on export performance in either the 1970s or 1980s. The major

reasons for failure of this export industry were processing and marketing limitations (Government of Niue 1979:40).

The successful expansion of taro exports, commencing in 1992, disguised the slow recovery of export industries from the effects of the second Cyclone Ofa in February 1990. As in other Polynesian countries, it was a response to the cessation of taro exports from Samoa. Also, there was an impetus to taro production brought on by an increase in farmer numbers as a result of retrenchments in the public service.

4.3 Non-agricultural exports

Non-agricultural exports were of some importance in the first two decades of the study period but had sunk to negligible levels in the last two decades. They were dominated by re-exports in the 1960s and 1970s, which could not be separated from domestic exports.

The manufacture of footballs was the main non-agricultural export in the 1980s, but its effect was felt only in the first half of the decade and exports had ceased by 1989 (ESCAP 1992:16). Their export value peaked at US$101 k in 1982. Small values of stone aggregate exports were recorded in 1982 and 1983.

5. Analysis of Commodity Export Performance: Tuvalu

Trends in export values in Tuvalu over the whole study period are presented in Table 1. Results of the stochastic dominance analysis for total exports are presented in graphical form in Figure 10 and for RISKROOT analysis in Appendix 10. Comparable results for agricultural exports are presented in Figure 11 and Appendix 11, and for non-agricultural exports in Figure 12 and Appendix 12.

5.1 Overall trend

The 1980s was the dominant decade for the value of total exports, given an absolute risk aversion coefficient of 0.002 below the BRAC of 0.028 reported in Appendix 10. The mean value of total exports in the 1980s was much higher than the value in the 1960s. The standard deviation was even higher, but not sufficiently so to offset the higher mean. The worst performing decade was the final one of the study period. The 1990s were stochastically dominated by the 1970s in the second degree, while the 1970s were stochastically dominated by the 1960s in the second degree and the 1980s in the first degree.

Agricultural export values declined over the study period by an average US$8.1 k per annum, significant at less than 1 per cent significance level, a rate of decline of 12.1 per cent. Average annual non-agricultural export values increased over the whole study period by US$7.3 k per year, or 17.3 per cent, significant at less than 1 per cent significance level. The high rate was due chiefly to the fact that there were no non-

agricultural exports recorded prior to 1980. Of greater contemporary interest, non-agricultural export values declined over the final two decades of the study period by an annual average of US$62.6 k, significant at less than 1 per cent significance level, or 15.8 per cent per annum.

5.2 Agricultural exports

Copra has been the only agricultural export of note in Tuvalu, and the experiences of the copra export industry over the past few decades can be clearly seen in the results of the stochastic dominance analysis for agricultural exports. Tuvalu shared with Kiribati a long history of copra production for export, with the calculations of copra export values for Tuvalu extracted from the combined statistics for the Gilbert and Ellice Islands for the 1960s according to shares of export volumes.

The value of copra exports increased over the 1960s by an average of US$33 k per year. Despite a marked recovery in export value in the mid-1970s commodity export boom, when exports were valued at US$561 k in 1974 and US$213 k in 1975, the industry was showing signs of fatigue by the end of the decade and declined disastrously in the early 1980s. Cyclone Bebe adversely affected copra production in 1972. The government initiated a subsidised replanting program during the 1980s. It was partly successful but most palms are now old and susceptible to cyclone damage (McGregor and McGregor 1999:70).

Unlike neighbouring Kiribati, copra production in Tuvalu was on such a small scale that it made the economics of export ever more dubious with inexorably declining real world oils prices. A brief recovery in copra export value occurred in 1985-86, with the high world prices prevailing in yet another mid-decade commodity boom, but it was short-lived. Copra export volumes and values declined to negligible levels in the late 1980s. No exports were made in 1988 but world price increases in 1989 elicited some export response, indicating that industry profitability was sensitive to export prices. Export volumes remained low in the 1990s, with no exports made at all in 1992, 1995 and 1996. Production capacity was further weakened by three cyclones in 1997 (McGregor and McGregor 1999:74). ADB (1997:67) opined that copra was unlikely to become a significant export again. The government recently introduced price support to provide some incentive for growers to persevere with copra production in acknowledgment that they had precious few alternative commercial options.

In the mid-1980s, the government encouraged the export marketing of sweet potato to neighbouring countries that were unable to produce enough staple root crops. The endeavour foundered on internal shipment and other marketing difficulties, such as product deterioration and high transport costs (Talake 1992).

5.3 Non-agricultural exports

With negligible non-agricultural exports from Tuvalu in the first two decades of the study period, the analysis focuses on the 1980s and 1990s. The 1980s stochastically dominated the 1990s in the first degree, due to success in two exports: fish, between 1982 and 1984, and stamps, throughout the 1980s but especially from 1980 to 1984. Given that Tuvalu has the largest sea-to-land ratio of any country in the world, its government had long recognised that fisheries development offers the greatest scope for expanding commodity exports and is supported in this belief by foreign donors (Fairbairn 1993:27). But it has struggled to turn these resources to its economic advantage. The National Fishing Corporation of Tuvalu has seldom made a profit (ADB 1997:78). Between 1982 and 1984, a time when the copra export industry was struggling, substantial amounts of reef fish were exported as part of a USAID project (ADB 1997:75). In the first year of export, the value of fish sold overseas (US$208 k) was almost 20 times the value of copra exports (Fairbairn 1993:56). The value of fish exports reached US$437 k in 1984, after which export ceased as a result of a lack of bait fish (Fairbairn 1993:27).

Creative advantage was taken of the small size and remoteness of the country in the 1970s by developing a philatelic export industry that was facilitated by the activities of an agent in the United Kingdom. The value of stamp exports, which peaked at US$2.49 million in 1981, was largely responsible for the period having the highest mean export value throughout the study period. But the novelty value had worn off somewhat by the late 1980s, and the stamp export value had sunk to US$97 k by 1989 due to weak world demand for philatelic products (Fairbairn 1993:32) and problems with the overseas agent (ESCAP 1992:4). Stamps were nevertheless the only major export in the second half of the decade.

The garment industry commenced in 1989 and US$65 k of shirts were exported to Australia under SPARTECA (Fairbairn 1993:29-30).

6. Conclusions

Stochastic dominance analysis was used to analyse commodity export performance in Cook Islands, Kiribati, Niue and Tuvalu over the period from 1960 to 1999. In Cook Islands, total export values declined significantly over the study period, brought about by a significant decline in the value of agricultural exports while non-agricultural exports showed a small annual increase.

Non-agricultural exports in Kiribati grew during the first two decades of the study period due to higher phosphate export values. However, the cessation in phosphate exports in 1980s meant that non-agricultural export values were much lower in the second half of the study period. Non-agricultural export values nevertheless recovered slightly from this

setback, growing modestly over the final two decades from a low base at the beginning of the 1980s. Agricultural export values declined over the study period, offsetting the gains in non-agricultural export values over the final two decades so that total export values in the 1990s only marginally dominated those in the 1980s.

Total export values in Niue declined substantially over the study period, with falls in both agricultural and non-agricultural export values. The largest decline in agricultural and non-agricultural exports occurred between the 1970s and 1980s. The mean annual values in the 1980s were less than half those in the 1970s for both categories of exports.

The worst performing decade in Tuvalu was the final one of the study period while the mean value of total exports was highest in the 1980s, owing much to the rapid but brief growth of the philatelic industry. Agricultural export values declined over the study period. Non-agricultural export values increased through marine exports, due chiefly to the fact that there were no non-agricultural exports recorded prior to 1980, but values trended downwards towards the end of the study period.

The results reported above seem to confirm the assessment made by (Mellor 1997a:71) that these inadequately endowed countries are 'seen as having insufficient natural resource endowments for sustainable economic development (in the absence of permanent international support)'. The fisheries sector holds the key to whether the economies under study (bar Niue) can transform themselves into productive ones by exploiting further the fishery resources within their EEZs to develop domestic fishing industries.

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Appendix 1 Cook Islands Total Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	9462.80	1782.23	5863.00	11961.00	
1970s	6662.20	2690.79	3709.00	11724.00	0.00012
1980s	4296.80	1076.14	2570.00	6919.00	0.00018
1990s	3321.60	675.11	2307.00	4602.00	0.00026

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPOSITE RESULTS

AT ALL RACS THE DOMINANT SET IS 1 1960s

Appendix 2 Cook Islands Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	7231.20	1224.25	5623.00	8966.00	
1970s	4866.80	2104.34	2596.00	9237.00	0.00017
1980s	1643.20	475.06	1007.00	2439.00	0.00031
1990s	637.10	254.82	246.00	999.00	0.00088

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 1 TIMES

1 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTION CDFS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTION CDFS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS DO NOT CROSS -- 3 IS DOMINANT

COMPOSITE RESULTS

AT ALL RACS THE DOMINANT SET IS 1 1960s

Appendix 3 Cook Islands Non-Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	2231.50	860.55	239.80	3072.70	
1970s	1795.35	704.85	1053.90	2988.50	0.00050
1980s	2653.65	1257.39	1529.90	5912.10	0.00045
1990s	2684.49	684.30	1565.10	3938.00	0.00037

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s THE DISTRIBUTION CDFS CROSS 1 TIMES

A BREAKEVEN RAC = .0015304308 ABOVE WHICH DIST 2 DOMINATES

HERE THE UTILITY DIFFERENCE = -.18511152E-15

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s THE DISTRIBUTION CDFS CROSS 2 TIMES

3 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000

3 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 -.1000000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s THE DISTRIBUTIONS DO NOT CROSS -- 4 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s THE DISTRIBUTIONS DO NOT CROSS -- 4 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s THE DISTRIBUTION CDFS CROSS 1 TIMES

4 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000

A BREAKEVEN RAC = -.0000525716 ABOVE WHICH DIST 4 DOMINATES

HERE THE UTILITY DIFFERENCE = -.75338304E-15

COMPOSITE RESULTS

BELOW RAC = -.00005255716 THE DOMINANT SET IS 3 1980s

ABOVE RAC = -.00005255716 THE DOMINANT SET IS 4 1990s

Appendix 4 Kiribati Total Exports

(a) 1960s and 1970s

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	18949.70	8839.17	8375.00	33221.00	
1970s	41263.70	13397.22	28812.00	66932.00	0.000033

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s

THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

(b) 1980s and 1990s

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1980s	3822.90	2040.47	1451.00	8941.00	
1990s	3765.70	1361.46	1937.00	6381.00	0.00026

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1980s TO DISTRIBUTION 2 CALLED 1990s

THE DISTRIBUTION CDFS CROSS 3 TIMES

A BREAKEVEN RAC = .0000533877 ABOVE WHICH DIST 2 DOMINATES

HERE THE UTILITY DIFFERENCE = .00000000

Appendix 5 Kiribati Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	5382.40	1577.48	3381.00	8245.00	
1970s	4859.60	3193.68	1794.00	13554.00	0.00020
1980s	2695.80	1795.15	330.00	7125.00	0.00026
1990s	2313.80	1074.98	665.00	4096.00	0.00040

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 1 TIMES
1 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTION CDFS CROSS 3 TIMES
A BREAKEVEN RAC = .0007393261 ABOVE WHICH DIST 3 DOMINATES
HERE THE UTILITY DIFFERENCE = -.89724954E-15

COMPOSITE RESULTS

AT ALL RACS THE DOMINANT SET IS 4 1960s

Appendix 6 Kiribati Non-Agricultural Exports

(a) 1960s and 1970s

SUMMARY STATISTICS ON THE DATA (US$ M)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	13.57	8.78	4.62	28.10	
1970s	36.54	12.11	24.73	62.37	0.0399

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s

THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

(b) 1980s and 1990s

SUMMARY STATISTICS ON THE DATA (US$ M)

Distribution	Mean	Std dev	Min	Max	RAC
1980s	1.13	.54	.27	2.08	
1990s	1.45	.50	.79	2.29	0.7752

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1980s TO DISTRIBUTION 2 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

Appendix 7 Niue Total Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	522.39	216.04	269.60	941.30	
1970s	502.97	161.69	265.50	800.50	0.0020
1980s	237.37	192.22	49.30	531.20	0.0027
1990s	213.79	118.28	39.10	328.50	0.0044

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 2 TIMES
A BREAKEVEN RAC = .0021415450 ABOVE WHICH DIST 2 DOMINATES
HERE THE UTILITY DIFFERENCE = -.15108383E-15
A BREAKEVEN RAC = .0848407450 ABOVE WHICH DIST 1 DOMINATES
HERE THE UTILITY DIFFERENCE = -.76581741E-15

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT
COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT
COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT
COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS CROSS 2 TIMES
A BREAKEVEN RAC = .0025656731 ABOVE WHICH DIST 4 DOMINATES
HERE THE UTILITY DIFFERENCE = -.17225200E-15
A BREAKEVEN RAC = .0246824043 ABOVE WHICH DIST 3 DOMINATES
HERE THE UTILITY DIFFERENCE = -.97935662E-15

COMPOSITE RESULTS

BELOW RAC = .0021415450 THE DOMINANT SET IS 1 1960s
BETWEEN .0021415450 AND .0848407450 THE DOMINANT SET IS 2 1970s
ABOVE RAC = .0848407450 THE DOMINANT SET IS 1 1960s

Appendix 8 Niue Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	302.72	160.62	66.30	549.50	
1970s	391.39	53.43	262.60	465.10	0.0029
1980s	188.44	158.84	31.30	444.10	0.0034
1990s	188.02	131.12	20.50	318.00	0.0053

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 1 TIMES
2 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000
A BREAKEVEN RAC = -.0087167148 ABOVE WHICH DIST 2 DOMINATES
HERE THE UTILITY DIFFERENCE = .45778686E-14

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT
COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS CROSS 2 TIMES
A BREAKEVEN RAC = .0001058063 ABOVE WHICH DIST 4 DOMINATES
HERE THE UTILITY DIFFERENCE = .21584489E-15
A BREAKEVEN RAC = .0115823186 ABOVE WHICH DIST 3 DOMINATES
HERE THE UTILITY DIFFERENCE = -.40014902E-16

COMPOSITE RESULTS

BELOW RAC = -.0087167148 THE DOMINANT SET IS 1 1960s

ABOVE RAC = -.0087167148 THE DOMINANT SET IS 2 1970s

Appendix 9 Niue Non-Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	219.68	85.99	102.40	391.90	
1970s	147.91	173.67	.00	453.80	0.0054
1980s	48.93	40.61	4.40	128.10	0.0102
1990s	25.79	25.57	9.60	95.10	0.0268

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s THE DISTRIBUTION CDFS CROSS 1 TIMES
1 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000
A BREAKEVEN RAC = -.0058580067 ABOVE WHICH DIST 1 DOMINATES
HERE THE UTILITY DIFFERENCE = .00000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTION CDFS CROSS 1 TIMES
A BREAKEVEN RAC = .0184895084 ABOVE WHICH DIST 3 DOMINATES
HERE THE UTILITY DIFFERENCE = .28741862E-15

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS CROSS 1 TIMES
A BREAKEVEN RAC = .0385935694 ABOVE WHICH DIST 4 DOMINATES
HERE THE UTILITY DIFFERENCE = -.69711049E-15

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s THE DISTRIBUTION CDFS CROSS 1 TIMES
3 HAS BEEN FOUND DOMINANT BETWEEN -.100000000 .1000000000

COMPOSITE RESULTS

BELOW RAC = -.0058580067 THE DOMINANT SET IS 2 1970s

ABOVE RAC = -.0058580067 THE DOMINANT SET IS 1 1960s

Appendix 10 Tuvalu Total Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	267.12	132.28	107.60	480.30	
1970s	215.48	139.46	35.80	561.20	0.0041
1980s	751.11	718.05	76.70	2523.60	0.0021
1990s	135.25	87.52	.00	247.40	0.0023

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 3 TIMES
1 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000
A BREAKEVEN RAC = -.0086186757 ABOVE WHICH DIST 1 DOMINATES
HERE THE UTILITY DIFFERENCE = .00000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTION CDFS CROSS 1 TIMES
A BREAKEVEN RAC = .0275177636 ABOVE WHICH DIST 1 DOMINATES
HERE THE UTILITY DIFFERENCE = .37190316E-15

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTION CDFS CROSS 2 TIMES
2 HAS BEEN FOUND DOMINANT BETWEEN .1000000000 -.1000000000
COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPOSITE RESULTS

BELOW RAC = .0275177636 THE DOMINANT SET IS 3 1980s

ABOVE RAC = .0275177636 THE DOMINANT SET IS 1 1960s

Appendix 11 Tuvalu Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	267.12	132.28	107.60	480.30	
1970s	215.48	139.46	35.80	561.20	0.0041
1980s	70.03	89.23	.00	314.00	0.0070
1990s	29.57	32.28	.00	100.00	0.0201

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s
THE DISTRIBUTION CDFS CROSS 3 TIMES
1 HAS BEEN FOUND DOMINANT BETWEEN .0000000000 .1000000000
A BREAKEVEN RAC = -.0086186757 ABOVE WHICH DIST 1 DOMINATES
HERE THE UTILITY DIFFERENCE = .00000000

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 1 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 2 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s
THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPOSITE RESULTS

BELOW RAC = -.0086186757 THE DOMINANT SET IS 2 1970s

ABOVE RAC = -.0086186757 THE DOMINANT SET IS 1 1960s

Appendix 12 Tuvalu Non-Agricultural Exports

SUMMARY STATISTICS ON THE DATA (US$ K)

Distribution	Mean	Std dev	Min	Max	RAC
1960s	.00	.00	.00	.00	
1970s	.00	.00	.00	.00	0.0000
1980s	681.10	697.22	66.00	2494.00	0.0008
1990s	125.10	86.17	.00	238.00	0.0007

PAIRWISE RESULTS

THE BOUND READ IN FOR THE RAC LIMITS IT TO BETWEEN +/- .100000E+00

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 2 CALLED 1970s

THE DISTRIBUTIONS ARE COINCIDENT -- NO DOMINANCE

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPARING DISTRIBUTION 1 CALLED 1960s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 4 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 3 CALLED 1980s

THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPARING DISTRIBUTION 2 CALLED 1970s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 4 IS DOMINANT

COMPARING DISTRIBUTION 3 CALLED 1980s TO DISTRIBUTION 4 CALLED 1990s

THE DISTRIBUTIONS DO NOT CROSS -- 3 IS DOMINANT

COMPOSITE RESULTS

AT ALL RACS THE DOMINANT SET IS 1 1980s

Figure 1 Cumulative density functions, total exports: Cook Islands

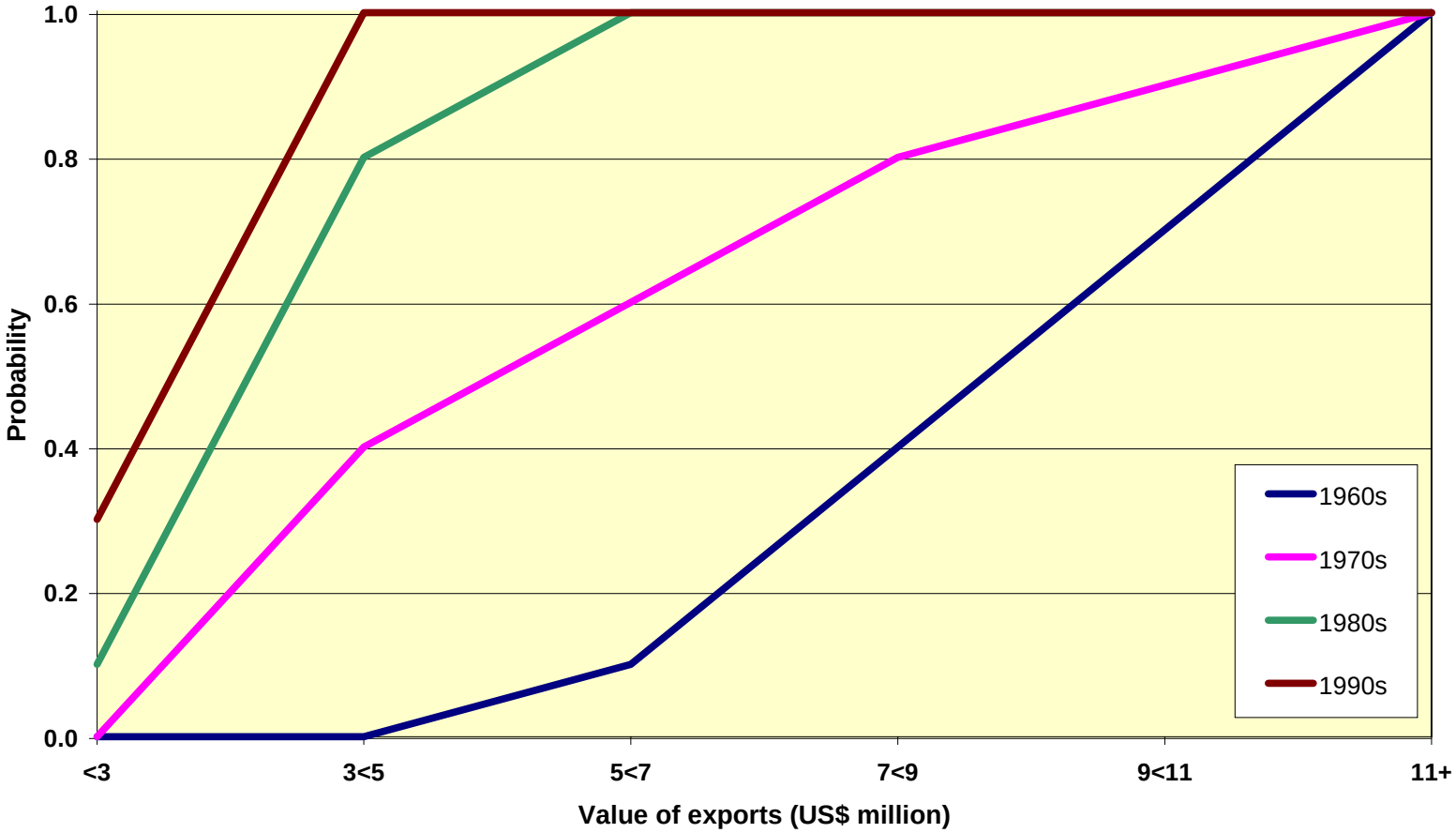

Figure 2 Cumulative density functions, agricultural exports: Cook Islands

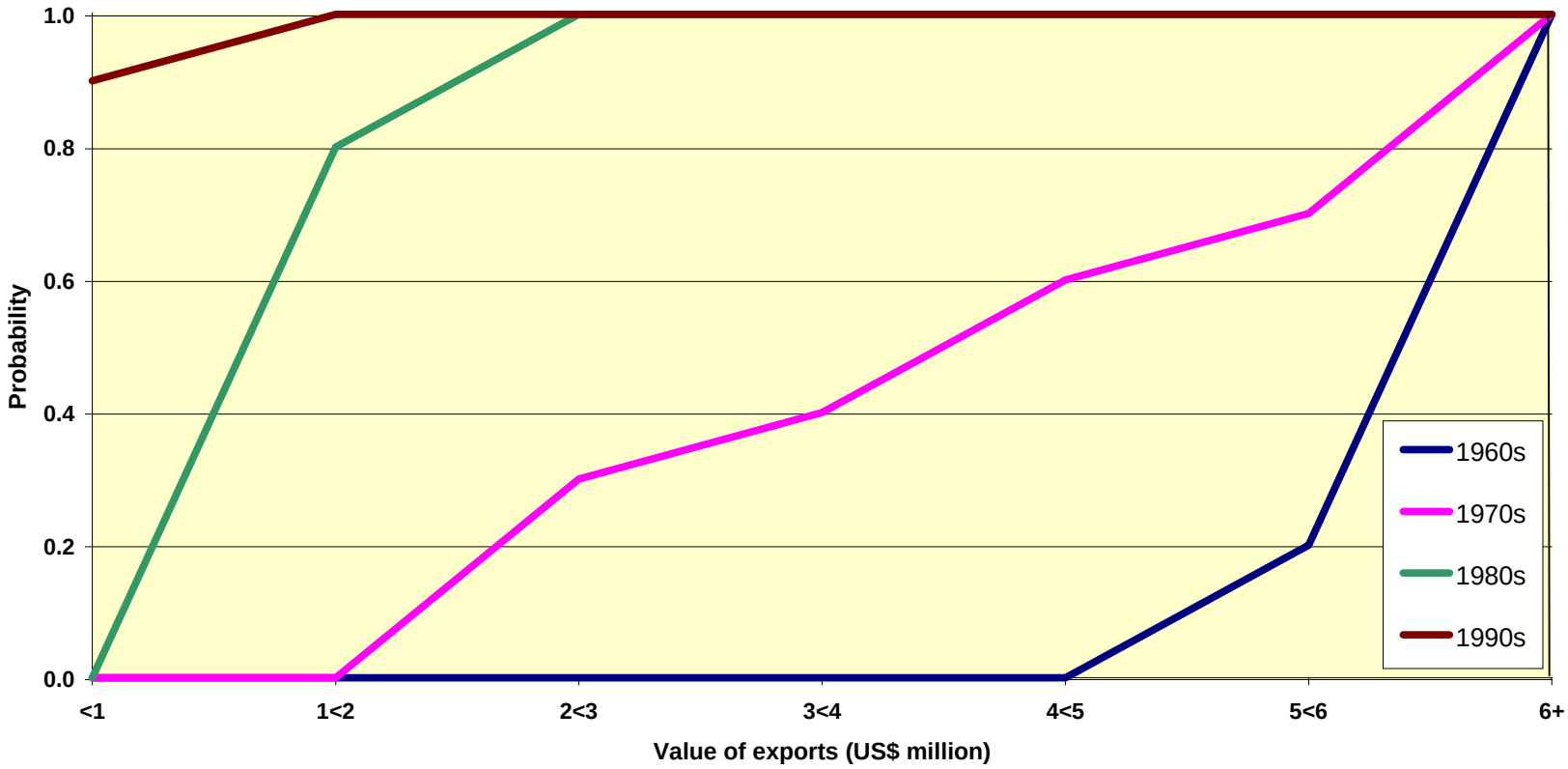

Figure 3 Cumulative density functions, non-agricultural exports: Cook Islands

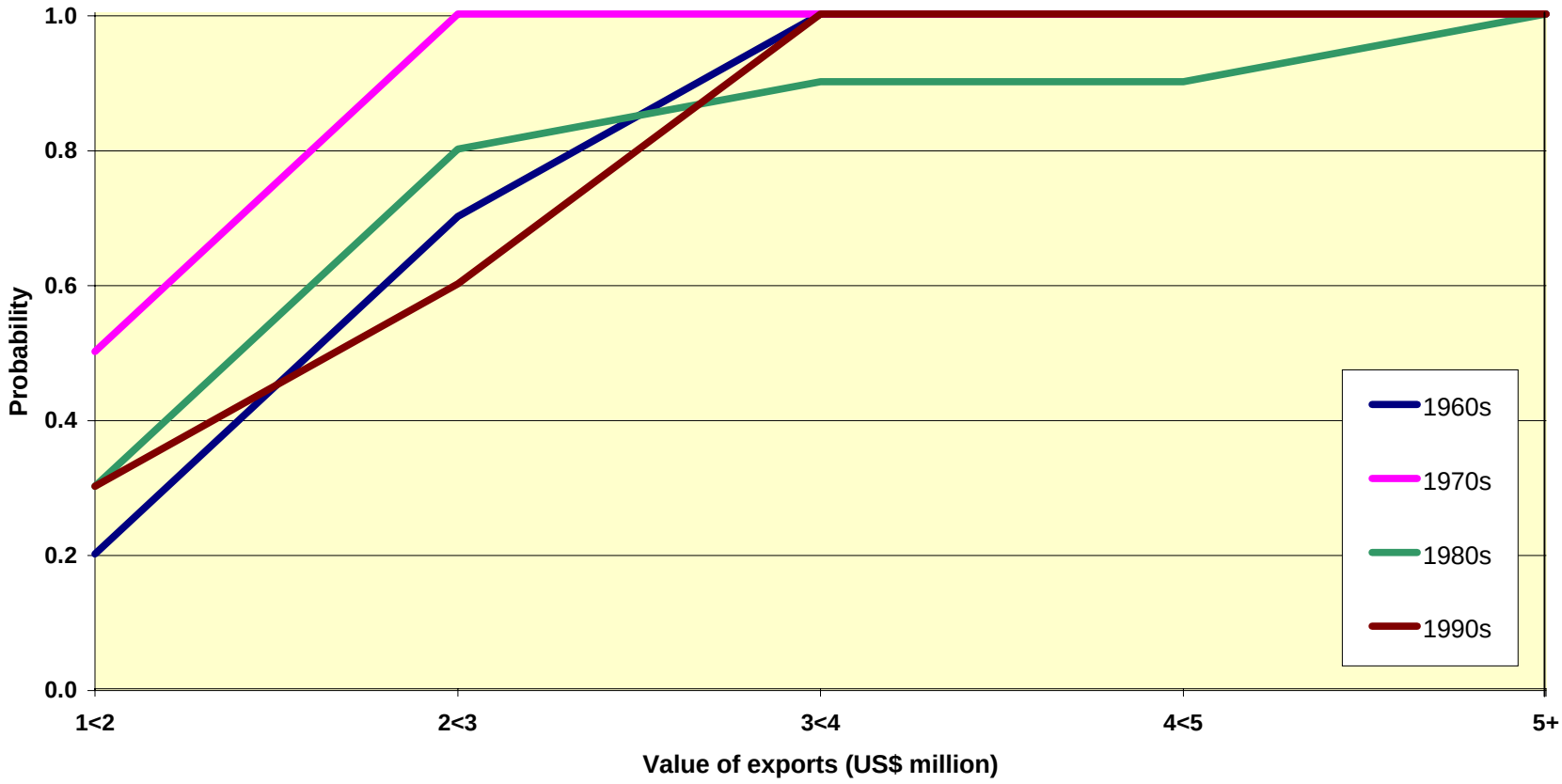

Figure 4 Cumulative density functions, total exports: Kiribati

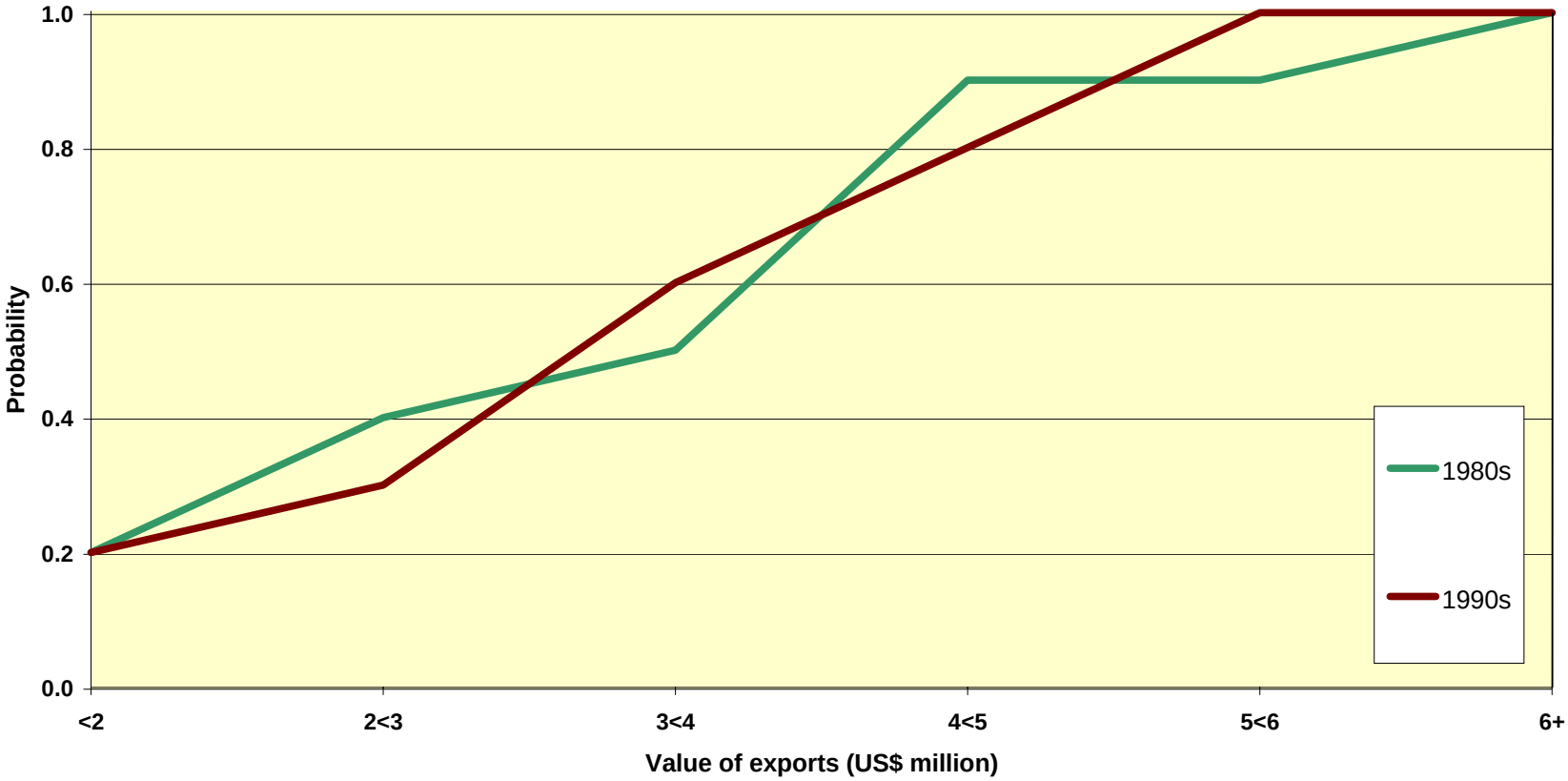

Figure 5 Cumulative density functions, agricultural exports: Kiribati

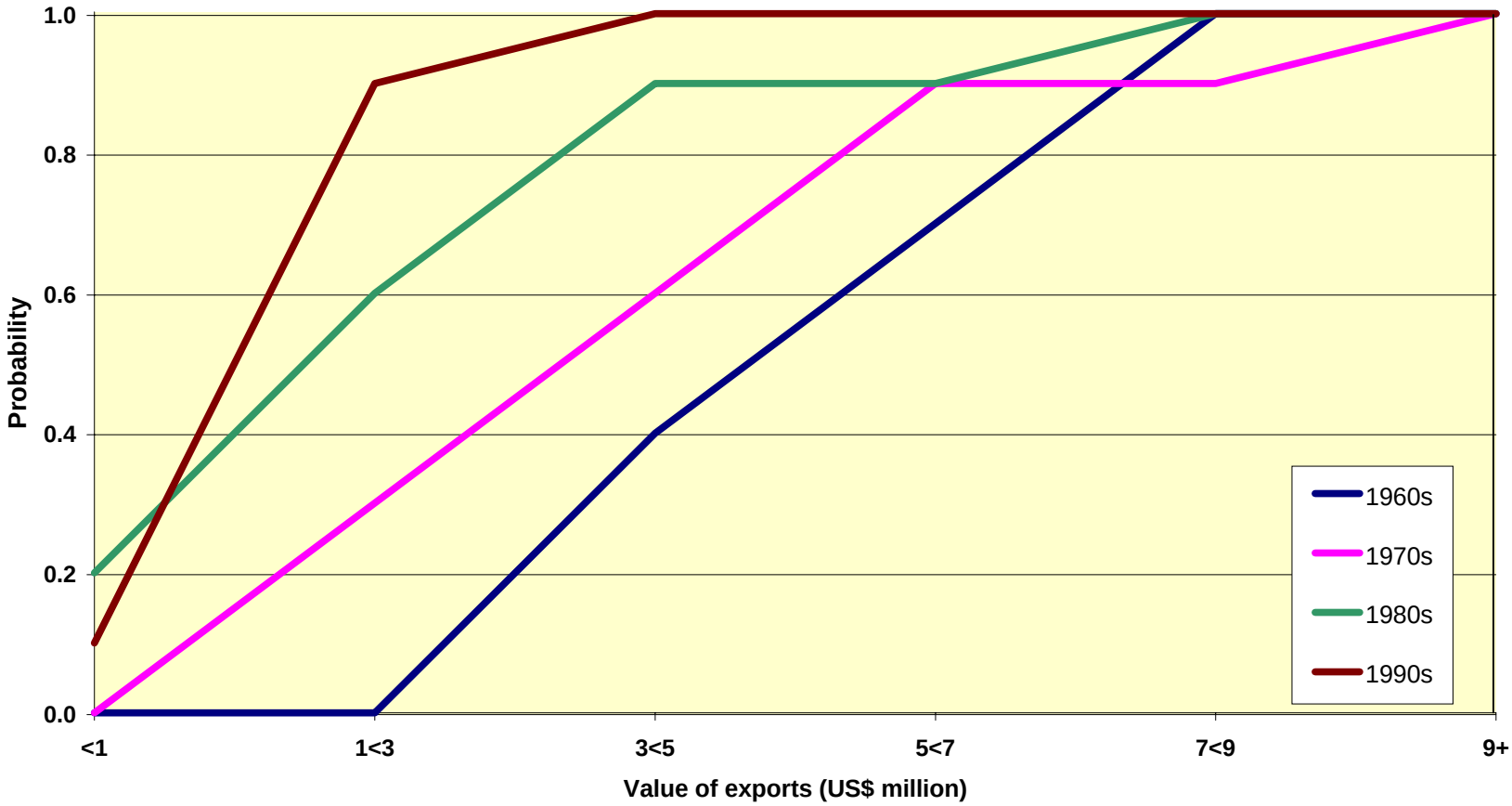

Figure 6 Cumulative density functions, non-agricultural exports: Kiribati

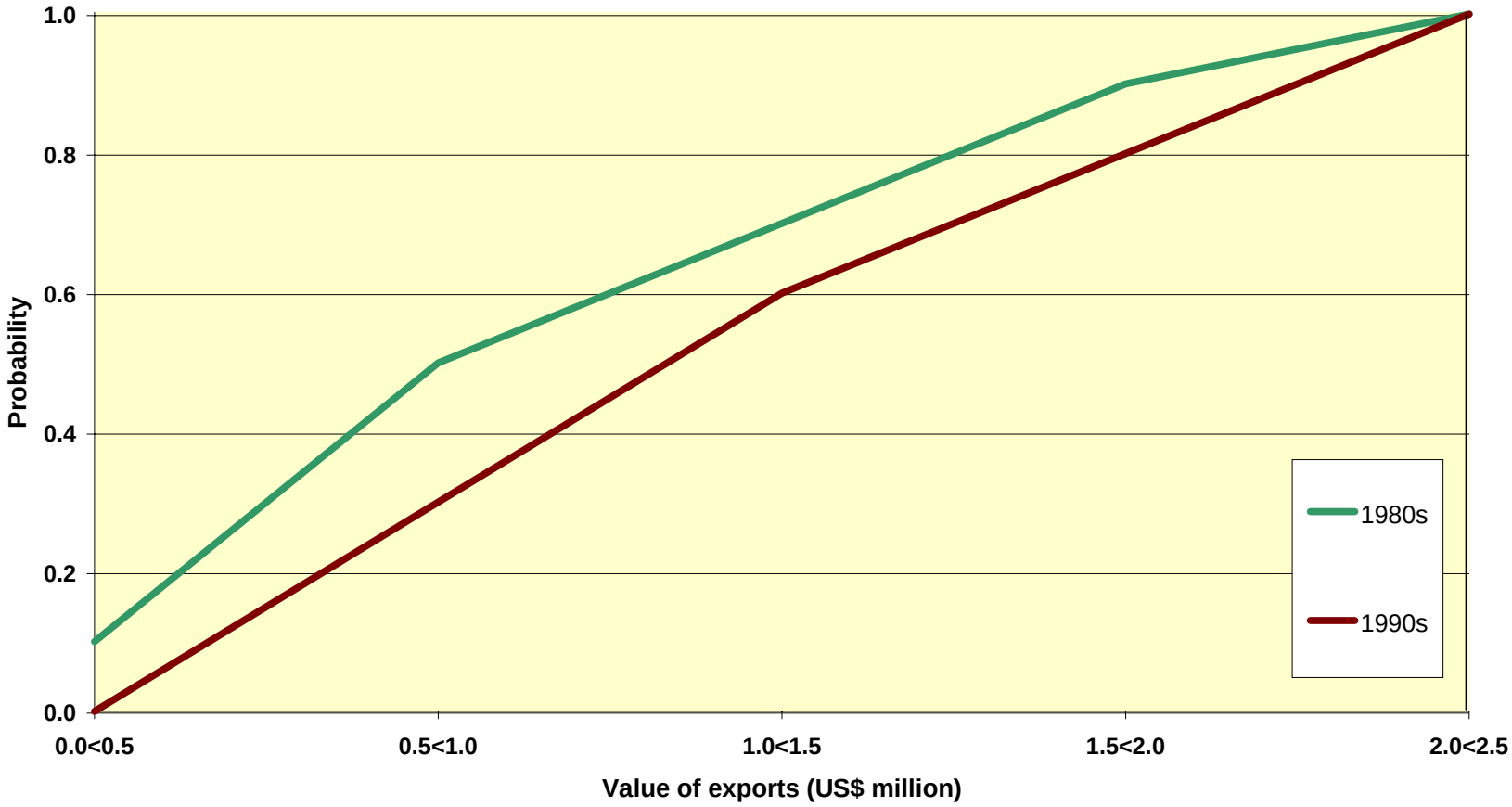

Figure 7 Cumulative density functions, total exports: Niue

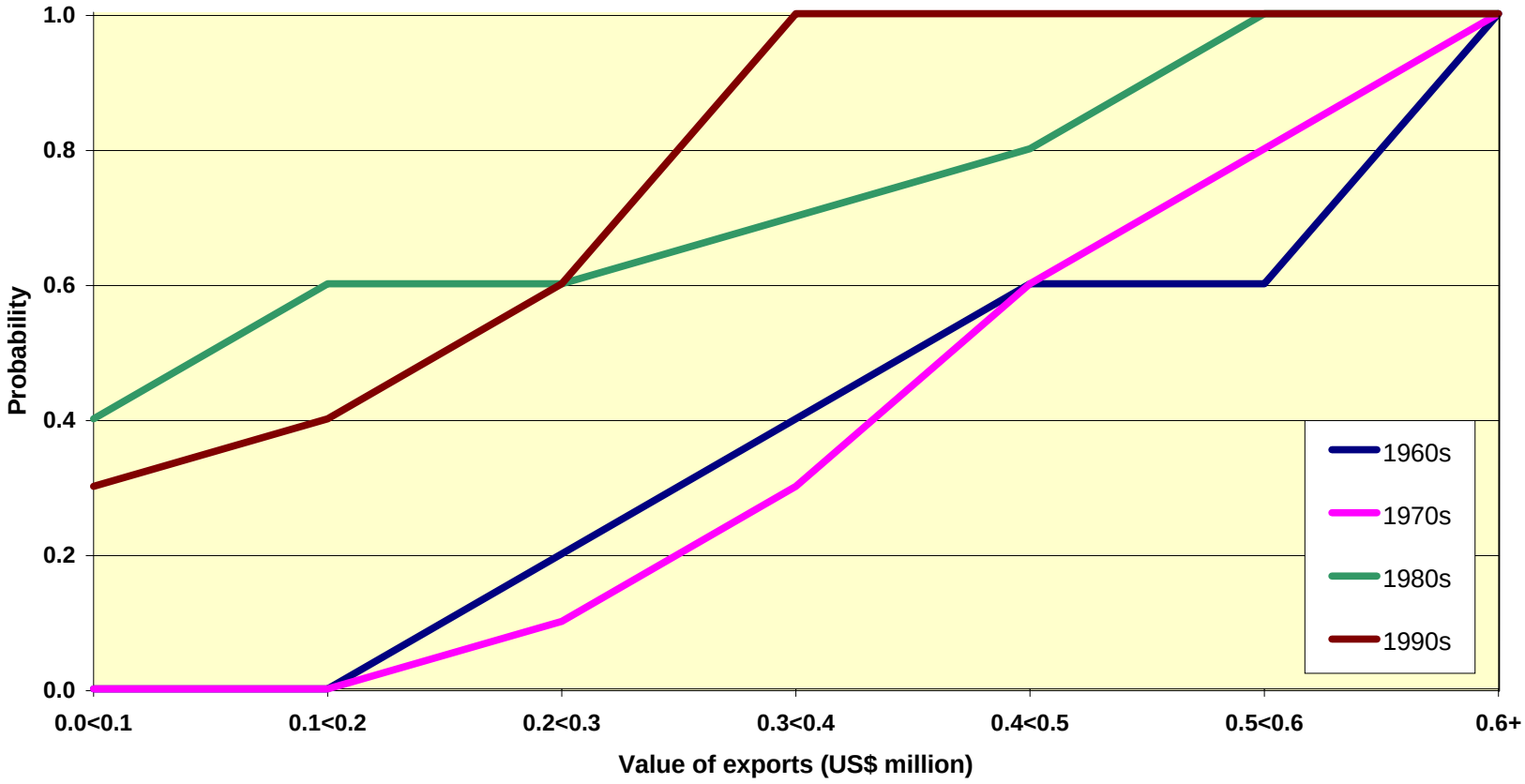

Figure 8 Cumulative density functions, agricultural exports: Niue

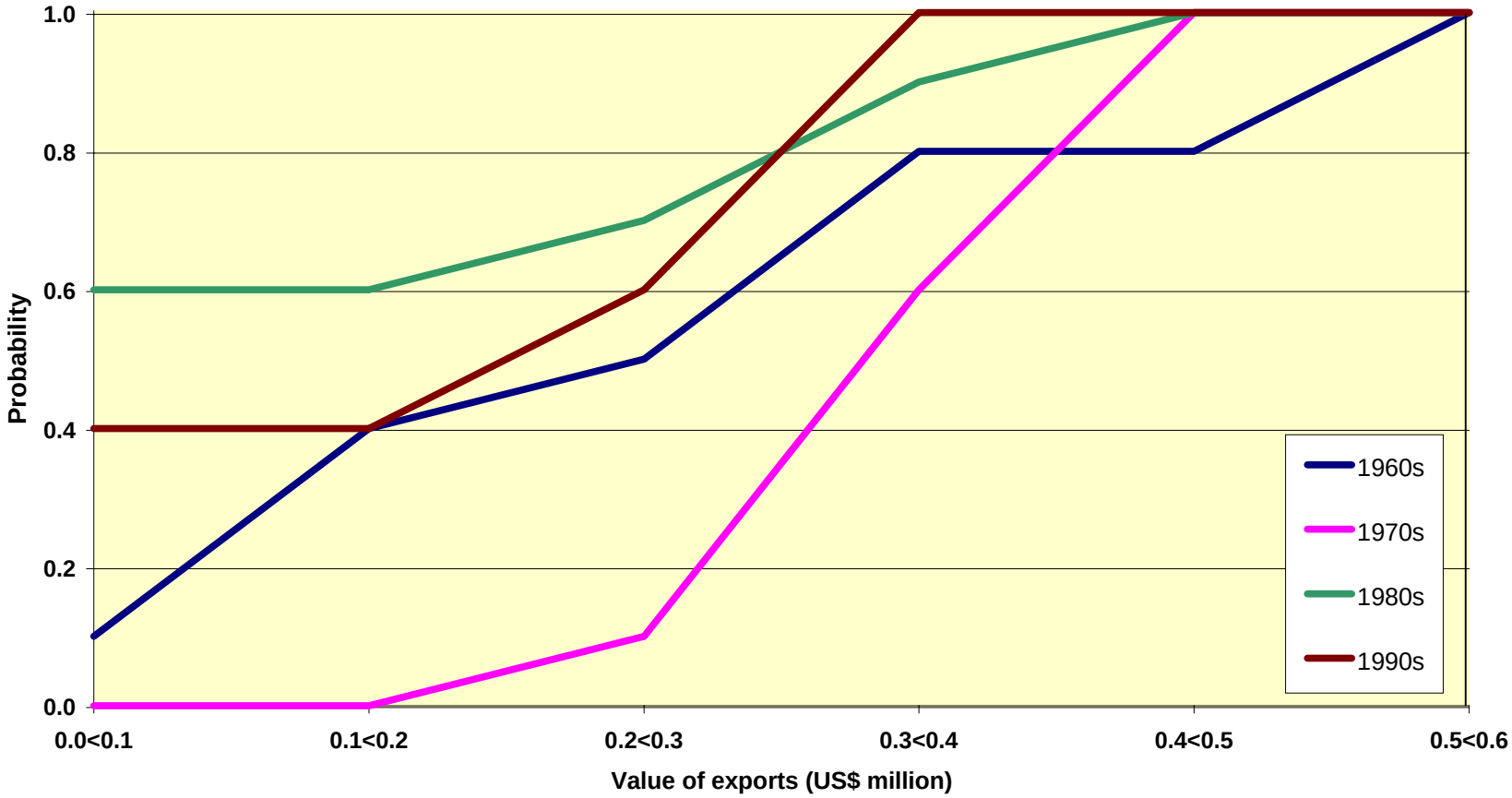

Figure 9 Cumulative density functions, non-agricultural exports: Niue

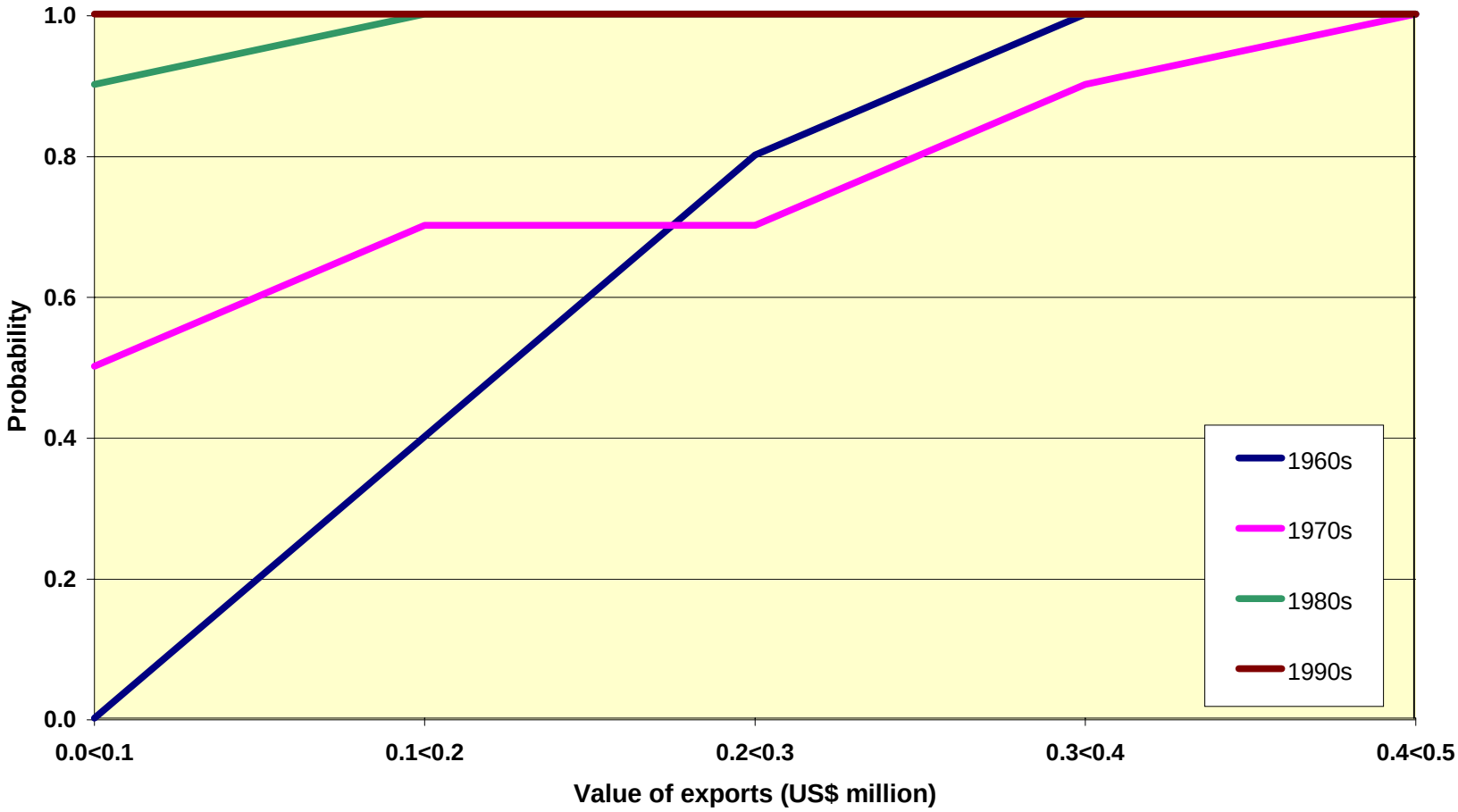

Figure 10 Cumulative density functions, total exports: Tuvalu

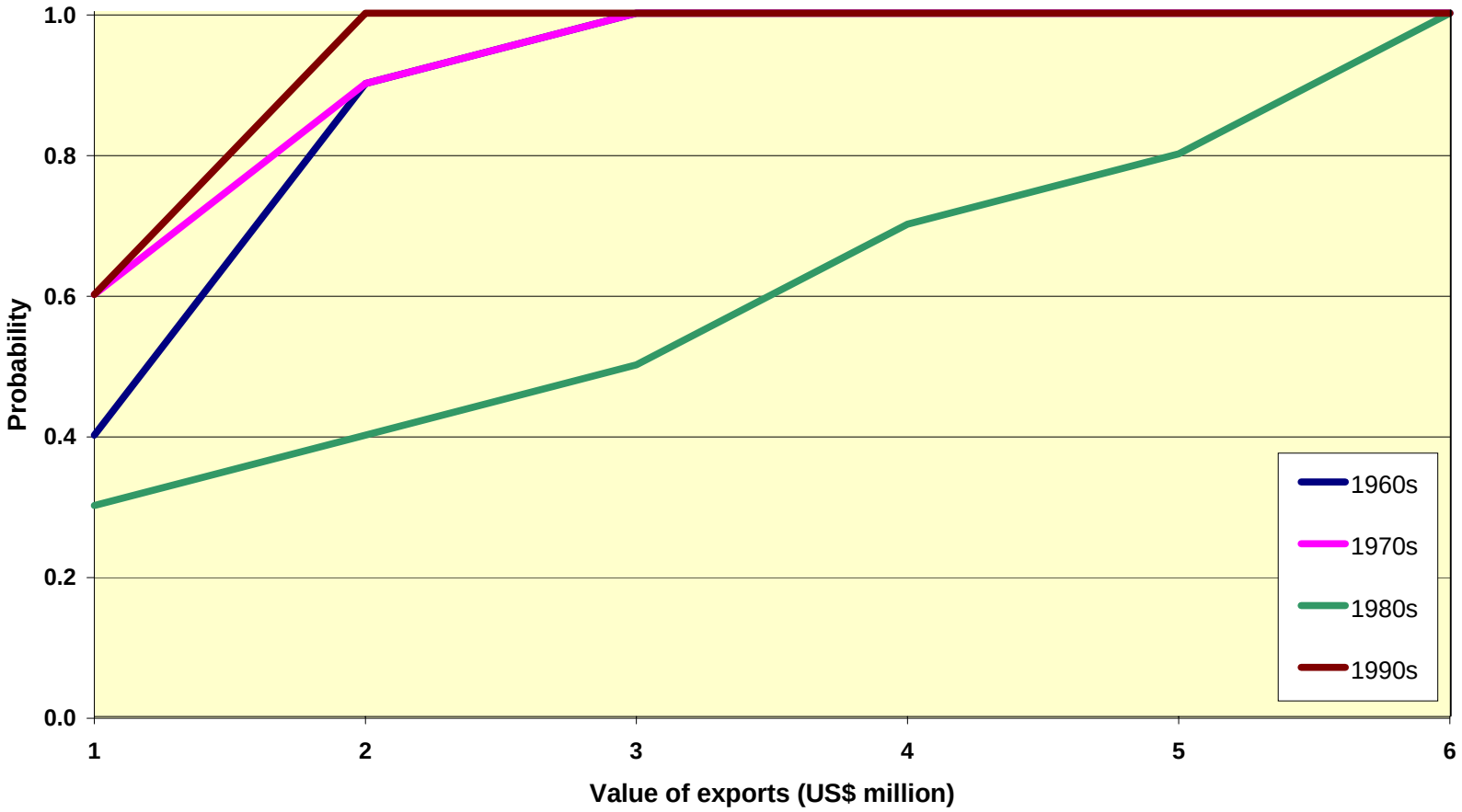

Figure 11 Cumulative density functions, agricultural exports: Tuvalu

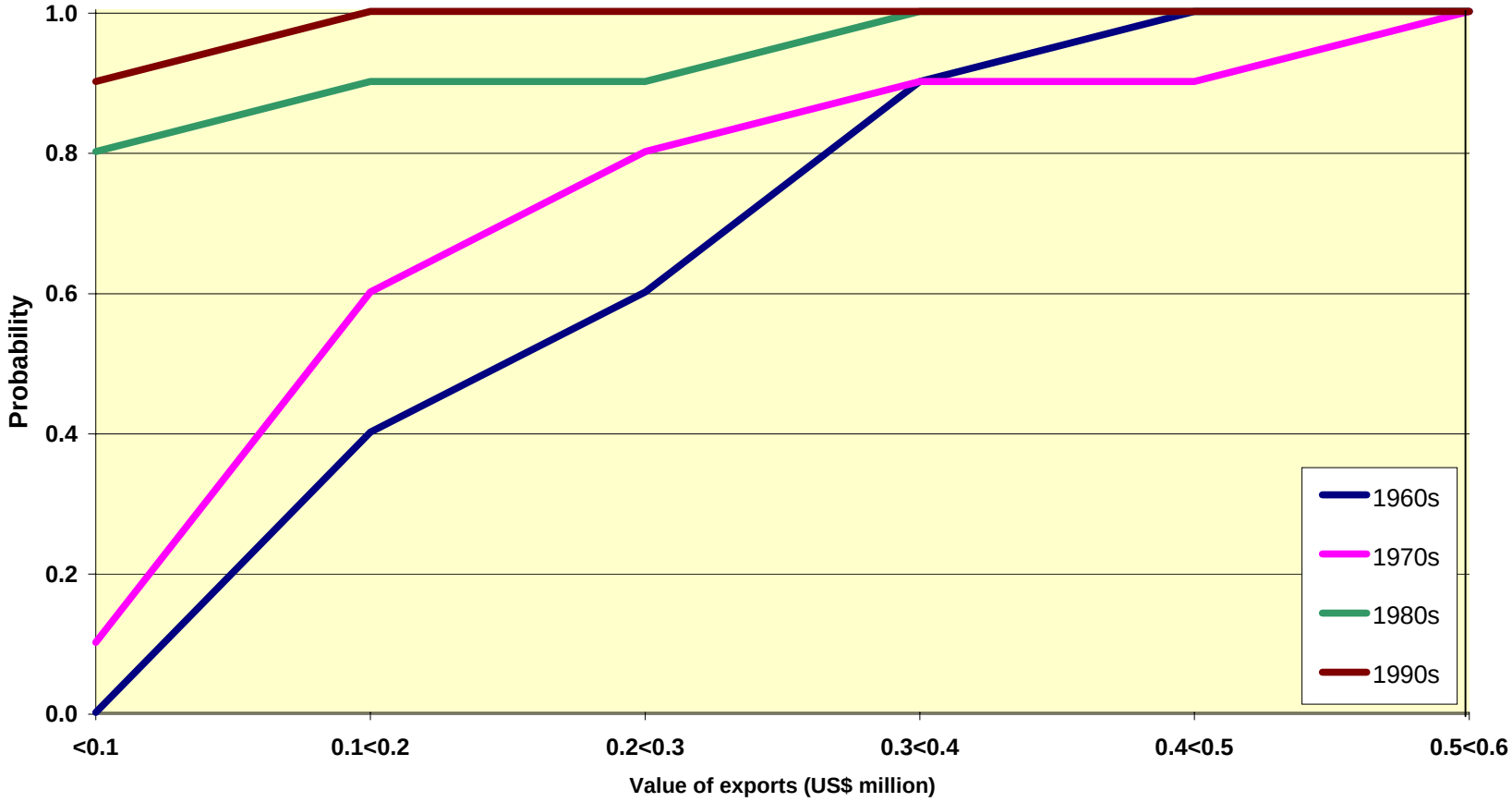

Figure 12 Cumulative density functions, non-agricultural exports: Tuvalu