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**EXPENDITURES IN AND REVENUES FROM THE UKCS:  
ESTIMATING THE HYPOTHETICAL SCOTTISH SHARES  
1970 – 2003**

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**1. Introduction**

Scotland benefits in a number of ways from the exploitation of North Sea oil and gas. The investment and operating expenditures required for production and processing are to a considerable extent located on the Scottish mainland. Substantial employment offshore and onshore is directly and indirectly generated. Scotland also shares in the benefits of oil and gas exploitation from being a part of the United Kingdom to which the gross revenues and those from taxation accrue.

There has been much public debate concerning the share of the revenues which would accrue to an independent Scotland. There has been no comprehensive published study of the full contribution of the upstream oil and gas industry to Scotland as a separate country. In this paper estimates are made of the hypothetical shares of expenditures, production and revenues which would have been attributable to Scotland had it been an independent country. These are provided over a historic period starting in 1970 with projections made until 2003.

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## 2. Methodology and Assumptions

### a) Data

A large database incorporating basic field-related data for all of the UKCS has been built up over many years in the Department of Economics, University of Aberdeen. Data on all investment expenditures, operating costs, production, and decommissioning costs are incorporated in this database. The data have been validated by the operators of the fields concerned. The fields in question relate to all those developed since the 1960's, including those which have development approval but are not yet producing. Also included are future fields which have not yet received development approval but are seriously being considered for development by the operators concerned. For some of these fields the data has been validated by the operators and in other cases independent estimates have been made by the authors.

With respect to exploration and appraisal (E and A) activities the information on wells drilled and the value of expenditures on the activities have been taken from various issues of the Oil and Gas Resources of the UK, Energy Report, Volume 2 produced annually by the DTI and published by the Stationary Office. For future years estimates of expenditures were made by the authors. Other expenditures are also relevant. These include overhead and R and D costs which are allowable as deductions for Petroleum Revenue Tax and Corporation Tax. Estimates were made of both of these and tested against some public information. Estimates were also made of the loan capital employed to calculate the amount of loan interest allowed as a deduction for corporation tax purposes. This was also tested against information available from public sources.

b) The Boundary Issue

For purposes of the study the UKCS had to be divided between Scotland and the rest of the United Kingdom. Over the years there has been considerable debate about how the boundary line might be drawn. A principle which has much merit on grounds of equity, legality and precedence is that of equidistance<sup>1</sup>. According to this the dividing line is drawn starting from the onshore boundary point and extending into the North Sea such that the line is equidistant from the nearest points on Scottish and English territory (including relevant islands). Of course, many other procedures could be employed to determine the boundary, but they generally involve more value judgements, and political negotiation.

If the above procedure were adopted the division of known fields, both producing and future probable developments, is such that 15 fields in the Central North Sea would be allocated to the rest of the UKCS along with all those in the Southern North Sea and the Irish Sea. The division of E and A costs was determined according to (a) the respective numbers of wells (as a measure of activity), and (b) the relative cost of wells in the various sectors of the UKCS. Thus on average wells in the Southern North Sea cost around 50% of those in the rest of the UKCS.

Similar procedures were followed to allocate the shares of eligible overheads and R and D expenditures to the two sectors. The R and D activity was modelled in relation to development expenditures, and the overheads to operating expenditures. Loan capital was allocated to investment on an individual field basis.

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<sup>1</sup> For a full discussion of the issue see E. D. Brown (1978) "It's Scotland's Oil?: hypothetical boundaries in the North Sea – a case study", Marine Policy, January, pp. 3-21.

(c) Financial Modelling

The financial modelling utilised all the data discussed in Section 2(a) above. The modelling simulated production, investment and operating expenditures, gross revenues, royalty and tax payments, and post-tax returns. Emphasis was given to the calculations in money-of-the day (MOD) terms to facilitate comparisons with published official data. The historic gas prices incorporated in the modelling reflect estimates of those employed in actual contracts. For new contracts signed from 1999 onwards prices of 10 pence, 14 pence, and 17 pence per therm in real terms have been employed to estimate possible future revenues. Similarly, oil prices of \$10, \$14, and \$18 in real terms have been employed for 1999 onwards.

**3. Results**

a) Consistency with Official Published Data

The results of the modelling were tested against the official published data for the whole of the UKCS relating to production, investment and operating expenditures, gross revenues, and tax revenues. These are published in various issues of the Oil and Gas Resources of the United Kingdom, Energy Report, Volume 2, noted above. The results of the present study for the historical period were found to be consistent with those in the official data.

b) Scottish Shares

(i) Oil Production

In Chart 1 the Scottish share of oil production is shown for the period 1975 – 2003. This has generally exceeded 90%. In the early 1980's when oil prices peaked the share exceeded 98%. In recent years it has been 94% - 95%. It will rise somewhat over the next few years with the growth in output from West of Scotland, and the declines in the fields in the English sector of the Central North Sea and in the Irish Sea.

(ii) Gas Production

The Scottish share of gas production from 1977 – 2003 is shown in Chart 2. In the early years it was zero as all production came from the Southern North Sea. It then grew substantially from the late 1970's as a result of the development of oil fields in the Central and Northern North Sea containing large amounts of associated gas. In 1990 and 1991 the Scottish share fell sharply. This was a period when oil production was falling, to a considerable extent as a consequence of the safety upgrading instigated in response to Lord Cullen's recommendations. There was a related fall in associated gas production in the Central and North Seas, while in the same period production from the Southern North Sea was on a rising trend.

Since the early 1990's the Scottish share of gas production has broadly increased following the development of several large new fields in the Central North Sea in particular plus the fruits of the redevelopment of Brent in the Northern North Sea. Over the next few years the Scottish

share of gas production will increase still further as output from new fields such as Britannia, ETAP, Elgin/Franklin and Shearwater continues to rise. By 2001 over 50% of gas production from the UKCS will come from the Scottish sector.

(iii) Total Hydrocarbon Production

The Scottish share of total hydrocarbon production from the UKCS (expressed in barrels of oil equivalent) is shown in Chart 3 for the period from 1975 – 2003. The combined share grew rapidly from the mid – 1970's to reach 82% in 1984. The fall after 1985 reflects the decline in production from Central and Northern North Seas at a time when production was rising in the Southern North Sea. From 1992 to date the Scottish share has always exceeded 72%. Over the next few years it should rise to 78% - 79% due to (a) the significant growth in production from the Central North Sea and West of Scotland, and (b) the attainment of plateau output in the Southern North Sea and Irish Sea.

(iv) Development Expenditures

The Scottish share of field development and terminal expenditures for the period 1972 – 2003 is shown in Chart 4. As early as 1973 this was nearly 84%. It grew rapidly to reach 98% in 1977. Such very high shares were obtained because investment in gas fields in the Southern North Sea were very substantial in the second half of the 1960's, but fell to comparatively insignificant levels in the 1970's.

From 1981 the Scottish share fell substantially for some years. In this period there was some resurgence of investment in the Southern North Sea. Further, in the second part of the 1980's there was a natural

reduction following the oil price collapse in 1986. This reduction contrasted with the position in the Southern North Sea. The lowest Scottish share was 58% in 1988. This was the year of the Piper Alpha tragedy which also had the effect of curtailing new field developments, with priority being given to safety enhancements.

In recent years the Scottish share of development activity has increased substantially. In 1997 it was as high as 88%. This reflects expenditure on a number of large new field developments such as Britannia, Foinaven, Schiehallion, ETAP and Elgin/Franklin. The Scottish share will continue to exceed 80% over the next few years. For example, under the \$14 and 14 pence scenario the share is nearly 85% in 2000, 88% in 2001, and as much as 95% in 2002.

(v) Share of Operating Expenditures

The Scottish share of aggregate operating expenditures (including overheads related to the UKCS) is shown in Chart 5 for the period 1975 – 2003. From the late 1970's to 1987 the Scottish share exceeded 80%. Occasionally it exceeded 86%. Generally this reflects the more expensive nature of the operations in the Scottish sector. The fall in the Scottish share in the 1990's has reflected the effects of cost-reducing measures, the scope for which was relatively greater than in the Southern North Sea given the larger base. (The figure for 1988 is an outlying case reflecting the unique insurance payments following the Piper Alpha disaster). In more recent years the share of operating expenditures attributable to the Scottish sector has risen as a consequence of a number of large developments which require substantial production-related expenditures. The share has now reached 80%, and it should increase

over the next few years. For example, under the \$14 and 14 pence scenario the Scottish share would reach 81% - 82% in the years 2002 and 2003.

(vi) Gross Revenues

The Scottish share of gross revenues in the period 1975 – 2003 is shown in Chart 6. This depends on both the volume of production and oil and gas prices. The relationship between oil and gas prices over the period has not been direct. Oil has always been priced at its fair market value but gas pricing has reflected changing institutional and market situations. The early gas contracts from the Southern North Sea signed in the 1960's contained only very limited indexation clauses, and from the early 1970's onwards the prices relating to these contract have certainly been below open market values. In the 1980's and early 1990's some contracts were signed at much higher prices. Indexation provisions vary across contracts, but typically there are links to the producer price index, fuel oil/gas oil prices, and sometimes coal or electricity prices. These features were incorporated in the financial modelling.

The Scottish share of total gross revenues is seen to increase rapidly from the mid-1970's to reach 95% in 1981. This period coincided with both rapidly increasing oil production and prices. Since then the share has fallen to a low point of 69% in 1991. This reflected the fall in oil prices throughout the period, and the decrease in production from the Scottish sector in the second half of the 1980's. During this period production in the Southern North Sea was rising. Also, gas prices on average did not fall in this period. From 1992 onwards the Scottish share has always exceeded 70% and approached 79% in 1995. The fall in very recent

years reflects (a) the tailing off in the growth of oil production at a time when gas production in the Southern North Sea and Irish Sea was still rising, and (b) the collapse in oil prices in 1998. Over the next few years the Scottish share should rise from the 71% level attained in 1998. Under the \$14 and 14 pence price scenario, for example, the share rises to nearly 77% in 2002. This primarily reflects the increased output from the Scottish sector.

Under the \$18 and 17 pence scenario the Scottish share rises to 79% in 2000 and 2001. Under the low price scenario (\$10 and 10 pence) it is 70% in 2000 and 73% in 2003.

(vii) Royalty and Tax Revenues

The Scottish share of royalty and tax revenues is shown in Chart 7. It increased rapidly in the second half of the 1970's to reach a maximum of 98% in 1982. This was due to a combination of (a) very fast growth in oil production, (b) huge increases in oil prices, and (c) the continuation of relatively low gas prices. The major increase in taxable capacity from volume and price changes was thus concentrated in the Scottish sector.

Since 1982 the Scottish share of tax revenues has followed a generally slow and irregular downward trend. The fall in the oil price from the early 1980's onwards has been a major factor. The fall in production in the Central and Northern North Seas in the later 1980's (when production in the Southern North Sea was rising) also contributed to the decline.

The upturn in oil production in the 1990's has been a main causal factor behind the increase in the Scottish share in recent years. In 1996 production growth coincided with relatively high oil prices. (In that year North Sea prices averaged around \$21). This boosted the Scottish share to 82%. In 1998 the collapse in the oil price plus very large deductions for the major investments incurred in the Scottish sector in recent years greatly reduced the taxable base. For that year the Scottish share is estimated at 66%.

The Scottish share also depends on the impact of the tax system, both absolutely and with respect to its relative impact in the Scottish and non-Scottish sectors. The Petroleum Revenue Tax (PRT) was changed in 1983 such that for fields developed from April, 1982 onwards in areas outside the Southern North Sea the volume allowance for new fields became 10 million tonnes. In the Southern North Sea this allowance later became only 2.5 million tonnes. In 1993 PRT was abolished for all new fields.

The effect of these tax modifications, taken in conjunction with the changing structure of production from fields of different vintages, is that, other things being equal (such as oil and gas prices), the Scottish share is on a falling trend. The tax changes noted above have meant that an increasing share of oil production is coming from non-PRT paying fields. For any given oil price PRT revenues are falling at a noticeable pace. In the Southern North Sea and Irish Sea revenues from PRT, while smaller compared to those from the Scottish sector, at any given price are not falling so fast.

As a result of all the above factors the Scottish share of total tax revenues over the next few years is likely to be less than it has generally been before 1998. Thus under the \$14 and 14 pence scenario the Scottish share is around 67% in 1999, 53% in 2000, 54% in 2001, 64% in 2002 and 68% in 2003. Under the \$18 and 17 pence price scenario however, the Scottish shares become 76%, 70%, 70%, 74% and 75% for the same years. Under the \$10 and 10 pence scenario the Scottish shares become 56%, 45%, 48%, 49% and 54% for the same years.

The absolute values of tax revenues are, of course, of prime importance. These have fallen dramatically from their peak in the period 1984 – 86. Broadly speaking the Scottish share peaked at times when the absolute levels were also around their highest levels. In the early 1990's the absolute levels of tax revenues were quite low reflecting a combination of relatively low prices, stagnating production, and substantial investment with associated deductions and allowances for PRT and corporation tax. In financial years 1996/97 and 1997/98 at £3.6 billion and £3.4 billion respectively aggregate tax revenues were significantly higher reflecting higher oil prices and production. For 1998/99 and 1999/2000 the official forecasts are £2.6 billion and £1.3 billion respectively<sup>2</sup>.

#### **4. Summary and Conclusions**

In this paper the hypothetical Scottish shares of activities in the UKCS relating to production, development investment and operating expenditures, gross revenues and tax revenues have been calculated for the period since 1970. This has been undertaken with the aid of (a) a large database relating primarily to the

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<sup>2</sup> See HM Treasury (1998), Pre-Budget Report: Steering a Stable Course for Lasting Prosperity, Cm. 4076, p. 119.

individual fields and (b) financial modelling. Allowance has been made for E and A expenditures, R and D costs, and allowable overheads in the determination of taxable income.

The hypothetical Scottish share of UKCS activities required the determination of a boundary between Scotland and England. For the North Sea the principle of equidistance was employed. This principle has merit on grounds of equity, legality and widespread use.

The financial modelling simulated the hypothetical Scottish shares. It was found that the Scottish share of the operating expenditures has always been very high since 1976 reflecting not only the larger volume of activity but the more expensive nature of the operations in the deeper waters off Scotland compared to the Southern North Sea. Typically the Scottish share has been around 80%. The very high share attributable to Scotland will continue over the next few years.

The Scottish share of investment expenditures has been more variable reflecting the fluctuations in such investment. These have largely been dominated by oil price movements. In recent years the Scottish share has been rising because a higher share of aggregate investment has taken place in Scottish waters. The share, currently around 85%, will substantially exceed 90% over the next few years.

The Scottish share of total hydrocarbon production has, of course, been very high since the late 1970's, frequently approaching 80%. It has fluctuated somewhat, however, showing some decrease in the later 1980's and early 1990's when oil production fell and gas production in the Southern North Sea continued to grow. The Scottish share should continue to increase over the

next few years to reach 80% in 2003. Interestingly the Scottish share of total gas production is set to increase to over 50% in the next few years.

From an economic viewpoint the gross revenues are generally more important than physical production. The Scottish share of these depends on the relative prices of oil and gas as well as comparative production. The Scottish share was found to reach extremely high levels (well over 90%) when real oil prices peaked in the early 1980's. Since then there has been a decrease. Currently the very low oil prices have pulled down the share to around 71%, but the increasing dominance of production from the Scottish sector should ensure that the share of revenues remains extremely high. Even at the \$14 oil price the share should increase to 76% in 2000, and 78% in 2003.

The determination of comparative tax revenues involves further complexities. These relate to (a) the calculation of taxable income in the two sectors, and (b) the comparative incidence of the tax system. Taxable income in the two sectors will be determined by respective production, oil and gas prices, and deductions and allowances related to investment and operating expenditures. Other things being equal taxable capacity in the Scottish sector has been higher when oil production and prices are relatively high compared to gas, and when the deductions for the various expenditures are comparatively low. The Scottish share was extremely high in the early 1980's when oil prices were at their peak and the investment costs relating to the largest oil fields had already been recovered. Thus in 1981 and 1982 the Scottish share was over 98%. Since then it has fallen with oil prices. Currently the Scottish share at 66% is comparatively low compared to 1996 and 1997 because of (a) the collapse in oil prices, and (b) the very large deductions and allowances relating to recent large investments presently being utilised. Under the \$14 price the share would be 67% in 1999 but only 52% in 2000. This low figure reflects particularly large

deductions for investment expenditures. In 2002 the share would be 64% and in 2003 68%.. If oil prices were to increase to \$18 the Scottish share of tax revenues would increase dramatically. It would become 76% in 1999, 70% in 2000 and 2001, 74% in 2002 and 75% in 2003.

### **Addendum**

1. This paper has concentrated on the determination of the shares of activity in the UKCS which would accrue to an independent Scotland. From an economic viewpoint it is the absolute levels of production and values of the investment and operating expenditures, gross revenues and tax yield which are important. These are shown in the Appendix. Key features of the findings are the fluctuations in field investment expenditures over the period and the generally downward trend in tax revenues since the first half of the 1980's. This trend was reversed for a few years starting in 1994. The relatively high oil prices pertaining in 1996 were responsible for the significant increase in that year.

The tax take in 1998 and 1999 is relatively low not only because of low oil prices but as a consequence of the utilisation of large capital allowances relating to the major investments incurred in the Scottish sector in recent years. These reduce taxable income. It follows that from 2001 onwards when a considerable share of these investments have been written off the tax take should rise substantially even under low oil prices.

2. The boundary line dividing the Scottish and English sectors of the North Sea could be drawn in various ways. If the present line of jurisdiction were employed 15 extra fields in total covered in the study would then

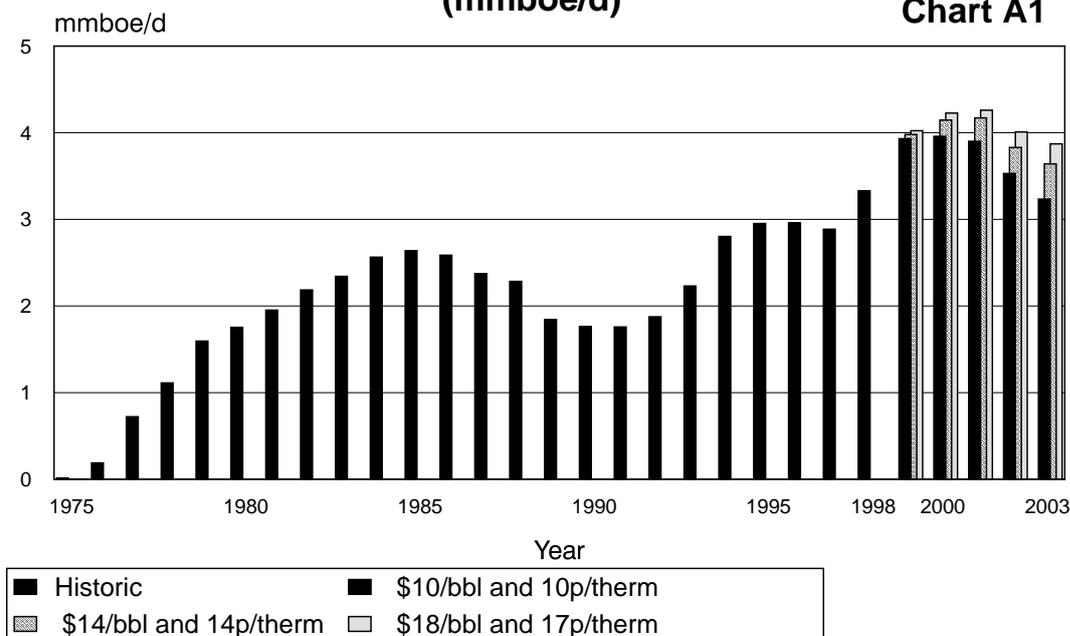
fall into the Scottish sector. The effect of this in terms of production and revenues would be tiny. The great majority of the fields are quite small. Four (Angus, Argyll, Duncan and Innes) have already been decommissioned. Others such as Orion, Janice and Iris have not yet started production. The largest in terms of initial reserves is Fulmar but current production levels are low. In 1998 oil production in the Scottish sector using the equidistance principle was estimated at around 2.6 million b/d. The total production in 1998 from the additional fields which become part of the Scottish sector using the present line of jurisdiction is estimated at only 0.064 million b/d. For gas the corresponding increase in production in 1998 is even smaller being around 2.6 billion cubic feet in relation to around 1,428 billion cubic feet using the equidistance principle.

### Appendix

#### Total Hydrocarbon Production in Scottish Sector

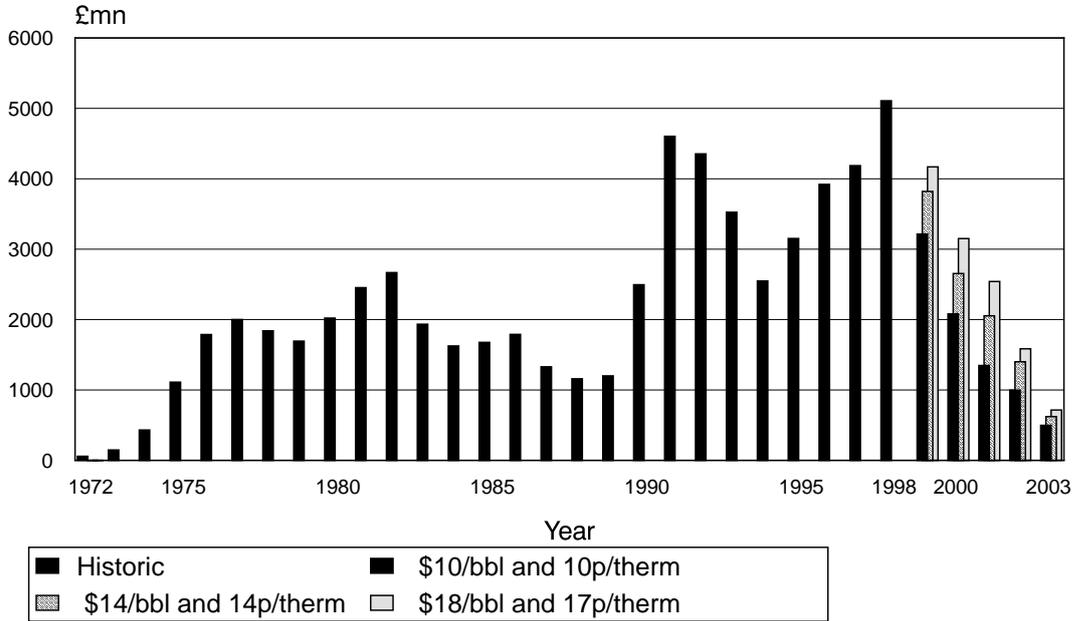
(mmboe/d)

Chart A1



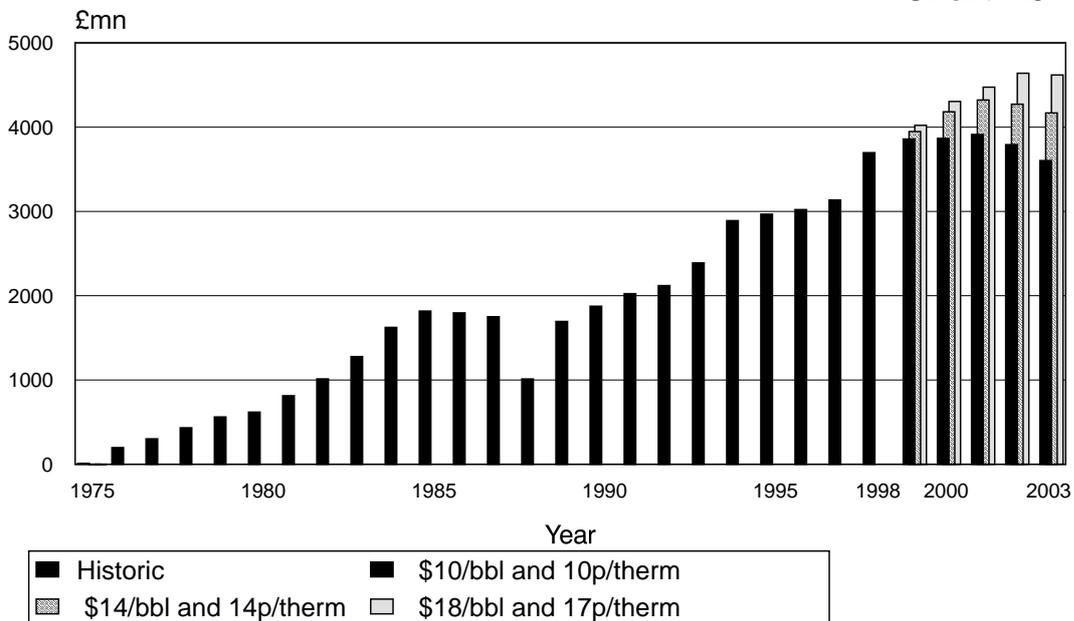
## Development Expenditure in Scottish Sector (£mn)

Chart A2



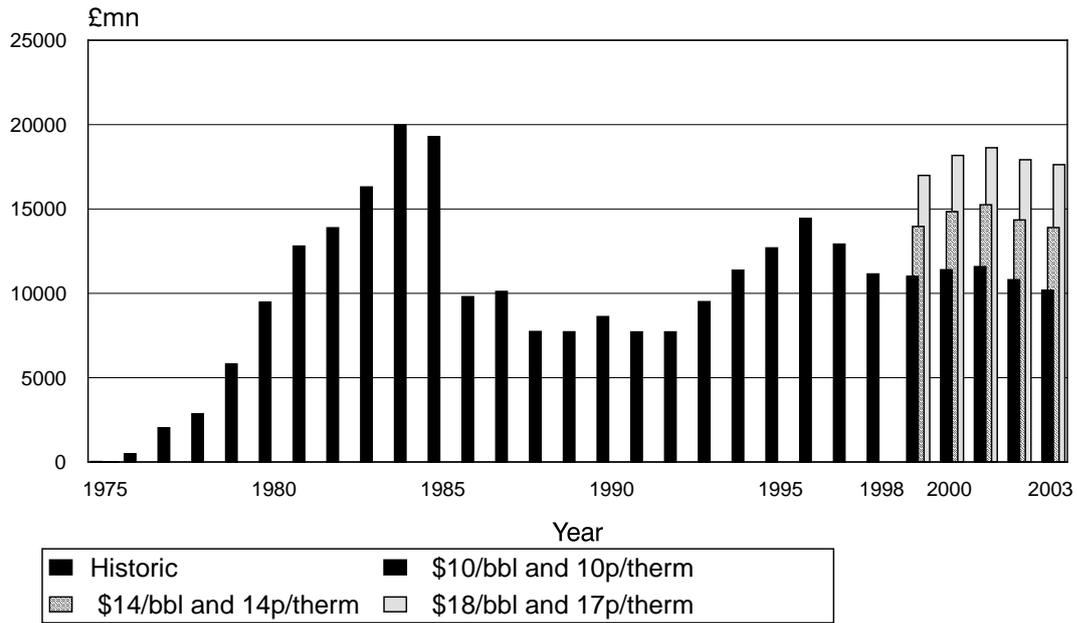
## Operating Expenditure in Scottish Sector (£mn)

Chart A3



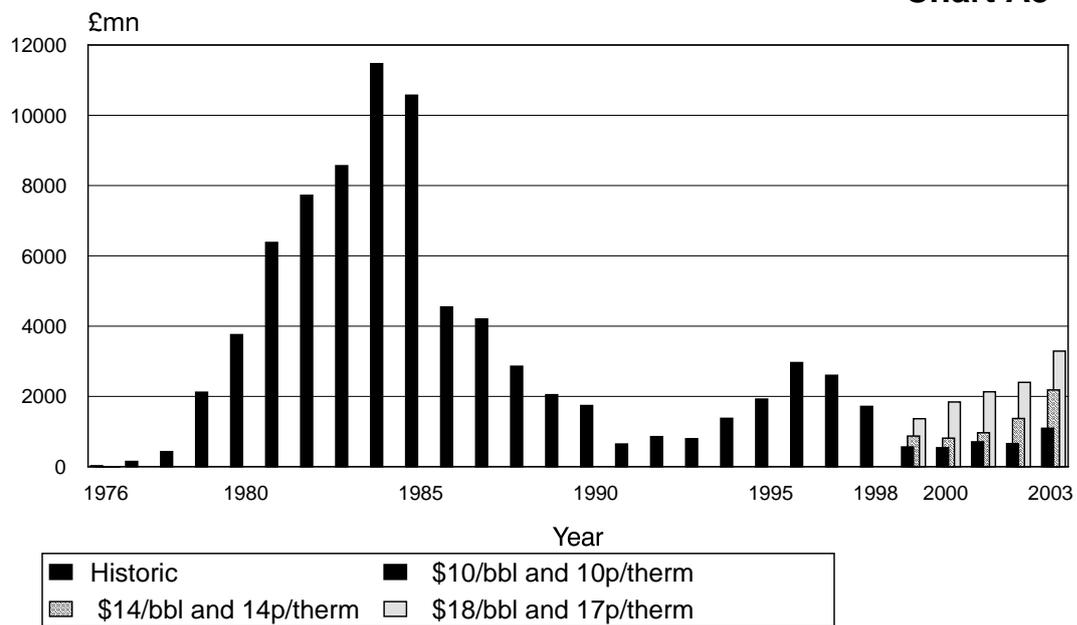
## Gross Revenues from Scottish Sector (£mn)

Chart A4

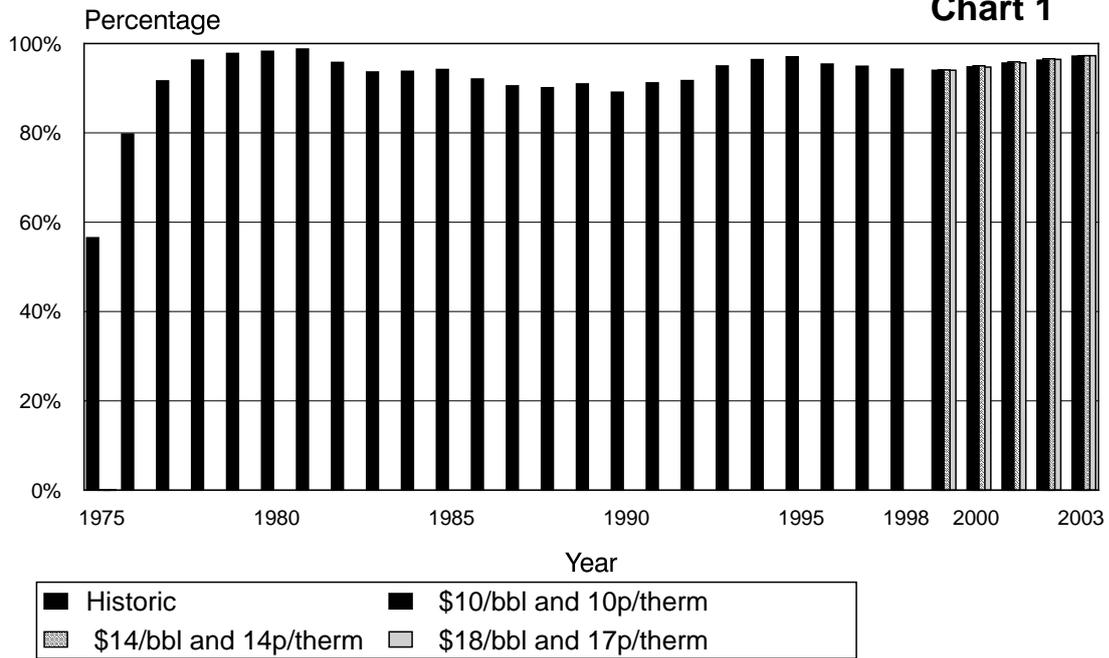


## Tax Revenues from Scottish Sector (£mn)

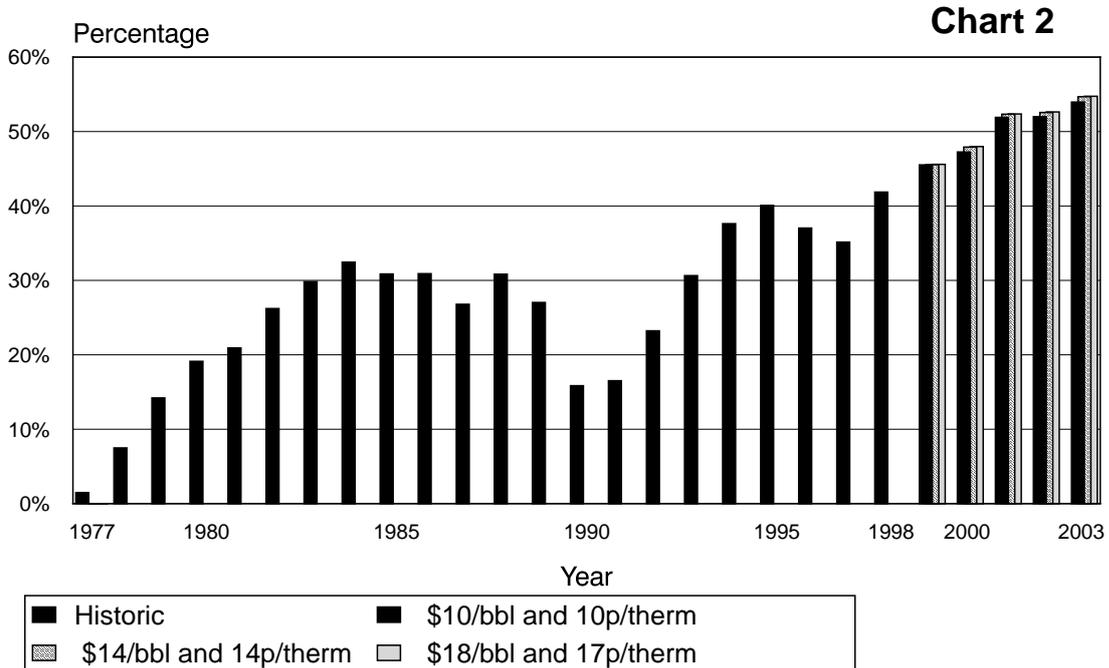
Chart A5



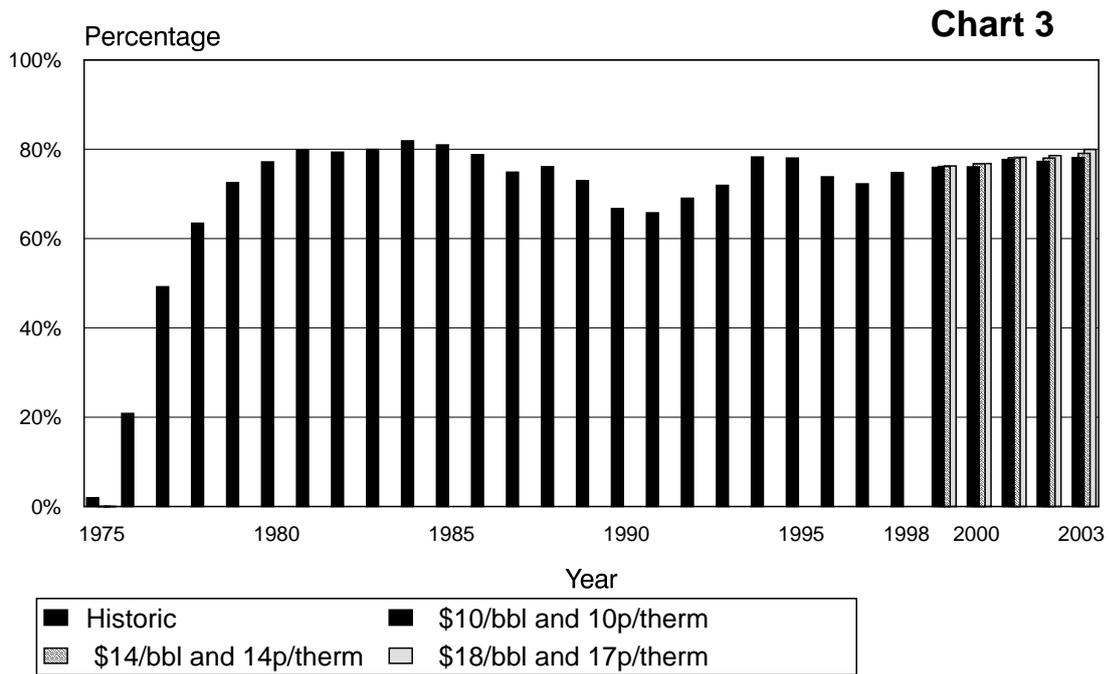
## Scottish Share of Total Oil Production



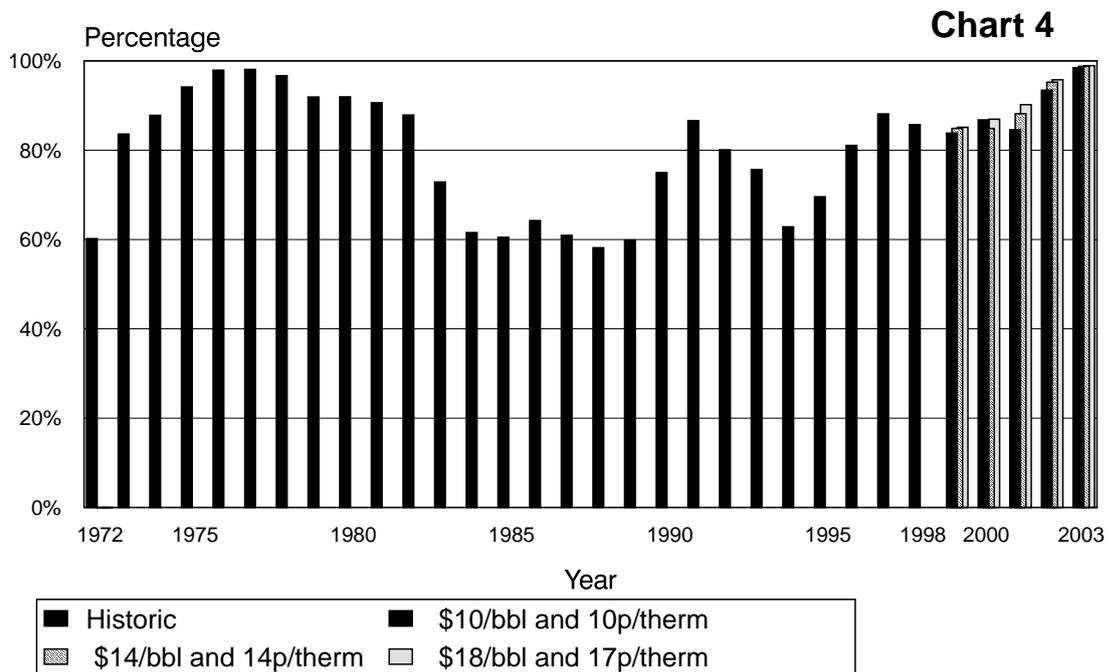
## Scottish Share of Total Gas Production



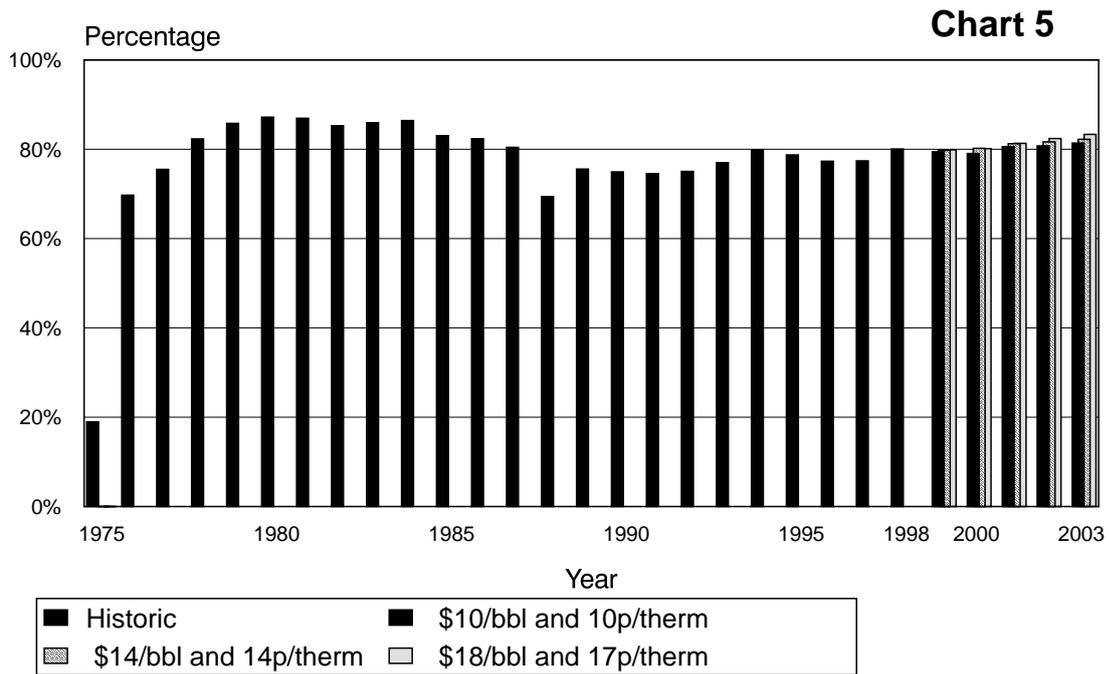
## Scottish Share of Total Hydrocarbon Production



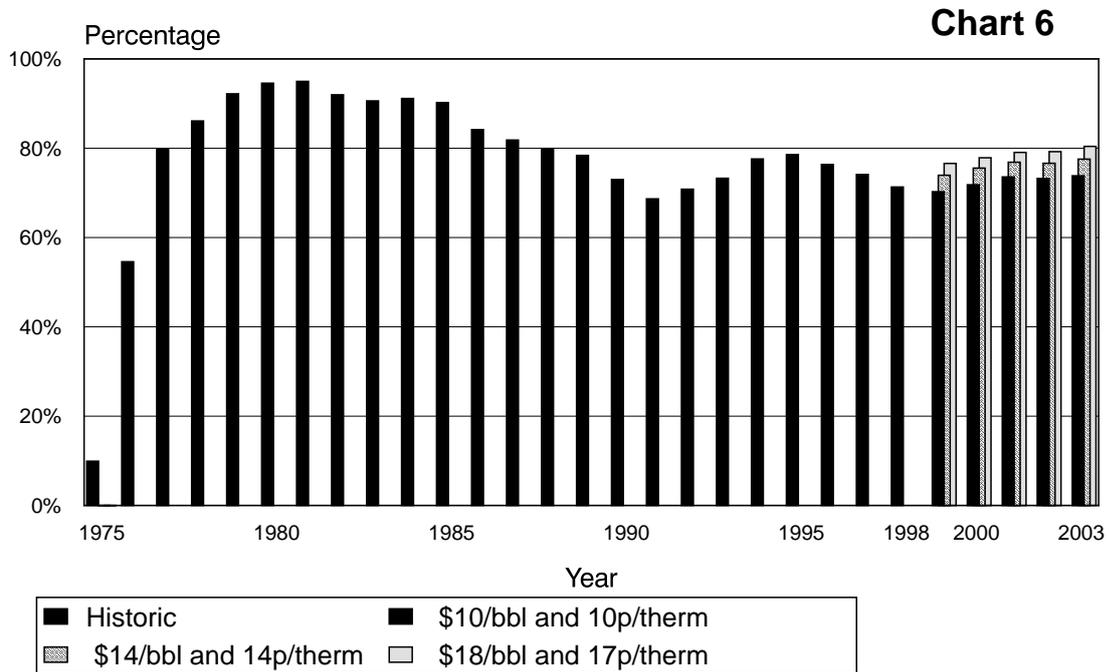
## Scottish Share of Development Expenditures



## Scottish Share of Operating Expenditures



## Scottish Share of Gross Revenues



# Scottish Share of Tax Revenues

Chart 7

