Value of the **PHARMACEUTICAL INDUSTRY** to the **UK ECONOMY**

By David Hale and Adrian Towse

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Office of Health Economics

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Foreword

Although there is widespread agreement about the important role the pharmaceutical industry plays in the UK economy, there is no easily available source presenting the chief figures in a clear and easily interpretable way. The purpose of this paper is to do precisely that. It is based on serious research and analysis by economists, and provides a perspective within which the industry may be understood, and criticised, and assessed.

Economists are well aware of how cautious one must be in making an assessment of the value of an industry to an economy. One advantage of the present case is that the industry is relatively easy to define and delineate. Even then the authors have erred on the side of caution. The industry itself, no doubt, will complain that they have been too conservative, especially in countenancing the possibility that the net value of the contribution could even be below £1 billion per annum. My own judgement is that in economic assessment it is always better to err on the low side, enabling other experts to argue for an increase if they are able to do so validly.

May I finally draw the reader's attention to the seriousness of the economic theory that underlies a study of this kind. Its professional standards are high, and provide a basis for significant further debate. The authors are to be congratulated for that, and for making an important contribution to this part of industrial economics.

MAURICE PESTON
House of Lords

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1 Introduction

The UK-based pharmaceutical industry is a highly successful sector of the UK economy producing over £8.5 bn (at manufacturers' prices) worth of output in 1992, providing employment for over 76,000 people, and creating a trade surplus of £1.3 billion in 1992. Given these impressive figures it is of interest to assess the overall net benefit which the UK economy derives from the existence of a successful pharmaceutical industry based in the UK. This paper attempts to estimate this. We have benefited from discussions with economists within the Department of Health (DH), and the Department of Trade and Industry (DTI), and with George Yarrow of Hertford College, Oxford. Any estimates or errors in this paper are, however, attributable solely to the authors.

2 Summary estimate of net benefit

Based on our assumptions, the estimate of net benefit is comprised of the following elements:

	£ million (1992)
Benefits:	
Supply side externalities	not quantifiable
Benefit to patients	not quantifiable
Labour rent	70
Export rents	410-730
Rents from non-UK production	300
Terms of trade	1,050-1,400
Cost savings:	nil
Net benefit	1,830-2,500

The assumptions and calculations on which these estimates are based are set out in the remainder of the paper. The key assumptions are those about:

- elasticities in the terms of trade calculation;
- the relative prices of pharmaceuticals in the UK and other major markets;
- which country's price level best reflects sustainable long run supply costs, including the costs of research and development.

Our overall conclusion is that the value of the pharmaceutical industry to the UK economy in 1992 was around £2 billion per annum. The results are however highly sensitive to the assumptions used. On some assumptions the annual value would be below £1 billion. Our view is that under all reasonable assumptions the pharmaceutical industry is making a net contribution to the UK economy of several hundreds of £millions per annum.

3 The Counter-Factual

In order to calculate estimates of benefit it is necessary to have

some baseline case, or 'counter-factual', from which to measure. This paper compares the current performance of the pharmaceutical industry with a theoretical alternative in which there is no UK-based pharmaceutical industry.

We have assessed three potential situations which would match the counter-factual:

(i) There are no research or production facilities located in the UK. Sales and marketing facilities are for the UK market only, which is served by imported products;

(ii) There are no corporate headquarters of pharmaceutical companies located in the UK;

(iii) Institutional investors choose not to hold UK pharmaceutical companies' shares in their portfolios, which are dominated by shares in domestic concerns.

We discuss the relevance of (ii) and (iii) in section 7.5.

4 Estimation issues

In measuring the net contribution of the UK based pharmaceutical industry we are assessing the opportunity cost value of the resources currently utilised by the industry, essentially asking how else the resources could be used. We must determine how much better or worse off the UK would be by having resources employed in the pharmaceutical industry rather than in other sectors of the economy. This approach raises two issues, which we consider in turn.

4.1 Short-run vs long-run

If the entire pharmaceutical industry were 'lost' suddenly there would be significant unemployment and large amounts of redundant capital in the pharmaceutical industry and in sectors supplying services to the industry. It is likely that in the short term the UK economy would suffer substantial adjustment costs before all these resources could be re-employed elsewhere in the economy, as many assets have relatively specific uses and many employees have highly specific skills. These adjustment costs may be greatly

reduced if the change occurred gradually over a very long time horizon.

Any estimate of short-run adjustment costs incurred is highly dependent on the way in which the counter-factual is assumed to come about. This is not the focus of this paper. **This paper focuses on the long term effects which would remain even after the economy has regained 'equilibrium'**. All the resources currently being used in the pharmaceutical industry are assumed to be utilised in other sectors, in the long run. The question is the extent to which these alternative uses are of less value to the economy.

4.2 Transfer payments

The aim of this paper is to estimate the degree to which the UK-based pharmaceutical industry benefits the UK economy in aggregate. We are not, for this exercise, considering benefits which redistribute income from one part of the UK population to another part of the UK population, although such redistributions can have an impact on economic incentives. Any element of benefit or cost which is a direct 'transfer' within the UK is excluded from the net value estimates.

5 Outline of potential benefits accruing to the UK economy

We have identified several ways in which the UK economy, in theory, may benefit from the 'presence' of the pharmaceutical industry. These are as follows:

- *Supply Side Benefits;* positive externalities which may accrue to universities, to the NHS, and to other industries resulting in lower unit costs and the ability to provide improved services or products. Knowledge gains produced by R&D will not be utilised exclusively within the originating company. Parties other than the originator benefit from the advancement of knowledge. Although some information exchange is not location dependent, for example, presentations at conferences

and publications, other benefits do result from informational exchanges due to proximity, or from the same individuals working on projects for different organisations.

- *Benefits to Patients;* these may in principle arise from the speedier introduction of therapeutically beneficial medicines to the UK market, because development work is undertaken in the UK, and to the introduction of treatments which may never have been discovered but for work in UK laboratories.
- *Direct Benefits;* rents which accrue to UK residents through three sources: higher wages to employees; higher profits to owners; and higher tax receipts to the UK Exchequer.
- *Terms of Trade Effects;* the competitive advantage held by the UK based industry enables it to sell large volumes of product in competitive domestic and foreign markets. If this output were to be lost and replaced by imports it is likely that there would be a terms of trade effect, in that national income would be reduced by the need for a lower exchange rate to enable other goods and services to be exported.

6 Outline of potential costs to the UK economy

It appears to be the case that the existence of an innovative pharmaceutical industry in any country is linked, to a significant degree, to the treatment which companies receive in their domestic marketplace. In the UK, the government purchases the overwhelming proportion of ethical pharmaceutical products consumed in the UK, through the NHS. This relationship between government and the industry is important. In the UK market companies have freedom in the pricing of new products to the NHS, whilst the government, through the Pharmaceutical Price Regulation Scheme (PPRS), controls the overall profit earned from sales to the NHS. This 'relational contract' built up over a significant period of time is intended to provide companies with 'reasonable' prices for their products. If there were to be no UK-based pharmaceutical industry, the government could, in theory,

abandon the PPRS policy of providing a reasonable return and attempt to push prices paid for the newly imported products below current UK price levels through opportunistic purchasing. If lower prices could be paid by the UK, then the calculation of the net value of the UK pharmaceutical industry would have to allow for the opportunity cost to the UK of not currently achieving these lower prices. The potential costs associated with this are detailed below:

- *Direct Costs;* savings that could be achieved by obtaining lower prices on products currently imported. In the case of products currently supplied by UK production, lower prices could save an element of the revenue which is currently remitted abroad as profit or dividend. The rest of any saving from the NHS paying lower prices for UK supplied products would only give rise to a transfer payment within the UK;

- *Distortionary Costs;* costs to the wider economy resulting from having higher prices than necessary paid out of public funds. This might result in one or more of public expenditure on other programmes being lower, taxes being higher than otherwise, or higher government borrowing increasing upward pressure on interest rates;

These costs exclude general 'deadweight' losses. Deadweight losses occur when prices are above socially optimum levels, because consumers tend to buy less of a good when the price is high than they would have done had the price been lower, closer to the socially optimal price. As a result there is a loss of satisfaction to the consumer (lower consumer surplus). This 'deadweight' loss becomes smaller and smaller the more inelastic, or less responsive to price movements, demand is. Aggregate UK consumption of pharmaceuticals does appear to be relatively inelastic with respect to aggregate price changes, (depending more on clinical need than the general pharmaceutical price level). If we assume no change in the pattern of prescribing is likely in response to a general lowering of price levels (rather than a switch from one product to another because of a change in relative prices) then deadweight losses are zero.[1]

1 We should note that in theory there is a trade off between direct cost savings and deadweight losses. If we assumed demand was elastic then deadweight losses would be higher but direct cost savings lower.

7 Estimation of long-run benefits

7.1 R&D spin-offs (supply-side externalities)

The pharmaceutical industry in the UK spent £1,451 million in 1992 (ABPI) on research and development. This gross expenditure in itself does not benefit the UK economy because these resources, would, in the long run, be used in other sectors. However R&D is a use of resources which may substantially benefit companies, institutions, and individuals other than those who pay the bill. These additional benefits of R&D would be foregone were the resources employed in non-research environments. Pharmaceutical R&D is primarily an investment in the acquisition of knowledge. The nature of advancements in knowledge make it unlikely that only the originating company will take advantage of them. Knowledge is largely non-rivalrous in consumption, and it is difficult to exclude people from utilising it, not withstanding patent law, giving it some characteristics of a public good. Non-excludability is greater in respect of pharmaceutical R&D if investigation is carried out externally, in academic institutions, in hospitals, and in other firms. Thus the funding pharmaceutical company receives the information which it has paid for but the researchers also retain the knowledge. Relationships between external researchers and industry are enhanced with proximity and this promotes increased informational exchanges in both directions, which increase the 'spin-off benefits' of R&D.

In order to assess the potential of these spill-over effects it is useful to assess how much is spent in the various areas of R&D. Table 1 shows an approximate breakdown of revenue R&D expenditure into the constituent areas.

Revenue R&D expenditure divides in an approximate ratio of 2:1 into development and discovery.

Discovery by its nature is initiated by 'basic research', defined by the CSO as 'work undertaken primarily for the advancement of scientific knowledge without a specific application in view'. Chemical development similarly deals with knowledge which is not pharmaceutical industry specific. These initial stages witness a significant degree of collaboration between the companies and academic research institutions. In the region of £100 million is estimated to be spent on university collaboration. Much of this

research expands the scientific knowledge base and benefits other industries when they require particular, related, problems solved.

Table 1 **Breakdown of pharmaceutical industry's R&D expenditure by function**

	% of revenue R&D[1] approx.	*£ millions (1992)[2] approx.*
Discovery	30%	350
Development		
– Pharm/chem development	20%	230
– Animal studies	12%	115
– Clinical evaluation	22%	255
– Regulatory affairs	3%	35
– Miscellaneous	13%	175
Capital:	20% of total	290
Total		1,450

Source: 1. OHE, adapted from Lumley C.E. et al. 2. OHE

A significant amount of clinical evaluation is carried out within hospitals, under contract. When clinical testing is carried out in teaching hospitals there is again an increase in the knowledge base and, as in the case of universities, there is direct benefit in terms of the improved teaching and practice of medicine.

Examples of benefits to related industries would include the growth of bio-informatics where pharmaceutical research into areas such as DNA analysis have assisted a new UK-based industry to develop an international advantage. The agriculture, food, and brewing industries can also utilise some of the advances in scientific understanding which come out of pharmaceutical R&D expenditure. Informational spin-offs can lower costs or boost product quality improving the competitiveness of other sectors.

The pharmaceutical industry spends a significantly higher proportion of its income on R&D than any other major sector of the UK economy (as shown in Appendix 1). Even if the resources 'released' under the counter-factual were to be utilised in another hi-tech sector it is likely that a significant reduction in R&D levels would result. This would entail foregoing the spin-off effects associated with the 'lost' R&D.

A literature search has not given us a basis for attempting to quantify these spin-off effects and so no further analysis is attempted.

7.2 Patients' consumer surplus/health gain

Benefit to patients is a second area of benefit where we have not found a basis for calculating a reliable estimate. Patients gain a great deal of benefit from pharmaceutical products. However, the narrow question posed by this paper is to what degree patients would be worse off if there were no UK-based industry, and the NHS was importing all of its pharmaceuticals. The situation we are seeking to assess here is whether or not some beneficial products will reach the UK market more slowly if the innovating company is no longer UK based. Additionally some compounds may simply never have been invented. We have not attempted to develop a method for estimating these important benefits.

7.3 Labour rents

Recent studies show that significant inter-industry wage differentials exist. These differentials are not only large but persistent over time and space, internationally and domestically. The wage differentials persist even after controlling for a wide variety of worker and job characteristics, and they run through the full range of posts in the industries affected.

The evidence laid out in Appendix 1 indicates that the pharmaceutical industry is one of the industries supplying labour rents. Everyone working in the pharmaceutical industry in all countries earns these rents. With a total UK-based industry labour cost of £1,530 million (Appendix 4) and the final wages after adjustment for skill differences being 11 per cent above the industrial average, the expected rents are £140 million. However some of the rents are earned from the payments made by the NHS for its medicines. This element of labour rent is a transfer payment within the UK and so, as detailed earlier, will not be claimed as a

benefit to the UK economy. If we make the simplifying assumption that 50 per cent of the labour rents are due to production for domestic consumption (approximately one half of UK output goes into the domestic market) then only 50 per cent, or £70 million, of the labour rents calculated are in fact a benefit to the UK economy as a whole. Such gains would be additional to the export rents discussed below, as labour cost including labour rent is incorporated in long run average cost.

7.4 Rents from exports

Rents are by definition the revenues taken over and above the long run average cost (LRAC) of production. Included in the calculation of LRAC are all the short run expenses which must be incurred and also an allowance for the risk adjusted cost of capital. LRAC is therefore the return which is just sufficient in order to keep a set of resources in their current use in the long term.

We have made the *simplifying assumption* that the UK price level approximates to the LRAC of producing pharmaceuticals in the UK. There is reasonable a priori justification for assuming that the overall UK price level approximates this LRAC better than other available price level measurements. In the UK market, unlike most other European markets, companies are allowed to freely determine the price of new products. Whilst at the same time the PPRS controls the level of profit which companies can earn on sales to the NHS, each firm is, in principle, being allowed the opportunity to cover the cost of capital which is included in long run average cost, but not to earn excessive returns. At the same time the purchasing policy of the NHS promotes competition by not favouring domestic products. The UK market is therefore competitive and limits profit to a 'reasonable' level.

Appendix 2 illustrates the calculation of export rents. Any country which pays higher prices than the LRAC (LRAC is based on UK price index of 100) will have a price index in excess of 100. The value of rent earned by UK pharmaceutical exports to these markets depends on the total value of exports and the degree to which their price levels exceed UK prices. The estimate produced

for total export rent equals £615 million. This includes some rents which are remitted abroad to foreign owners and so can not be termed beneficial to the UK economy in our framework. The benefit to the UK economy will equate to £615 million less post tax earnings remitted abroad. Corporation tax will be paid to the UK Treasury before any dividends are calculated so the tax revenue from these rents will all be regarded as a gain. We realise that the tax calculation depends on accounting procedures, however we will assume that rents are treated as profit. Assuming a long run tax rate of 33 per cent the benefit to the UK ranges from £410 million to £615 million assuming 50 per cent and 100 per cent UK ownership respectively. The benefit to UK economy from export rents is therefore estimated as in the range £410 million - £615 million.

7.5 Rents on sales which originate overseas

Rents from export sales by UK-based companies, both UK-owned and foreign-owned, have been assessed above. Companies which are labelled as UK-owned, i.e. with corporate HQs located in the UK and significant UK share ownership, generally have significant production and research facilities located overseas, for example Glaxo Wellcome's overseas manufacturing output is over 2.5 times its UK manufacturing output.

It is a reasonable assumption that production located overseas is also able to earn rent because of the research and development and managerial base which exists UK. The loss of UK managerial expertise and high quality UK research and development makes it entirely possible that rents from overseas-based sales would be lost, i.e. companies would be less successful.

A conservative estimate of the sales which UK-owned pharmaceutical companies generate abroad, which originate overseas would be £6 bn. Assuming that these sales contain a rent element, contributed to group post-tax profits, of 5 per cent, which is also conservative given our estimates that UK exports generated 13 per cent of revenues as rent, the rent attributable to overseas sales originating abroad is in the region of £300 million.

It is likely that some rents would continue to be earned by pharmaceutical companies after they had shifted all R&D and manufacturing activity and their corporate HQ out of the UK. If the companies continued to be owned by UK shareholders then the UK would receive these rents. It is likely in practice that UK shareholdings would also diminish, as most institutional and personal share portfolios are dominated by companies with UK HQs. In principle, however, even if shares were sold, the price obtained would reflect the expected value of future rents. In practice, of course, this may not occur.

Our estimate of £300 million does not depend on a change of share ownership. It is assumed to arise from lower rent earning following the loss of the benefits of UK location. If shares were disposed of by UK citizens, and prices did not reflect future rent earning capacity, additional losses would occur.

7.6 Terms of trade effect

The UK's competitive advantage in pharmaceuticals has allowed it to produce 'premium quality' products which sell well in the competitive purchasing environment of international markets. Appendix 3 discusses the impact which the movement from the current situation to the counter-factual would have on the exchange rate and the terms of trade. The removal of the UK-based pharmaceutical industry would bring about, in the short run, a deterioration in the trade balance equal to the gross output of the domestic industry, around £7.5 billion (total output less inter-company trading within the UK). All exports would disappear and all domestic production purchased by the NHS would be replaced by imports. In order for this deficiency to be made up, other industries would have to increase their output of exportables. The resources to produce this increased output are available, in principle, from the resources freed by the pharmaceutical industry. However the UK has a competitive advantage in the market for pharmaceuticals. Other industries would have to lower the prices of their goods and services to a degree in order to sell the extra output which they are able to produce. The lower the unit price falls the more units that must be

sold in order to make up the £7.5 billion, and the greater is the loss of potential rents and surpluses in these other sectors. As more resources are used to make goods which must be exported to maintain equilibrium, fewer goods are available for domestic consumption. The estimated impact set out in Appendix 3 is in the range £1.05 billion – £1.4 billion per annum.[2]

8 Alternative rent calculation – a value-added approach

An alternative to assuming that certain market conditions produce prices which approximate to LRAC is to estimate the LRAC directly from cost data. The Census of Production provides estimates of industry sales, bought-in materials and services, wages and salaries, and depreciation of fixed assets. These figures provide the basis for calculating the net profit of the industry. In order to calculate 'rents' we must subtract the risk adjusted opportunity cost of capital from this. The Census also provides an estimate of capital employed. We have applied a recent estimate of the nominal opportunity cost of capital in the pharmaceutical industry by the Office of Technology Assessment of 14 per cent per annum. This compares closely with estimates used in other studies. Appendix 4 lays out the value-added based rent calculation. The overall rent estimate is £1,487 million. This estimate includes rent on sales to the NHS which we exclude from the rent calculation as a transfer payment.[3] There is, however, no simple and accurate mechanism whereby we can divide this value added into export rent and transfer payment. Roughly one half of the output of the UK industry is purchased in the UK, so if we crudely assessed the transfer payment as half of the value added, the total export rents, as calculated using the value added approach, would be around

2 This terms of trade effect, whilst being a real cost which the economy would have to bear, is not necessarily unique to the pharmaceutical industry.

3 It could be argued that the value added rent on NHS sales should not be regarded as a transfer but as a proxy measure for the additional benefits derived by NHS patients from the quality of the medicines supplied by the UK-based industry. We have, however, treated this aspect of benefit as unquantifiable.

£745 million. Not all of this value added will accrue to the UK economy some will be paid out, after tax, to non-UK owners. If we apply the same rate of long run corporation tax, 33 per cent, and the same range of non-UK ownership, between zero and 50 per cent foreign ownership, which were used earlier, then the value added remaining in the UK economy is in the range £495 million – £745 million. This is comparable to the £410 million – £615 million range estimated in section 7.4.

9 Estimate of potential cost savings

9.1 Cost savings and transfer payments

If we initially assume that some cost saving by the NHS is feasible it is important to understand which elements produce cost savings for the UK economy as a whole. If the industry were entirely UK-owned, supplying the NHS from UK plants, then any payments made to the pharmaceutical companies by the NHS would remain within the UK. There would be no direct savings for the UK under these circumstances. Any cost saving to the NHS would be a redistribution of income within the UK and so a transfer payment. Potential savings for the UK economy accrue only to the extent that lower prices would reduce the amount of monies paid by the NHS which 'leak' abroad via profit remitted to overseas owners, or alternatively that lower prices are obtained for products currently imported. Only if all products were currently imported, or the entire UK-based industry was foreign-owned, would savings to the NHS be equal to savings to the UK economy. In practice therefore, any estimates of savings have to be adjusted to remove the transfer element.

9.2 The potential for cost savings

Opportunistic purchasing of pharmaceuticals might, as in other industries, be based on three approaches:

- obtaining volume discounts
- 'spot' purchases where suppliers sell at below average cost
- finding suppliers with lower costs or who are able and prepared to accept lower profits.

Adjusting for volume

The ability of a country to employ leverage on the price paid through opportunistic bargaining may be directly linked to the volume of products it purchases. France, along with some other European countries, purchases a much higher volume of medicines than the UK and so may be able to 'negotiate' lower prices more easily (France spends £9 bn per year on pharmaceuticals, over twice the UK expenditure). The price indices calculated by IMS (Appendix 2) show ex-manufacturer prices for the top 50 products for the UK having a similar price to France. Other indices however, do show French prices as being lower (for example the 1989 BEUC index and 1991 IWI index). Analysis of 'volume adjusted' international prices place the UK price at the low end of the scale, questioning the ability to achieve much lower prices, given low UK per capita consumption of pharmaceuticals.

Spot purchasing aimed at free-riding

Cost savings may well be available in the short run, although the ability of wholesalers and entrepreneurs to move product across national boundaries, combined with a likely reluctance of companies to signal to other governments a willingness to accept lower prices, will limit the willingness of the industry to supply at low prices in the long run.

A lower long run cost?

It may well be that our assumption that UK price levels represent a good approximation to long run average costs is incorrect. Overall French price levels, for example, may well be below UK levels, and France has some domestically owned companies with international capability. As discussed above, although the IMS index we have used shows a French price level for new products close to the UK level, older indices have suggested French price levels may be half those of the UK. If French prices were lower and approximated to long run average cost, then the UK may be able to purchase at lower prices than current UK levels under the counter-factual.

9.3 A calculation of cost savings

If it were true that, say, the Spanish price level in the IMS index and not the UK price level could be achieved by the NHS when

opportunistically purchasing medicines then the potential cost saving achievable would be approximately 17 per cent of NHS expenditure on pharmaceuticals. In 1992 the NHS expenditure on pharmaceuticals was £3,490 million. The potential cost saving to the NHS which would be obtained if Spanish prices were paid is thus approximately £600 million. If account is taken of the transfer element (assuming that one third of NHS purchases are imported and that UK ownership of the UK-based industry lies in the range 50-100 per cent) of this NHS saving, then the saving to the UK is reduced to between £200 million and £400 million.

If Spanish prices reflected LRAC then the calculation of export rents would have to be adjusted. The estimated level of gross rents would rise to £950 million which, using the same assumptions regarding taxation and ownership patterns as before, revises the estimate of gain to the UK economy in the range £630 million – £950 million. The net benefit calculation would thus not change significantly overall. Our assumptions are, however, that UK prices represent LRAC, and that, given low UK volumes, and cross border arbitrage within Europe, it is unlikely that in the long run, the UK could make savings.

10 Conclusion

On the basis of our assumptions and estimates, the UK-based pharmaceutical industry provides a substantial net contribution to the UK economy. Our calculations provide us with a range of figures, shown below, which can be summated to provide an estimate of the value of the UK-based pharmaceutical industry to the UK economy.

If all the quantifiable benefits are assumed to be relevant we obtain a valuation within an estimated range of £1,800 million to £2,500 million per annum. This valuation excludes those elements which we felt a reliable estimate could not be provided for, i.e. the supply side externalities of R&D and the benefits which patients receive.

	£ million per annum
Benefits:	
Supply side externalities	unquantifiable
Benefit to patients	unquantifiable
Labour rent	70
Export rents	410-730
Rents from non-UK production	300
Terms of trade	1,050-1,400
Cost saving	nil
Total	1,830-2,500

Our overall conclusion is that the value of the industry to the UK economy is around £2 billion per annum. The results are however highly sensitive to the assumptions used. On some assumptions the annual value would be below £1 billion. Our view is that under all reasonable assumptions the industry is making a net contribution to the UK economy of several hundreds of £millions per annum.

Appendix 1

Labour Rents

Katz and Summers[1] identify three key relationships which help in determining which industries will be paying a large wage premium:

(1) a significant positive relationship exists between value added per worker and wage premium;

(2) a similar relationship exists between the capital-labour ratio and the wage premium;

(3) a high level of research and development tends to coincide with a high wage premium.

The pharmaceutical industry scores highly on all three counts. In terms of R&D expenditure the following comparisons can be made

Industry	**R&D spend as % of Sales**
Pharmaceuticals	17.5%
Electronics	10.5%
Aerospace	9.5%
Chemicals	6%
Motor Vehicles	2%
Electrical Engineering	1.5%
Mechanical engineering	1%

Source: OHE adapted from Pharma Facts, ABPI.

Pharmaceuticals are a high technology industry, exactly the type of industry which Tyson[2] indicates will make the payments of labour rents. Hence pharmaceutical companies the world over are paying their employees a wage which is above that which they could achieve in other, less intensively hi-tech, industries.

The implication is that displaced workers from the pharmaceutical industry would find it extremely difficult to match the remuneration which they currently receive. In reference to Airbus Industrie, Katz and Summers conclude that 'policy analysis should not treat the rent component of the wage bill as a social cost of production but as a component of the social surplus generated by the industry'. Such a conclusion applies equally to the pharmaceutical industry.

In the hi-tech, export intensive, industries of the USA, wages were around 10 per cent above the average, *after being adjusted for skill differences.* International comparisons show such patterns to be similar across

developed countries. On this basis an approximate figure for total labour rent in the UK would be £140 million based on wages and salaries of £1,530 million in 1992. This gross rent will be adjusted in the main body of the paper for transfers.

(1) L.F. Katz and L.H. Summers, 'Industry Rents: Evidence and Implications', Brookings Papers: Microeconomics, 1989.

(2) L.D'A. Tyson, 'Who's Bashing Whom? Trade Conflict in High-Technology Industries', Institute for International Economics, 1992.

Appendix 2

Calculation of export rents

Country	*Price index (UK=100)*[1]	*Total pharmaceutical exports from the UK*[2]	*Total long run cost of exports (£000s)*[3]	*Rent element of exports (£000s)*
Belgium	114	113,400	99,474	13,926
Denmark	163	46,300	28,405	17,895
France	99	332,800	336,162	–3,362
Germany	168	266,100	158,393	107,707
Italy	109	229,200	210,275	18,925
Netherlands	155	257,600	166,194	91,406
Spain	83	71,251	85,845	–14,594
USA	171	429,182	250,984	178,198
Totals		1,745,833	1,335,730	410,103

Sources: 1 IMS 1992 index based on top 50 products in UK market.
2 Customs and Excise, Business Monitor LSD.
3 Total Long Run Cost = {Total Export from UK * (100/country's price index)}
Rent Element of Exports = {Total Exports from UK – Total Long Run Cost}
Price index of 100 equals UK price and is assumed to equal LRAC.

Total pharmaceutical exports to the top 50 markets (£000s)	3,500,000
Total pharmaceutical exports to the 8 markets assessed (£000s)	1,745,833
Percentage of the top 50 export market held by these 8 countries (£000s)	50%
Export rent calculated for these 8 countries	410,103
Total export rent if we assume that the sales to rent ratio in the other half of the market is 50 per cent of that for the markets assessed (£000s)	615,153

We have argued in the main body of the paper that the largest markets are less able to free-ride on R&D costs than smaller, often less wealthy markets. If one assumes that this is so and that the half of the market not explicitly analysed generates rents at 50 per cent the rate of the markets assessed then the total rent is £615 million.

Rents based on Spanish prices as LRAC

If the LRAC were to coincide with Spanish prices the export rent would be significantly higher. Reapplying the above methodology on this basis, using the index of 83 as LRAC equivalent, rents are estimated as £950 million.

Appendix 3

Measuring the terms of trade effect

If the pharmaceutical industry did not exist in the UK exports would be reduced by approximately £3 bn. Current supplies to UK customers, other than inter-industry trade, would be replaced by imports, adding about a further £4.5 bn to the national import bill. There would, therefore be a net deterioration in the trade balance of around £7.5 bn. It is unlikely that this degree of disequilibrium could be corrected without some deterioration in the terms of trade.

Two distinct steps are taken in order to estimate the terms of trade effect.

(i) Estimating the change in the exchange rate required to correct the balance of trade position; and

(ii) Estimating the terms of trade effects of the required depreciation.

To calculate these we require the elasticity of the trade balance with respect to the exchange rate E_{tb}, and the elasticity of the terms of trade with respect to the exchange rate E_{tt}. The established formulae for making these calculations together with two sets of assumed values for the elasticities are shown below.

$$E_{tb} = \frac{Vx}{Vm}\,\frac{dx+1}{dx/Sx-1} - \frac{Sm+1}{Sm/dm-1}$$

$$E_{tt} = \frac{SxSm - dxdm}{(dx - Sx)\,(Sm - dm)}$$

	Case 1	Case 2
d_x (elasticity of demand for exports)	–3	–5
d_m (elasticity of demand for imports)	–1	–1
s_x (elasticity of supply for exports)	3	5
s_m (elasticity of supply for imports)	6	10
v_x (value of total UK exports)	£142.5 bn	£142.5 bn
v_m (value of total UK imports)	£150 bn	£150 bn

E_{tb} is dependent on the value of total imports and exports, which in this case are given as £150 bn imports and £142.5 bn exports, and on the elasticities of demand and supply of both exports and imports. E_{tt} depends upon the elasticities of supply and demand for both imports and exports. The precise figure for each elasticity is open to much discussion. However this analysis is based on long run elasticities which are likely to be significantly higher than the short run elasticities which would tend to produce higher transitional losses.

We have assessed a range of sets of elasticities to ascertain the impact these differences have on the resultant terms of trade effect.

Case one illustrates an example with lower long run elasticities. E_{tb} = 1.95 and E_{tt} = –0.36, these combine to produce a loss to the economy of around £1.4 bn per annum.

Case two illustrates the effect of using higher long run elasticities. E_{tb} = 2.9 and E_{tt} = –0.41, these combine to produce a lower loss to the economy of around £1.05 bn per annum.

On the basis of these two cases we assume that the terms of trade effect probably lies in the range £1.05 bn – £1.4 bn per annum in the long run.

Appendix 4

Value added approach to export rents

	£ Million (1992)
Total industry sales revenue	8,540
Bought-in materials and services	4,130
Gross value added (at factor cost)	4,410
Wages and salaries	1,530
Gross profit	2,880
Depreciation of fixed assets	270
Net profit	2,610
Fixed capital	5,380
Net current assets(1)	2,640
Capital employed	8,020
Opportunity cost of capital at 14 per cent(2)	1,123
Economic rent	1,487
Economic rent as a per cent of sales revenue	17.4%

(1) ICC figure for 90/91 scaled up for 1992 industry sales.
(2) Office of Technology Assessment (1993).

Data source: Report on the Census of Production, PA 257, 1992.

References

Association of the British Pharmaceutical Industry (ABPI), 'Pharma facts and figures', ABPI, September 1993.

Central Statistical Office, 'Business Monitor MM20', Government Statistical Service, December 1993.

Central Statistical Office, 'Business Monitor MM20A', Government Statistical Service, December 1993.

Central Statistical Office, 'Report on the Census of Production PA257, Pharmaceutical Products', Government Statistical Service, 1992.

Department of Health, 'Pharmaceutical Price Regulation Scheme', HMSO, October 1993.

Hildreth, A.K.G. and Oswald, A.J. 'Rent-sharing and Wages: Evidence from Company and Establishment Panels', Applied Economic Discussion Paper Series No. 154, Institute of Economics and Statistics, Oxford, October 1993.

Lumley, C.E. et al., 'UK pharmaceutical R&D investment in the 1980s', The Pharmaceutical Journal, 1989, vol. 243: 764-767.

Katz L.F. and Summers L.H., 'Industry Rents: Evidence and Implications', Brookings Papers: Microeconomics, 1989.

Shearson Lehman Hutton, 'Pharma Profiles', Shearson Lehman Hutton Securities, February 1990.

Tyson L.D'A., 'Who's Bashing Whom? Trade Conflict in High-Technology Industries', Institute for International Economics, 1992.

US Congress, Office of Technology Assessment, 'Pharmaceutical R&D: Costs, Risks and Rewards', OTA-H-522 (Washington, DC: U.S. Government Printing Office), February 1993.

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