ESTIMATING PHARMACEUTICAL COMPANIES' VALUE TO THE NATIONAL ECONOMY
Case Study of the British Pharma Group

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Contents

EXECUTIVE SUMMARY

Knowing the net value that companies, or whole sectors of the economy, bring is clearly important when considering economic and industrial policy. In this paper we estimate the economic contribution to the UK made by two British based, research intensive, pharmaceutical companies: AstraZeneca (AZ) and GlaxoSmithKline (GSK). These companies are the two members of the British Pharma Group – BPG. The paper demonstrates the practical application of an economic methodology based on estimating the 'economic rent' that the companies earn for the UK. Specifically we estimate the net additional income and wealth brought to the UK by these companies' activities in excess of the income they would be expected to generate in the next best alternative use(s) to which the labour and capital would be diverted if, hypothetically, AZ or GSK ceased to operate in the UK.

Summary Table 1 shows that in 2005 around 40% of the pharmaceutical industry's gross contribution to UK national income (GVA) was generated by the two BPG companies, which together accounted for a similar proportion of the 72,000 people employed in the UK pharmaceutical sector as a whole, nearly half of UK pharmaceutical exports and two-thirds of UK pharmaceutical research and development (R&D) expenditure.

Summary Table 2 shows the range of estimates we have calculated for the economic rent earned for the

	Gross value added (£mill)	Production (£mill)	Exports (£mill)	Trade balance (£mill)	Direct employment (permanent headcount)	R&D expenditure (£mill)
AZ (2005)	826	3,120	2,733	821	11,551	904
GSK (2005)	1,652	4,002	3,236	972	19,440	1,266
BPG (=AZ +GSK) (2005)	2,478	7,122	5,969	1,793	30,991	2,170
Total UK pharmaceutical industry (2004)	6,241	15,307	12,354	3,712	72,000	3,244

Summary Table 1: **Macroeconomic data – BPG companies and the UK pharmaceutical industry**

Note: Figures in *italics* are OHE estimates.
Sources: See Table 1 in the main body of the Briefing.

Summary Table 2: **Total economic rent generated by BPG companies, 2005**		
£ million p.a.	**BPG companies – all activities**	**BPG companies – manufacturing only**
Producer rents*	164-766	24-115
Labour rents*	115-137	39-48
R&D spillovers*	120-360	0
Sub-total	**399-1,263**	**63-163**
Possible terms of trade effect*	Highly uncertain but possibly in the range 600-2,900	Highly uncertain but possibly in the range 600-2,900

*Note: These terms are explained in Section 3 of the Briefing.

UK by AZ and GSK in 2005, disaggregated into the main sources of that rent, which are explained in Section 3 of this Briefing. It is clear that the two companies contributed significant net value to the UK economy. The scale of economic rent they earned in 2005 from the total of their manufacturing, R&D and headquarters activities was of the order of £0.4-1.3 billion, plus a 'terms of trade' effect of highly uncertain magnitude but possibly in the range £0.6-2.9 billion per annum. Thus the value of BPG companies to the UK economy is estimated to be at a minimum around £1 billion annually and could well be much higher.

Table 2 also shows the impact of an intermediate case to estimate the value attached specifically to the companies' manufacturing activities. Thus the final column of the table shows the estimated loss of economic rent in the hypothetical case that all of AZ's and GSK's manufacturing is assumed to leave the UK, but their R&D and headquarters functions are assumed to remain. The estimated economic rent due to the companies' manufacturing is thus of the order of £0.1-0.2 billion per annum, plus the same highly uncertain terms of trade effect as before possibly in the range £0.6-2.9 billion per annum.

The estimates presented in the paper are unavoidably approximate. They have been constructed on the assumption that *all* of the UK labour and capital currently used by AZ and GSK would immediately find alternative employment within the UK in the hypothetical situation that those two companies were to close down their UK operations.

Also, there are some aspects of the value of the two BPG companies to the UK for which we have not been able to provide estimates. Owing to lack of data, we have not included rents captured in the UK that may be obtained by the companies from royalties and licence payments. We have also not attempted to estimate whether the companies' activities lead to other types of net value to the UK

beyond economic rent such as earlier achievement of any health benefits for patients, or whether any reputational benefits are conferred to a country by its association with the companies' activities.

To set the figures shown in Summary Table 2 in context, the estimated net economic rent earned by many enterprises in any economy can be expected to be close to zero: i.e. they yield as much economic value as, but not significantly more than, the next best alternative uses of the capital and labour they employ. We could find no published empirical estimates of total economic rent earned by a company or an industry for a country in other sectors of the economy.

1 INTRODUCTION

It is a matter of concern both to policy makers and to the owners and employees of enterprises in an industry to understand the importance of those enterprises to the national economy. There may be various aspects of that importance including, for example, their contribution to national income; the reputation and quality of an industry's companies and products; and their fit with national policies such as the development of a knowledge-based economy as part of a strategy to improve national competitiveness. The focus of this paper is on a method for estimating the net addition to national income, if any, that results from employing resources – labour and capital – in a particular activity rather than in their next best alternative uses. In other words: how much poorer would a country be if an industry and its companies were to cease their activities there, even if all the labour and capital released were subsequently to find re-employment elsewhere in the economy.

To demonstrate the approach we have estimated the net value to the UK economy in 2005 of the pharmaceutical businesses of the two member companies of the British Pharma Group (BPG),

Table 1: Macroeconomic data – BPG companies and the UK pharmaceutical industry

	Gross value added (£mill)	Production (£mill)	Exports (£mill)	Trade balance (£mill)	Direct employment (permanent headcount)	R&D expenditure (£mill)
AZ (2005)	*826	3,120	2,733	**821	11,551	904
GSK (2005)	*1,652	4,002	3,236	**972	19,440	1,266
BPG (= AZ + GSK) (2005)	*2,478	7,122	5,969	**1,793	30,991	2,170
Total UK pharmaceutical industry (2004)	6,241	15,307	12,354	3,712	72,000	3,244

Sources: National Statistics – Annual Business Inquiry; http://www.abpi.org.uk/statistics accessed 7/12/06; and BPG company data. AZ and GSK provided data on the values of their respective exports from the UK, UK production, their UK labour costs and numbers employed in the UK, and UK capital stock. Data were not provided on rate of return on capital employed in the UK. For the purposes of the illustration in this paper, the authors assumed that the 2005 return on capital employed was, for both companies, 21%. This is the allowed rate of return according to the UK Pharmaceutical Price Regulation Scheme (See: ABPI and Department of Health, 2004).

Notes: Figures in *italics* are OHE estimates, as follows:
* AZ's UK labour costs in 2005 were £614 million, and GSK's were £1,241 million. The cost of capital is, for illustrative purposes, taken to be 21% of the capital employed, which was £2,346 million for AZ and £3,494 million for GSK. As the proportion of AZ's shares held by UK residents was 43%, and for GSK was 56% (company data in each case), the estimated 2005 GVA by AZ was £826 million (= 614 + [0.21x2,346x0.43]) and by GSK was £1,652 million (= 1,241 + [0.21x3,494x0.56]).
** Estimated by assuming company's proportion of national pharmaceutical trade balance = company's proportion of total pharmaceutical industry exports.

namely AstraZeneca (AZ) and GlaxoSmithKline (GSK).[1] The background to the study can be illustrated by macroeconomic data indicating the scale of AZ, GSK and the pharmaceutical industry as whole. Table 1 shows gross value added (GVA, i.e. contribution to national income[2]), production, exports, balance of trade, direct employment, and research and development (R&D) expenditure, for the most recent year for which data are available: 2004 for the UK industry as a whole, and 2005 for the BPG companies.

If we assume that output and employment by the total UK pharmaceutical sector in 2005 was similar to that in 2004, then Table 1 shows that around 40% of the pharmaceutical industry's contribution to UK national income (GVA) was generated by the two BPG companies, which together accounted for a similar proportion of the 72,000 employed in the UK pharmaceutical sector as a whole, nearly half of UK pharmaceutical exports and two-thirds of UK pharmaceutical R&D expenditure.

However, if the UK-based activities of AZ and GSK were undertaken somewhere else in the world, the

net economic loss to the UK economy would be less than that suggested by figures in Table 1, as some or all of the UK resources currently used by those companies (labour and capital) would be re-employed elsewhere in the economy. Nevertheless, even if all of the UK labour and capital currently used by the BPG companies were to be gainfully re-employed, it has been shown that they would obtain a remuneration below that which they obtain in the pharmaceutical industry (PICTF, 2001; Hale and Towse, 1995). The *extra* that labour and capital can earn in its current use relative to the next best alternative use is called 'economic rent'.

We estimate in two ways the economic rent earned. First, we assess the impact of assuming that all the UK-based activities (R&D, headquarters and manufacturing) of the companies are removed to another country. In other words, we address the hypothetical question 'how much worse off would the UK be if the BPG companies moved out?' Second, as a refinement, we also estimate the loss to the UK economy assuming that only manufacturing were to be removed, but that R&D and headquarters activities continue in the UK as currently.

However, we have not attempted to estimate whether the companies' activities lead to other types of net value to the UK beyond economic rent such as:

- whether their activities in the UK lead to earlier or higher uptake in that country of the medicines they develop, and of any consequent

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[1]The BPG provided financial support to the Office of Health Economics in undertaking this study. The BPG is a formal association with two members, namely the UK operating companies of the two largest UK-headquartered pharmaceutical companies: AstraZeneca and GSK.

[2]"Gross value added is the difference between output and intermediate consumption for any given sector/industry. That is the difference between the value of goods and services produced and the cost of raw materials and other inputs which are used up in production." (Office for National Statistics, glossary of economic terms available at: http://www.statistics.gov.uk/about/glossary/economic_terms.asp)

earlier achievement of health effects for patients. UK patients may benefit from speedier introduction of new medicines if more of the development work for them, especially the clinical trials, is undertaken in the UK (Corrigan and Glass, 2005; Walley et al., 2004). In the extreme, if it were argued that some treatments might never have been discovered but for work in UK laboratories, then substantial foregone future health benefits would result. These are potentially important benefits but we have not found a basis for calculating a reliable estimate of them. Extra patient benefits have therefore been left out of the quantification of overall benefits;

- whether any reputational benefits are conferred to a country by its association with the companies' activities. The visible departure of a long-standing and significant player in the UK economy could be argued to have a detrimental effect on the business culture of the UK as a whole, and of how the UK is seen internationally as a location for business.

Thus, the estimates presented in the paper are likely to be an underestimate of the total actual value that BPG companies provide to the UK.

2 THE CONCEPT OF ECONOMIC RENT

In a market economy, each production factor (e.g. labour) would receive an income equal to or greater than its marginal opportunity cost – that is, the income available in the next best use of the factor. Any excess earnings above the marginal opportunity cost are referred to as economic rent.

Milgrom and Roberts (1992) define the rent obtained by workers, the labour rent, as 'the portion of earnings in excess of the minimum amount needed to attract a worker to accept a particular job'. Thus if someone is earning £20,000 for a job and the next best job they could do would pay them £15,000, then the economic rent they are earning in their current employment is £5,000, the difference between the two. The same principle applies to capital, which may yield greater profits (adjusted for risk) in one activity than in its next best alternative use.

In line with this approach, we estimate the value generated by labour in the UK and by capital owned by UK residents that is employed in the BPG companies' functions based in the UK, net of the return they would receive if used elsewhere in the UK economy.

A large quantity of macroeconomic literature, theoretical and empirical, has been devoted to arguing about the extent to which labour and capital can be expected to be fully employed within an economy and what happens when a significant chunk of activity closes down or relocates to another country. At one extreme, it might be argued that few of the labour and capital resources freed up would find worthwhile re-employment, other than over the very long term. The approach taken here is at the other extreme and in line with the requirements of the UK government when appraising the appropriateness or otherwise of government intervention[3]: assuming that all resources would be fully and immediately re-employed within the country. Hence the estimates of value that result are conservative, representing the minimum economic value that a company brings to a country.

3 METHOD: OVERVIEW

Our approach is based on the methodology described in the joint Association of the British Pharmaceutical Industry (ABPI), Department of Health, Department of Trade and Industry (DTI) and HM Treasury study undertaken for the Prime Minister's Pharmaceutical Industry Competitiveness Task Force (PICTF) in 2000 and published in the December 2001 PICTF report *Value of the Pharmaceutical Industry to the UK Economy* (PICTF, 2001). The PICTF report presented an estimate of the economic value added by the pharmaceutical industry as a whole to the UK economy. The current report looks at the value of two individual companies who provided up to date and detailed data on their worldwide and domestic sales (by country), UK R&D expenditure and numbers of people employed in the UK. The data provided by the two members of the BPG – namely AZ and GSK – are set out at Appendix 1.

We make the assumption that the resources currently employed by the two BPG companies in pharmaceuticals would in effect be reallocated to other productive sectors of the economy but not in other pharmaceutical companies. The departure of AZ and GSK from the UK would not of itself provide a reason for the remainder of the global pharmaceutical industry to switch more of their activities from the rest of the world to the UK, and so make use of the ex-BPG company resources there. Indeed, depending on the scenario that is assumed to be prompting the departure from the UK by AZ and GSK, it is perhaps

[3]This 'crowding out' assumption – if resources were not tied up doing A they would all be employed doing B – has been a consistent element of UK Government policy appraisal for many years. Its most recent manifestation is the 2003 edition of the HM Treasury guidance: "The Green Book: Appraisal and Evaluation in Central Government".

more likely that other pharmaceutical companies would also be wanting to relocate some or all of their work out of the UK. Hence, if any of the ex-AZ or -GSK employees were to be taken on by other pharmaceutical companies in the UK this would probably be at the expense of other employees being effectively crowded out from those companies.

We estimate the net loss due to the hypothetical relocation abroad of AZ and GSK activities from a long term perspective, according to which, in equilibrium, all the resources currently used by the BPG companies would be efficiently re-allocated in other sectors or would leave the country to be employed in another economy. We do not attempt to assess any adjustment costs that might arise in the short and medium term to enable the factors of production dismissed by AZ and GSK to be utilised in other sectors, e.g. costs incurred by ex-employees to find a new job.

Estimates of the net value added by AZ and GSK to the UK necessarily exclude direct transfers from one part of the UK economy to another as transfers make no net contribution to the UK taken as a whole. For example, that part of the economic rent that originates from medicines sales to the NHS simply represents redistribution from the public sector (UK taxpayers) to the company and adds nothing to the UK economy overall.

We have assessed the economic rent generated for the UK economy by AZ and GSK under the following headings:

* *Producer rents*, which include:

  o *Economic rents earned from UK exports, and UK tax revenues from them*. These arise whenever it is possible to sell British goods or services at prices in excess of the cost of production, where those costs include a normal rate of profit. In other words, export rents are earned when it is possible to sell exports at prices that earn supernormal profits. For the purposes of this analysis we are not interested in any supernormal profits earned by a UK company selling to UK customers, as this would simply be a transfer from one part of the UK economy – consumers – to another – the owners of the UK capital invested in the company. Whether the rent earned from exports accrues to British owners of capital or, via taxation, to the British Exchequer it still represents net value to the UK economy;

  o *Economic rents earned from the overseas activities of UK-owned business*, and

captured by British shareholders or the British Exchequer, for example via dividend payments and capital gains from increased share prices, and from British taxation of those;

* *Labour rents*, i.e. economic rent earned by employees in the UK. This arises if, in our example, BPG companies pay their employees more than they could earn in their next most remunerative employment;

* *Spillover benefits from research and development (R&D) activity* that may be captured within the national economy by bodies other than the company making the original R&D investment. The flows of knowledge generated by R&D by one company in one sector can benefit other companies in the same or other sectors, and benefit public and charitable organisations too, for example by advancing scientific knowledge, by demonstrating innovative techniques and by providing new technologies with wide application (e.g. software);

* *Terms of trade effects*. The loss of a company's activities that contribute positively to a country's balance of trade might require a (small) depreciation of the country's currency in order to restore the overall balance of trade. In our example, if the activities of BPG companies ceased in the UK, the country's terms of trade would worsen, meaning that its population would have to work harder than before to continue being able to import as much as before from the rest of the world, or would have to import less. In other words, the UK would be made (slightly) poorer.

The following sections discuss the method for obtaining each of these in turn, and present results for the case study of the BPG companies.

4 PRODUCER RENTS

4.1 Rents from exports

The PICTF (2001) analysis used two different approaches to estimate the producer rents originating from pharmaceutical companies' activity in the UK, i.e. from their UK exports. (Activity undertaken in the UK by companies for UK customers does not add to the UK's net overall economic rent but is just a transfer between one group of people in the UK and another.)

In the first approach, total export rents were estimated as the difference between the rate of profit earned by the pharmaceutical industry and the rate earned by the rest of the economy. Economists at the DTI estimated the 1997 rate of return on capital to the UK pharmaceutical industry and compared that with the rate of return achieved in the same year by UK manufacturing industry as a whole. The difference between these two rates of return on capital, multiplied by the value of the pharmaceutical industry's asset base gives a direct estimate of the sector's total export rents.

However, as we do not have access to the data needed to update the DTI calculations for PICTF, we rely in this paper on the second method used by PICTF to estimate export rents, which was also used in Hale and Towse (1995). The reasonableness of our estimate using this second approach is then tested by comparing it with the estimate of export rents that would be implied if the rates of return calculated by the DTI for 1997 still held true in 2005.

The starting assumption is that UK medicine prices approximate to the long run average costs of producing them, which represent the costs of operating in the industry, including all short run expenses and the risk adjusted cost of capital. This assumption is not unreasonable: launch prices of new medicines are not regulated in the UK and the rate of companies' profits allowed by the Pharmaceutical Price Regulation Scheme (PPRS) is negotiated with Government to provide industry with

a reasonable but not excessive rate of profit on sales of branded medicines to the NHS, by reference to risk adjusted rates of return earned in other sectors of the UK economy (ABPI and Department of Health, 2004). If the view of critics of the PPRS were to be taken, that UK branded medicine prices can exceed their long run average cost including the cost of R&D, then that would imply that our estimate of export rent would be an understatement of the true economic rent earned for the UK by the companies.

UK producers gain economic rent when they export their products to a country where medicine prices exceed UK prices, and lose rent when export prices are below domestic levels. Hence, the size of the rent generated depends crucially on:

- the difference between the prices received by the manufacturers for medicines sold in other countries and the prices they receive when the same medicines are sold in the UK; and

- the scale of exports from the UK to higher-price markets, principally the US, versus those exported to lower-price markets, e.g. Italy and Spain.

Owing to the large numbers of medicines produced by AZ and GSK, the numerous different forms and strengths in which they are available, and the many countries in which they are sold, we have taken a simplified approach to comparing prices internationally, relying on existing aggregate analysis. Tables 2A and 2B show the calculations

Table 2A: **AstraZeneca export rents, 2005**

Country	(column a) Price index (UK=100)*	(column b) Total AstraZeneca exports from UK (£million)**	(column c) Total long run cost of exports (£million)	(column d) Rent element of exports (£million)	(column e) Rent captured in the UK (60.1% of total rent) (£million)
Austria	93	21.2	22.8	−1.6	
Belgium	94	71.0	75.5	−4.5	
France	93	143.9	154.7	−10.8	
Germany	104	129.8	124.8	5.0	
Italy	83	214.9	258.9	−44.0	
Netherlands	97	18.8	19.4	−0.6	
Spain	81	155.0	191.4	−36.4	
USA	191	599.9	314.1	285.8	
TOTAL		1,354.5	1,161.6	192.9	**116**

*Source: Second submission to the Office of Fair Trading by the ABPI (2006). Bilateral comparison using 2005 price information but converted to £s using average exchange rates over the five years 2001 to 2005. ABPI estimates based on IMS data.
** AstraZeneca data. Total AstraZeneca exports from UK in 2005 were £2,733 million. Thus, £1,379 million of exports went to other countries than those listed.

Table 2B: **GlaxoSmithKline export rents, 2005**

Country	(column a) **Price index** (UK=100)*	(column b) **Total GSK exports from UK** (£million)**	(column c) **Total long run cost of exports** (£million)	(column d) **Rent element of exports** (£million)	(column e) **Rent captured in the UK** (69.2% of total rent) (£million)
Austria	93	18.5	19.9	−1.4	
Belgium	94	46.9	49.9	−3.0	
France	93	340.5	366.1	−25.6	
Germany	104	163.0	156.7	6.3	
Italy	83	219.3	264.2	−44.9	
Netherlands	97	45.8	47.2	−1.4	
Spain	81	125.2	154.5	−29.4	
USA	191	591.8	309.8	282.0	
TOTAL		1,550.9	1,368.3	182.6	**126**

*Source: Second submission to the Office of Fair Trading by the ABPI (2006). Bilateral comparison using 2005 price information but converted to £s using average exchange rates over the five years 2001 to 2005. ABPI estimates based on IMS data.
** GSK data. Total GSK exports from UK in 2005 were £3,236 million. Thus, £1,685 million of exports went to other countries than those listed.

undertaken to assess the export rents for AZ and GSK respectively. The countries listed are those for which reliable international price comparisons were available. In particular, column a indicates the bilateral comparison of ex-manufacturer prices representing the price of the leading 150 branded medicines in the UK compared with their prices in other countries matched for form (e.g. tablet or liquid) and dosage strength. It uses 2005 price information but converts foreign currencies (US$ and €) to Sterling by using average exchange rates over the five-year period 2001-2005 to smooth out volatility in exchange rates. On the basis of this approach, in two markets, Germany and USA, medicine prices were on average greater than in the UK.

Column b reports the total of AZ and GSK pharmaceutical exports from the UK in 2005 to the countries listed in Tables 2A and 2B. Total 2005 pharmaceutical exports by those companies to all markets were £5,969 million. Thus the BPG companies exported £3,064 million worth of medicines from the UK to countries outside those listed in Tables 2A and 2B. For the purposes of this illustration we are, by default, assuming that no net economic rent is earned or given away in total in those exports, which are to a mix of markets including Japan (traditionally a high-price market – see for example Danzon and Kim, 2002) and smaller, lower income countries.

Column c includes the estimated long run cost of those exports, which is calculated as the value of exports expressed at UK price levels. This gives us the basis to measure the total rent from exports, which is the difference between the 'Total exports from the UK' and the 'Total long run cost of exports' (see column d). However, not all this rent will be retained in the UK. The Government's tax take is retained in the UK. On the basis of the marginal corporation tax rate in 2005, we assume that 30% of any export rents would be paid to the UK Exchequer and therefore captured in the UK. Of the post-tax rent, only the proportion belonging to UK shareholders will be retained in the country. An estimate of the proportion of shares held by UK residents is 43% for AZ and 56% for GSK (source: AZ and GSK data respectively).

Thus, the total proportion of export rents retained in the UK = 30% + (43% of (100-30)%) = 60.1% for AZ. A similar calculation implies 69.2% of export rents earned by GSK would be captured in the UK. As indicated in column e of Tables 2A and 2B, this implies that the benefit to the UK economy from export rents earned by the BPG companies in 2005 totalled about **£242 million**.

This result is sensitive to movements in exchange rates. For example, Sterling appreciation would result in lower export prices when expressed in Sterling and, therefore, in a substantially smaller economic rent. In the period 2001-2005 the average annual €/£ rate varied between 1.45 and 1.61, while the average annual US$/£ rate varied much more, ranging between 1.44 and 1.83.

4.2 Comparison of export rents estimate with the DTI approach

As part of the 2000 PICTF exercise, DTI used 1997 data to compare the pre-tax rate of return on capital employed in the pharmaceutical industry when R&D spending is regarded as current expenditure, which was 21.3%, with that prevailing in the manufacturing sector as a whole, which equalled 15.8%. The difference between the two rates, 5.5%, could be taken to represent the economic rent generated by the pharmaceutical industry (PICTF, 2001).

Alternatively, when R&D expenditure was capitalised, the rate of return on capital for the pharmaceutical industry exceeded that for manufacturing industry by only one percentage point, 14.2% versus 13.2%, according to the DTI calculations. Thus the UK pharmaceutical industry's producer rents could be estimated as lying in the range from 1% of capital employed, including capitalised R&D expenditure, to 5.5% of capital employed excluding capitalised R&D expenditure.

Applying the DTI assumptions to the net capital expenditure[4], excluding capitalised R&D, of AZ and GSK in 2005 (see Tables 3A and 3B), the producer rents generated by the companies would then be £129 million and £192 million respectively. As before, these figures have to be adjusted for the proportion of the rent that is retained in the country by the UK Exchequer and UK shareholders, namely 60.1% for AZ and 69.2% (with its greater proportion of UK share ownership) for GSK. Therefore, the total export rent could be around £78 million + £133 million = **£211 million**.

Table 3A: **AstraZeneca export rents, 2005 – DTI approach**

	Excluding capitalised R&D	Including capitalised R&D – Estimate
Capital employed by AstraZeneca* £ million	2,346	3,167
Economic rent portion %	5.5%	1%
Implied economic rent portion £ million	129	32
Rent captured in UK (60.1% of total) £ million	**78**	**19**

Source: Company data.

[4]This includes: net property, plant and equipment, net goodwill assets, net other intangible assets and non-equity investments.

Table 3B: **GlaxoSmithKline export rents, 2005 – DTI approach**

	Excluding capitalised R&D	Including capitalised R&D – Estimate
Capital employed by GlaxoSmithKline* £ million	3,494	4,717
Economic rent portion %	5.5%	1%
Implied economic rent portion £ million	192	47
Rent captured in UK (69.2% of total) £ million	**133**	**33**

Source: Company data.

The DTI's calculations for PICTF implied that the value of capital employed in the UK pharmaceutical industry increased by 35% when capitalised R&D was included. We apply that same ratio to the BPG companies' capital employed figures to give a rough estimate of capital employed including capitalised R&D. Then using DTI's estimate that producer rent equals 1% of the value of capital employed when that includes capitalised R&D would imply AZ's and GSK's producer rents in 2005 were £32 million and £47 million respectively (Tables 3A and 3B). The portion of this retained by the UK Exchequer and shareholders would be £19 million and £33 million respectively, giving a total estimate for the two companies of **£52 million**.

Thus the range of estimates of export rents using the DTI approach would be £52 million – £211 million. The estimate of £242 million that we derived in section 4.1 by assuming that UK prices represent average costs lies close to, but above the top end of this range.

It is worth reflecting that these export rents result from the manufacturing activities of the BPG companies in the UK, rather than from R&D or headquarters functions. Hence this part of the economic rent would be lost if the companies ceased to manufacture in the UK, even if they continued with R&D.

4.3 Rents from overseas activities

Some producer rents can also be captured by UK residents from companies' overseas activities. Both AZ and GSK have R&D and production activity located overseas which can produce an economic

Table 4: **BPG companies' rents from overseas sales plus export rents, 2005**				
£ million	Sales originating from overseas activity	Estimated rent (AZ 1.0-6.8%) (GSK 1.2-4.8%)	Rent captured in the UK (AZ 30.1%) (GSK 39.2%)	UK export rent (Source: Tables 2A, 2B, 3A and 3B)	Total producer rent
AstraZeneca	9,963	102-616	31-185	19-116	50-301
GlaxoSmithKline	17,658	207-847	81-332	33-133	114-465
TOTAL			112-517	52-249	164-766

rent, part of which accrues to the UK through UK shareholders' income from, and taxation of, repatriated profits. Some or all of this value would be lost to the UK if the companies were to move their UK activities abroad. This would be the case if it is assumed that companies' R&D, headquarters and other managerial functions based in the UK contribute significantly to the success achieved by their overseas affiliates because of the high level of expertise and managerial skills available in the country; or that the proportion of UK shareholders in those companies would fall towards zero if they were to relocate abroad. If neither of those assumptions holds in full, then the loss of rent from overseas activities should AZ and GSK relocate out of the UK would be less than the amount estimated in the remainder of this sub-section of the Briefing.

AZ's estimate of its sales generated from non-UK activities in 2005 is £9,963 million, calculated as the difference between total worldwide sales and the gross sales from the UK (source: AZ data). A crude estimate would be that approximately 1.0%-6.2% of this represents economic rent, as this is the same ratio of rent to sales as occurs in the UK according to our estimates (£32 million – £193 million of rent [see Tables 2A and 3A] earned from £3,120 million of UK production in 2005 [source: AZ data]), which amounts to £102 million-£616 million. To assess the benefit of this to the UK economy, the estimate has to be adjusted downwards to allow for the tax taken by overseas governments. Assuming that overseas marginal corporate tax rates average around the UK rate of 30%, then 30.1% (= [100-30]% x 43%) of these rents will be captured by UK shareholders, who hold 43% of AZ shares. This implies an economic rent accruing to the UK from the overseas activities of AZ of approximately **£31 million-£185 million**.

GSK had £17,658 million of 2005 sales generated from its non-UK activities (source: GSK data). The ratio of rent to sales in the UK is in the range 1.2%-4.8% for GSK according to our estimates (£47 million to £192 million of rent [see Tables 2B and 3B] earned from £4,002 million of UK production in

2005 [source: GSK data]). Applying these percentages to the total sales figure from non-UK activities implies total rents from overseas activities of £207 million-£847 million. Given that 56% of GSK shares are UK owned, and assuming as before that overseas corporate tax rates at the margin average around 30%, then 39.2% of these overseas rents will be captured by UK shareholders (= [100-30]% x 56%). This implies an economic rent accruing to the UK from the overseas activities of GSK of approximately **£81 million-£332 million**.

Thus the total rent captured in the UK from the overseas activities of the two BPG companies is estimated to be in the range **£112 million-£517 million** in 2005. The amount of rent from overseas activities that benefits the UK depends directly on the UK proportion of total shareholding.

As shown in Table 4, if we add the economic rent derived from post-tax earnings of overseas activities of BPG companies to the economic rent earned from their exports from the UK, then the total producer rent in 2005 is in the region of **£164 million-£766 million**, or in round terms between £0.2 billion and £0.8 billion.

This method of estimating rents earned for UK residents from the overseas activities of the BPG companies assumes that all rents are obtained via the prices at which those companies sell their medicines. An additional source of economic rent for the UK is that part of the royalties and licence fees paid to AZ and GSK by overseas companies and captured in returns to UK shareholders and in the UK taxation of those returns. However, no data on royalty licence fee earnings were available to us.

5 LABOUR RENT

Economic rent generated by an enterprise may be captured not only by shareholders and, through taxation, the Exchequer, but also by employees in the

form of a wage premium. That is, labour employed in a sector earning economic rent may be paid significantly more than it would receive in its next best alternative employment. Empirical evidence has shown that the distribution of wage rates varies systematically across sectors, both at national and international level. In particular, it has been argued that wages paid in the pharmaceutical industry, which is a highly innovative sector, exceed the average by around 10% for equivalent types of labour (Hale and Towse, 1995). The implication, in our example, is that it would be difficult for BPG companies' workers to find jobs in other sectors of the UK economy that would provide them with the same remuneration they obtain in their BPG posts.

In order to explain the presence of wage differentials, some authors have identified a number of possible reasons and tested their significance using different type of datasets. The results of a number of empirical studies have supported the view that industry affiliation plays an important role. In particular, the following key characteristics of the high-paying industries have been identified (Dickens and Katz, 1987; Katz and Summers, 1989) and tested using Great Britain data (Benito, 2000):

• industry profitability (i.e. industry ability-to-pay);

• industry concentration (i.e. product market power);

• capital-labour ratio.

The empirical analysis by Benito (2000) suggests the presence of a positive relationship between the industry wage premium and industry profitability but it does not provide evidence specific to the pharmaceutical sector. It should, however, be noted that the latter displays the characteristics listed above and therefore it is very likely that it pays labour rents.

The most recent estimates of the size of the wage premium offered by the pharmaceutical industry in the UK available in the published economic literature is that of 8% provided by Van Reenen's analysis of the 1998 Labour Force Survey. This was used in PICTF (2001) and is similar to earlier studies referred to by Hale and Towse (1995) that showed that in the pharmaceutical industry employees' wages had been at a premium of around 10% above what similar labour could earn elsewhere in the economy.

Applying the estimate of 8% as the labour rent obtained by people employed by the pharmaceutical industry to the 2005 BPG companies' UK employment costs of £1,855 million (AZ £614 million and GSK £1,241million; source: AZ and GSK data) implies total BPG company labour rents of up to £137 million (= (8/108) x 1,855).

However, this figure might overestimate the net benefit to the UK if some of the labour rents come from sales to the NHS and UK private market and therefore represent only a transfer between different parts of the UK economy. Total BPG companies' UK production in 2005 was £7,122 million, of which £5,969 million was exported and £1,153 million – 16% of total production – was domestic sales. Thus around 84% at least of the labour rents can be estimated to be due to the export business, if rents are earned in proportion to sales. Hence the estimated range of labour rents in 2003 would be **£115 million-£137 million**.

Within this total, about one third of the BPG companies' employees in the UK in 2005 were engaged in manufacturing, another third in R&D and a further third in other activities. If labour rents are spread across all types of activity, each would be generating around £38 million-£46 million of rent.

6 R&D SPILLOVERS

Recent economic literature has shown that R&D investment undertaken in one company could bring about economic benefits to other companies and organisations operating in the same industry, in other sectors, and also in other countries. The main sources of these positive externalities are scientific and technical advances and, more generally, knowledge flows generated and induced by R&D activity.

It is possible to group R&D spillovers into three categories:

• internal spillovers, i.e. benefits that are internalised by the company investing in R&D (i.e. ability of a company to employ knowledge and practical experience in future research);

• intra-industry spillovers, i.e. R&D benefits generated by one firm that are captured by other firms of the same sector. For example, R&D projects undertaken by competitors have a positive effect on pharmaceutical companies' research productivity (Henderson and Cockburn, 1996);

• inter-sector spillovers, i.e. the benefits from R&D conducted in one industry but used in other sectors of the national economy including other industries, universities, the public and charitable sectors (e.g. upstream firms can develop new intermediate goods embodying new technology that can be used an input in the production of other sectors).

The intra- and inter-industry externalities can be captured both at the national and international level, that is within and across countries. In line with the purpose of this study, we focus on spillovers from R&D in the UK that are captured by other UK bodies.

From the macroeconomic point of view, investment in R&D is one of the key sources of economic growth of modern economies. It has been shown that national R&D investments of OECD countries have a strong influence on productivity growth, as they play a key role in stimulating innovation and also in facilitating faster adoption of new technologies (i.e. technology transfer) (Griffith et al., 2004).

Park (2004) based his empirical analysis of time series data for 14 OECD countries and three East Asian economies on an adaptation of this model to take account of international and inter-sectoral spillover effects between manufacturing and non-manufacturing industries. He found evidence of highly positive inter-sectoral spillovers from manufacturing to non-manufacturing sectors, measured in terms of elasticity of output with respect to R&D stock. On the basis of the econometric model used, this suggests that the manufacturing sector may provide many high-technology intermediate goods for the non-manufacturing sector and shows that technological advances in the manufacturing sector can bring about productivity improvement in other sectors. Park also estimated the social rate of return to manufacturing R&D and confirmed that it is significantly above the private rate of return[5].

An alternative approach uses accumulated patent counts rather than cumulative R&D expenditure as a measure of knowledge stock, and employs patent citations to capture knowledge spilling over from the 'inventor' to other firms (Griliches, 1990; Jaffe et al., 1993; 2000; Scherer, 1981). For example, in the pharmaceuticals sector, a patent associated with a project in the early stage of drug development undertaken by one firm can form the basis of other research projects and therefore be cited by either scientific papers or patent applications made by other companies. However, as patents are available internationally, patent citation counts do not reflect spillover effects *within* one country and so are not relevant to our analysis of the benefits generated by the R&D conducted by BPG companies in the UK and captured by other parts of the UK economy.

Our literature search has yielded no more recent estimates of the relevant rates of return than those presented in PICTF (2001). In the PICTF report, pharmaceutical company R&D spending was estimated by the DTI as yielding the investing company

a return of 14%. We have been able to find no pharmaceutical sector-specific estimate but Van Reenen and colleagues estimated the return to the chemicals industry as a whole from investment in R&D by any one company in that sector as 40% (PICTF, 2001). Thus 26% (40%-14%) is from benefits accruing to companies in the sector outside the original investor in R&D. Averaging the results from a range of studies in the economic literature implied that the total social rate of return to R&D spending exceeds the private rate of return captured by the investing company by 37 percentage points[6]. If 26 of these percentage points are captured by other companies in the pharmaceuticals sector, that leaves 11% (37%-26%) being captured by the rest of the economy.

The value of these R&D spillovers to the rest of the economy, which would be lost to the UK if the BPG companies took this part of their activity offshore, is thus estimated as 11% of the £2,170 million of BPG companies' total R&D expenditure in 2005, i.e. £239 million (source: AZ and GSK data). This estimate is highly uncertain, however, owing to the wide range of values attributed to the social rate of return to R&D in different studies. A reasonable range of estimates for the spillover effects of R&D might be plus or minus 50%, i.e. **£120-360 million** (see Table 5).

It should be noted that if some of the £2,170 million were diverted to R&D undertaken in other sectors, then the net loss to the UK economy due to the removal of BPG companies' R&D would be less than £239 million. However, the pharmaceutical industry has by far the greatest propensity to invest in R&D among industry sectors in the UK (Department of Trade and Industry, 2005).

Table 5: **BPG companies' R&D expenditure and spillover effects, 2005**

£million	R&D spend	11% (spillover effect)	Range of spillover effect
AZ	904	99	
GSK	1,266	139	
Total	2,170	**239**	**120-360**

7 TERMS OF TRADE EFFECT

The relocation of net exporting enterprises out of a country would have a negative effect on that economy's balance of trade due both to the loss of their net exports and to the need to replace with imports some or all of any of those enterprises'

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[5]He estimated that it is between two and six times greater. Other authors report similar results, including Griliches (1992) and Hall (1996).

[6]This is because it was assumed that the private rate of return obtained by pharmaceutical companies is 14% and a number of studies show that the social rate of return is around 50% (Griliches and Lichtenberg, 1984; Jones and Williams, 1998; Sveikauskas, 1981).

domestic production which was purchased by British customers. Without BPG companies' UK-based activities, the UK's balance of payments would be worsened to the extent of their net exports, which are positive and of the order of £1.793 billion, and also by the need to increase imports of medicines to replace the £1.153 billion of UK produced pharmaceuticals sold to the NHS and other UK purchasers by BPG companies in 2005 (source: AZ and GSK data). Thus the total trade gap to be closed would be of the order of £2.9 billion.

This disequilibrium of the balance of trade might (subject to certain conditions, which are discussed below) be corrected by a depreciation of the country's currency, worsening its terms of trade so that it would have to sell more exports to buy any given quantity of imports. The bigger the depreciation required, the greater the worsening of the terms of trade implied, and hence the poorer the country has become.

7.1 Theoretical framework[7]

We model the relationship between the terms of trade, the exchange rate and the balance of trade on the basis of the elasticity approach, which focuses on the substitution effects in consumption induced by exchange rate movements. In a standard two-country (domestic and foreign) and two-good (exports and imports) model, the domestic income and prices are constant, and the only variable is the exchange rate. Non-tradable goods and monetary financial assets are not considered.

A rise in the exchange rate (i.e. a depreciation of the home currency with respect to the foreign currency) makes foreign goods relatively more expensive leading to a decrease of consumption of imports and an increase of consumption of domestic alternatives. The overall effect on the Sterling value of imports depends on the UK's price elasticity of demand for imports (Dm) and the rest of the world's price elasticity of supply of imports into the UK (Sm). A Sterling depreciation also makes UK exports cheaper in terms of foreign currency and so should lead to an increased demand from the rest of the world for UK exports. The overall effect on the Sterling value of exports depends on the rest of the world's price elasticity of demand for UK exports (Dx) and the UK's price elasticity of supply of exports (Sx).

The hypothetical loss of the BPG companies' UK-based activities would cause a deterioration of the balance of trade which could be corrected through a depreciation of Sterling. However, for the balance of trade to improve with depreciation, the increase in the Sterling value of exports has to exceed any increased Sterling cost of imports. This result occurs if the sum of the absolute values of domestic and foreign elasticities of demand for imports is greater than one. This condition is referred to as the Marshall-Lerner condition, which assumes infinitely elastic supply for exports and imports, i.e. the supply prices are not influenced by changes in consumption patterns in either domestic or foreign countries. However, this condition may not be met, especially in the short run. We have therefore applied a more general condition allowing for finite supply elasticities, known as the Robinson-Bickerdike condition and, starting from this, have estimated the terms of trade effect using the approach set out by Dornbusch (1975).

The approach involves two steps, and is similar to that described in Appendix 3 of Hale and Towse (1995). Starting from a given change in the balance of trade that needs to be corrected – a £2.9 billion worsening if AZ and GSK were to leave the UK – we first estimate the change in the exchange rate that is required to achieve this adjustment. That is, we estimate the elasticity of the UK trade balance to a change in the exchange rate (E_{TB}), as follows:

$$E_{TB} = \frac{Vx}{Vm} \cdot \frac{Dx(1+Sx)}{(Dx-Sx)} - \frac{Sm(1+Dm)}{(Sm-Dm)}$$

where Vx is the Sterling value of total UK exports of goods and services (£322.298 billion in 2005) and Vm is the value of total UK imports of goods and services (£366.540 billion in 2005).[8]

Then, in the second step, we estimate the terms of trade effect of the required adjustment to the exchange rate. In other words, we estimate the elasticity of the terms of trade to the exchange rate (E_{TT}), as follows:

$$E_{TT} = \frac{DmDx-SmSx}{(Sx-Dx)(Sm-Dm)}$$

To compute the loss to the economy we follow Hale and Towse (1995) and estimate it as:

$$(E_{TT}/E_{TB}).G$$

where G = the trade gap to be closed = £2.9 billion in our example.

7.2 Empirical estimates of price elasticities of demand and supply for imports and exports

We conducted a literature search to find empirical estimates of demand and supply price elasticities.

The results are reported in Appendix 2. Empirical studies undertaken in the last decade (Barrell and te Velde, 1999; Crozet and Erkel-Rousse, 2004; Hooper et al., 2000; NIESR, 1998; Pain and Wakelin, 1997; Pain and Young, 2000) imply that for the UK the price elasticity of demand for imports is in the range −0.5 to −0.6 and the price elasticity of demand for UK exports is in the range −1.0 to −1.6. Hence the sum of the magnitudes of the price elasticities lies in the range 1.5-2.2, meaning that the Marshall-Lerner condition is satisfied.

The estimation of these elasticities is open to debate, given the complexity of the subject and the controversy existing over the econometric method to adopt. In our analysis we have therefore tested the effect of a number of scenarios in order to allow for combination of low, medium and high values of the elasticities. We were unable to find any empirical estimates of price elasticities of supply and so have used a range of plausible values to test out the likely range of terms of trade effects.

Because of the uncertainty surrounding the figures employed, caution should be used when considering the results.

7.3 Some scenarios

We have estimated hypothetical terms of trade effects from losing the activities of the BPG companies from the UK for a range of scenarios, as shown in Table 6. At one end of the scale (labelled "low impact" in Table 6) we have used the elasticities in Hale and Towse's 'Case 1'. In the other scenarios we have used the range of demand elasticities found from our search of empirical literature, and have varied the supply elasticities up to infinity in one scenario to test the likely upper limit of the terms of trade effect.

According to the elasticity scenario used, the estimated impact in a year could vary very widely, from around £0.6 billion to over £7 billion in our example. The result is extremely sensitive to the assumed values of the price elasticities. The top end of the range shown in Table 6 exceeds the £2.9

billion size of the trade gap that the hypothetical loss of the BPG companies would open up, and so, although theoretically possible, seems implausible. A terms of trade effect in the range **£0.6 billion to £2.9 billion** is more likely. Evaluating terms of trade impacts is the most uncertain, least well empirically supported, element of the attempt to value an enterprise's net value to the national economy. With the current state of knowledge it is perhaps safest to say that terms of trade effects can be substantial — as in our example — but elusive.

8 MANUFACTURING

If all BPG manufacturing were to leave the UK, then there would no longer be any UK exports from those two companies and hence no more export rents. This would have a negative impact on the UK terms of trade. The labour rents earned by BPG's manufacturing work force would also be lost to the UK economy. The values of the lost export and labour rents and the scale of the terms of trade effect are discussed in sections 8.1, 8.2 and 8.3, respectively.

On the assumption that the proportion of GSK and AZ shares owned by UK residents would not be affected were the headquarters and R&D activities currently in the UK to remain, there would be no change to the proportion of rent from overseas activities that accrues in the UK.

The discontinuation of manufacturing alone, with no change to the amount of BPG companies' R&D undertaken in the UK would, by definition, not change the R&D spillovers benefiting the rest of the UK economy.

8.1 Producer rent from manufacturing

Moving manufacturing abroad would mean that it in effect becomes an overseas activity of the company, which is owned in part by UK shareholders. Hence some, albeit less, rent would still accrue to the UK via returns to UK shareholders. Using the calculations in Section 4.1 above, 69.2% of the export rent

Table 6: **Terms of trade effect scenarios for different combinations of price elasticities of demand and supply of exports and imports**

Scenario	Dx (demand exports)	Dm (demand imports)	Sx (supply exports)	Sm (supply imports)	Terms of trade effect (£million)
High impact	−1.00	−0.50	Infinite	Infinite	**−7,646**
Medium impact	−1.60	−0.60	5.00	10.00	**−2,255**
Low impact	−3.00	−1.00	3.00	6.00	**−589**

generated by GSK is captured by the UK if its medicines are manufactured in the UK and sold abroad but only 39.2% of the rent is captured if the medicines are manufactured abroad. A similar calculation implies 30.1% rather than 60.1% of export rents earned by AZ would be captured in the UK. Thus moving BPG manufacturing out of the UK would mean the UK economy losing 30% (69.2%-39.2% for GSK and 60.1%-30.1% for AZ) of the gross export rents currently earned by the two firms. From column d in Tables 2A and 2B and the third rows of Tables 3A and 3B the combined gross export rents of AZ and GSK are in the range £79 million-£385 million. Losing the two companies' manufacturing means that the UK loses 30% of that amount, which is equal to **£24 million-£115 million** of export rents foregone.

8.2 Labour rent from manufacturing

According to GSK data, manufacturing accounts for 44% of its UK workforce. Consequently, an estimate of the labour rent that would be lost to the UK if GSK's manufacturing went would be 44% of its £1,241 million labour costs in 2005 multiplied by 8/108, as in Section 5 above, giving £40 million. But, as discussed in Section 5, if some of these labour rents arise from sales to NHS customers they would then merely represent a transfer between different parts of the UK economy. As 81% of GSK's sales from the UK in 2005 were exports, a lower estimate of net labour rents earned for the UK by GSK's manufacturing labour force would be 81% of £40 million, namely £32 million. Thus estimated net labour rents for the UK from GSK's manufacturing are in the range £32 million-£40 million.

18% of the total AZ workforce in the UK are in manufacturing. Hence, an upper estimate of the labour rent that would be lost to the UK if AZ's manufacturing were to go would be 18% of its £614 million labour costs in 2005 multiplied by 8/108, giving £8 million. 88% of AZ's sales from the UK were exports. Hence, if some of the labour rents were due to domestic sales rather than exports, then a lower estimate of net labour rents earned for the UK by AZ's manufacturing labour force would be 88% of £8 million, namely £7 million. Thus estimated net labour rents for the UK from AZ's manufacturing are in the range £7 million-£8 million.

The total estimated range of labour rents for the two companies combined is therefore **£39 million-£48 million**.

8.3 Terms of trade effect of manufacturing

The loss of the BPG companies' pharmaceutical manufacturing activities in the UK would mean BPG stops exporting medicines from the UK. As explained in more detail in section 7, this would significantly worsen the UK balance of payments. The UK would lose BPG's net exports, which we estimated to be nearly £1.7 billion and would thenceforth need to import the previously domestically manufactured GSK and AZ medicines sold in the UK, which amounted to £1.153 million in 2005. Other things being equal, the UK trade balance would therefore worsen by £2.9 billion or more. Closing that trade gap could entail a small depreciation of the pound which would, as explained in Section 7, imply a worsening of the UK's terms of trade, the magnitude of which is highly uncertain but possibly in the range of **£0.6 billion and £2.9 billion**.

9 DISCUSSION

The estimates presented in the paper are unavoidably approximate. Our estimates have been constructed on the assumption that *all* of the UK labour and capital currently used by AZ and GSK would rapidly find alternative employment within the UK in the hypothetical situation that those two companies were to close down their UK operations. If any of the resources would subsequently remain unemployed for a significant period, then the value of the companies that now employ them to the UK economy is correspondingly greater. But if some of the labour and capital assets released by the (hypothetical) departure of AZ and GSK were to be employed by other pharmaceutical companies working in the UK and earning economic rent there, then the loss to the UK from the two BPG companies going would be reduced commensurately.

As discussed in Section 2 of this Briefing, there has been much debate about the extent to which labour and capital can be expected to be fully employed within an economy. Our approach has been in line with the requirements of the UK Government when appraising the appropriateness or otherwise of intervention: it is assumed that all resources would be fully and immediately re-employed within the country.

There are also some aspects of the value of the two BPG companies to the UK for which we have not been able to provide estimates. Owing to lack of data, we have not included rents captured in the UK that may be obtained by the companies from royalties and licence payments. We have also not attempted to estimate whether the companies' activities lead to other types of net value to the UK beyond economic rent such as earlier or higher uptake of medicines, and of any consequent health effects for patients, or whether any reputational benefits are conferred to a country by its association with the companies' activities.

To set our estimates of the value of AZ and GSK to the UK economy in context, the estimated net economic rent earned for a country by many enterprises in any economy can be expected to be close to zero. That is, the resources employed in these enterprises yield as much economic value as, but not significantly more than, the next best alternative uses of the capital and labour they employ. Published empirical estimates of total economic rent earned by a company or an industry for a country appear to be sparse.[9] This might reflect the publication routes of any such empirical analyses being via grey literature. The authors are aware of two previous sets of empirical economic rent estimates, for the pharmaceutical industry in the UK (Hale and Towse, 1995; PICTF, 2001).

Based on our research for this Briefing, two potentially large sources of economic rent in the pharmaceutical industry seem particularly ripe for further analysis: the scale and scope of R&D spillovers; and terms of trade effects. We found only a small amount of empirical evidence on positive effects induced by R&D undertaken by a company and captured by other organisations operating in the same country. Further research on the mechanisms and magnitudes of such spillovers would be valuable. In addition, it would be worth exploring the possible positive spillovers due to co-location of activities, for example understanding whether the proximity of R&D and manufacturing can improve productivity of both.

Terms of trade effects are evidently potentially large but are also highly uncertain. Additional study, therefore, around the relationship between the activities of individual exporting companies and overall social welfare in a country could be particularly useful. Our estimates have been based on a relatively simple comparative static approach. Research based on more dynamic models could be particularly valuable.

10 CONCLUSIONS

The preceding sections have demonstrated the difficulty of making empirical estimates of the economic rent that companies may earn for UK residents, and the extent of the assumptions that need to be made in doing so. Nevertheless, economic rent undoubtedly exists and broad order of magnitude evaluations can be attempted, as has been illustrated for the pharmaceutical activities in the UK of the two companies of the BPG.

[9]A free text search of entries in the "Economic Papers" database on 19th June 2006 (http://econpapers.repec.org/) produced 35 hits, but none concerned empirical estimates of a company's or a sector's economic rent earned for a national economy.

Table 7 summarises the key results, gathering the different elements of our estimate of the net economic benefits that the UK gains from the presence of AZ and GSK and would lose in the hypothetical case of their complete withdrawal from the UK, or from the loss of their UK manufacturing activities alone.

The total economic rent created for the UK is estimated to have been of the order of £0.4 billion-£1.3 billion in 2005. In addition the worsening UK terms of trade that could be expected to result could add a further annual cost. The size of this is extremely uncertain but appears to be of similar magnitude, at least £0.6 billion and perhaps even as much as £2.9 billion. Thus, the net value of BPG companies to the UK economy is estimated to be at a minimum around £1 billion annually and could well be much higher.

The final column of Table 7 shows the estimated loss of economic rent in the hypothetical case that all of AZ's and GSK's manufacturing is assumed to leave the UK, but their R&D and headquarters functions are assumed to remain. The estimated economic rent due to the companies' manufacturing activities in the UK is thus of the order of £0.1-0.2 billion per annum, plus the same highly uncertain terms of trade effect as before, possibly in the range £0.6-2.9 billion per annum.

These results must be seen in the context that many companies and sectors in the economy do not generate economic rent in any significant amounts. They may earn substantial incomes in aggregate for their employees, shareholders and lenders, but similar incomes would probably be earned by the labour and capital they use if they were to be diverted to their next best alternative uses. The loss of a company earning substantial economic rent for British residents – such as AZ and GSK currently – represents a net cost even if they immediately find employment and investment opportunities elsewhere in the UK economy.

Table 7: **Total economic rent generated by BPG companies, 2005**

£ million p.a.	BPG companies – all activities	BPG companies – manufacturing only
Producer rents	164-766	24-115
Labour rents	115-137	39-48
R&D spillovers	120-360	0
Sub-total	**399-1,263**	**63-163**
Possible terms of trade effect	Highly uncertain but possibly in the range 600-2,900	Highly uncertain but possibly in the range 600-2,900

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APPENDIX 1: BPG companies' data for 2005

Table 8: **Export sales from the UK**

Country	Total exports from the UK (£million)	
	AZ	GSK
Austria	21	19
Belgium	71	47
France	144	340
Germany	130	163
Italy	215	219
Netherlands	19	46
Spain	155	125
USA	600	592
Japan	394	154
Other	614	1,531
Total	2,733	3,236

Table 9: **Domestic sales, gross sales and total worldwide sales**

	Domestic sales to the NHS and other UK purchasers (£million)	Gross sales from the UK (£million)	Total worldwide sales (£million)
AZ	387	3,120	13,083
GSK	766	4,002	21,660

Table 10: **Capital employed in the UK and UK shareholders' ownership**

	Capital employed in UK-based activities (£million)	Proportion of company's shares held by UK residents (%)
AZ	2,346	43%
GSK	3,494	56%

Table 11A: **Number of employees, total labour costs, and R&D expenditure. AZ data**

Department	Number of employees in the UK	Total labour costs in the UK (£million)	Total expenditure in the UK (£million)
R&D	4,233		904
Manufacturing	2,121		
Other	5,197		
Total	11,551	614	

Table 11B: **Number of employees, total labour costs, and R&D expenditure. GSK data**

Department	Number of employees in the UK	Total labour costs in the UK (£million)	Total expenditure in the UK (£million)
R&D	5,700		1,266
Manufacturing	8,006		
Other	5,734		
Total	19,440	1,241	

APPENDIX 2: Long-run price elasticities of demand and supply for imports and exports

Table 12: **UK price elasticities of demand for exports and imports in studies published since 1995**

Reference (year published)	Country	Price elasticity of demand for exports	Price elasticity of demand for imports	Comments
Barrell & te Velde (1999)	D, F, I, UK	n/a	−0.58	
Crozet & Erkel-Rousse (2004)	D, F, I, UK	−1.10 or −1.11 depending on estimation model	n/a	Estimates adjusted for a measure of quality of exports. Without that measure, estimates were −0.93
Hooper et al. (2000)	UK	−1.6	−0.6	Estimates also provided for Can, D, F, I, J, US
NIESR (1998)	UK	n/a	−0.59	
Pain & Wakelin (1997)	UK, D, Dk, E, F, I, J, NL, S, SF, US − $^1/_2$-yearly data 1971 H2 − 1992 H2	−1.13 or −1.30 depending on estimation model	n/a	
Pain & Young (2000)	UK − elasticities used in NIESR model	"a little under 1"	"a little under 0.5"	"Based on econometric evidence for the UK over the past twenty-five years"

Note: n/a = not available

Table 13: **UK price elasticities of demand and supply for imports and exports assumed by Hale and Towse (1995)**

Reference (year published)	Country	Price elasticity of demand for exports	Price elasticity of demand for imports	Price elasticity of supply for exports	Price elasticity of supply for imports
Hale & Towse (1995)	UK − assumed elasticities:				
	Case 1	−3	−1	3	6
	Case 2	−5	−1	5	10

EconLit and Google searches revealed no empirical estimates of price elasticities of supply of either exports or imports for UK, US or EU.

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