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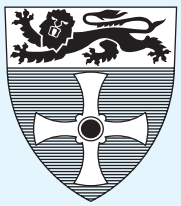

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CENTRE FOR RURAL ECONOMY

WHAT LESSONS FROM FOOT AND MOUTH?
A PRELIMINARY ECONOMIC ASSESSMENT
OF THE 2001 EPIDEMIC

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EXECUTIVE SUMMARY:

FOOT & MOUTH DISEASE CONTROL: LUNACY OR SENSE?

Continual exposure to gun-shots, massive funeral pyres and smoke palls as British livestock herds and flocks are decimated and the "English" countryside is shut down has caused some journalists and commentators to question the wisdom of the control strategy. Why not simply let the disease run its course? Animals won't usually die of it, and will recover and then be immune (at least for a while). And it doesn't harm people. So what's the problem?

Well, for a start, the disease is definitely extremely unpleasant for the unfortunate animals that catch it, with infection rates of 80% or more. Secondly, doing nothing would increase the costs of animal production. The last estimate (after the 1967 outbreak) suggested an increased cost of some 10% of the final farm value of meats and milk - about £700m each and every year at current levels of production and (depressed) prices.

Thirdly, because this is such a nasty and costly disease, most other developed countries in the world take care to eradicate and stay free of it. They will not accept animals or animal products from any country which has the disease endemic in its animals. The value of British livestock and meat exports is currently running at around £500m per year, and has been as high as £1000m. Some 30% of our sheep flocks and their shepherds depend on that export trade for their existence. Without it our hills and uplands, and the communities that go with them, would look very different.

In short, control of this disease is worth £1.2 billion a year for each and every year we are free of it. And being free of it is a public good. So, we have to take a collective, public decision about what to do about it.

We could vaccinate animals and prevent the disease from erupting. But if we did, we would have to live with the consequences - we would never be free of the disease, and it would erupt from time to time as the vaccines break down. Based on the costs estimated after 1967, the total capitalised cost of a vaccination programme run for the 34 years since then would be about £5 billion in today's money. On top of this cost would be the dislocation of other rural activities around the outbreaks, which might well be very considerably more than the direct costs of the vaccination policy. Because prophylactic vaccination does not eradicate the disease, our export trade would also be severely compromised under this option. In the last 34 years our exports have generated a cumulative sum of £56 billion. Vaccination would be an extremely expensive option.

More expensive than the present slaughter policy? The final cost of the present outbreak is still speculative. The NFU suggests that the present policy will cost the industry some £775 million if it lasts three months. The 30-week 1967 epidemic cost some £610 million in today's money, but this estimate did not include the effects on tourism or recreation in the affected rural areas. The English Tourist Council suggests that the present epidemic is costing these sectors £100 million a week, rising to £250 million a week as we approach the main tourist season. If the present epidemic lasts as long as the 1967 incident, we are looking at a total cost of some £7 billion. Add in the

second round effects and we could be talking about £10 billion. This is clearly a very large amount. But it is a major overestimate of the net costs of the policy. The £7 billion which might not be spent in the rural areas will be spent somewhere else - there are gainers from this epidemic, as well as losers - though this is little comfort to the losers. The £10 billion is, though, a possible cost to the rural areas, notwithstanding that offsetting gains will be made in the urban areas.

Even so, according to the benefits of being disease free (£1.2 billion a year), we could afford such an expensive epidemic once every ten years and still come out ahead. And we surely can learn enough from this present catastrophe to avoid such frequent occurrence. We clearly need to be a lot more vigilant than we have been about importing infected material and closing off the possibilities that such infected imports can get anywhere near our own livestock. We can be a lot more careful about tracing animal movements. We can be better at minimising the risks of spreading the infection. We can almost certainly improve the speed of response and necessary culling. We have managed to be free of this disease for 34 years since the last major outbreak. But in the meantime we have become far too complacent and too indifferent to the risks and the costs of risk management. As a society we will need to learn the lessons from the present outbreak and be willing to pay for a quality food chain.

Meanwhile, what should we be doing to cover the costs and trauma of the present outbreak and thus, of any future outbreaks? Surely those responsible should pay? Easily said, but impossible to do. Those responsible cannot

possibly cover the costs. Anyway, who is responsible? This was an accident looking for somewhere to happen. In a way, we are all, collectively, responsible by default. We delegate our responsibility to the government, and assume it is diligent in regulating and policing the food trade sufficiently that we stay disease free. We assume that government makes provision for any breakdown in its control measures. The costs of being disease free are the costs of being vigilant, and the costs we incur when the vigilance breaks down, as now, are that we have to control the disease outbreak. This disease control is a public good - not a private consumption item we can choose or decline. We all benefit, one way or another, from being disease free, through cheaper food and greater capacity to import or take foreign holidays than otherwise.

This is the major point. Disease control is not at all like motor accidents, as many economists assume. They argue that the costs of disease control should be borne through compulsory private insurance, and not the public purse. But disease control is far more like national defence. And we don't pay for national defence through private insurance, even though we could. Compensating losers from this disease epidemic is not subsidy, and it is not social security. It is simply paying the price for being and continuing to be disease-free. The winners from being disease free are everyone.

INTRODUCTION

On February 20th, 2001, an outbreak of foot-and-mouth disease (FMD) was confirmed amongst 2 cattle and 308 pigs at an abattoir in Essex, England. On the same day, a second outbreak amongst cattle and pigs was confirmed on a farm neighbouring the abattoir. Two days later, more cattle were confirmed to have the disease on another nearby farm. Three days later (23rd February) the disease was confirmed amongst 523 pigs at a sow-fattening unit at Heddon-on-the Wall, Tyne and Wear, which is thought to be the source of the epidemic.

During the course of the next few weeks, outbreaks were confirmed all over the country, stemming largely from movements of sheep, and some cattle, through several major markets, especially Longtown in Cumbria, Welshpool and Northampton, and associated movements of stock via dealers based, especially, in Devon and Herefordshire. Within three weeks, more than 250 outbreaks had been confirmed, and more than a quarter of a million livestock (mostly sheep) had either been slaughtered or were due to be killed in an attempt to control the disease. One outbreak had also been confirmed in France, connected to the export of sheep from Britain. Other countries on the continent of Europe were also concerned about being infected. By March 15th, the Minister of Agriculture had decided to extend the compulsory slaughter of infected animals to include precautionary slaughter of up to one million possibly uninfected sheep surrounding the major outbreaks, especially in Cumbria, Dumfries and Galloway.

The severity and rapid spread of the epidemic, and the obvious trauma of the control methods, produced a storm of public anxiety and concern. The press and media produced masses of stories of individual, local and regional catastrophes, damaged businesses and ruined lives. Sporting events were cancelled or postponed. Rural tourism and recreation were badly affected. Footpaths were closed and countryside access denied. Generations of work in building up pedigree herds and flocks, and family businesses, were threatened. Waves of accusation, as well as a raft of proposed solutions, quickly followed. All the ills of modern food systems, industrial agriculture, opportunistic commercialism, globalisation and free trade, and more were said to be illustrated by the disease and its consequences. Government was ridiculed for trying to do far too much and berated for doing too little and far too late. The rich and caring aristocracy (Prince Charles and the Duke of Westminster) organised a £1 million fund for the relief of stress amongst farmers and their kin. The government organised a Rural Task Force, to try and alleviate some of the damage. Others argued that local and national elections should be postponed until the movement restrictions could be lifted. All because of one tiny but clearly very nasty virus.

It is clearly far too early to carry out a full assessment of the 2001 foot and mouth disease (FMD) epidemic, which has yet to run its full course. However, the degree of public alarm and concern about the disease and the slaughter policy being used to control it is such that professional analysis is urgently needed to inform the growing public debate. This paper seeks to provide a preliminary analysis. No doubt there will be judgements made here which others will dispute. No doubt there will be alternative analyses and

different interpretations of the facts. Time and further research will prove some suppositions and estimates in this paper to be false. But dispassionate and careful analysis is taken here to be the only reliable approach to disentangling the obvious and very serious mess we seem to have got into. What should we have done? What should we do in the future? To answer such questions requires careful and sensible thought. Here is an economic framework necessary from which to derive some preliminary answers.

THE DISEASE

Foot and mouth disease is both seriously debilitating and exceptionally contagious, spreading both by direct and indirect contact (such as through vehicles) and also, though apparently slightly less readily, by wind and wildlife. It affects cloven-hoofed animals: cattle, sheep, goats, pigs and deer. It does not, on the whole, affect humans, though there have been reports of some relatively mild symptoms being exhibited in one or two people who had been close to serious infections. Rates of infection (proportion of exposed populations exhibiting clinical symptoms) are typically about 80% among cattle and sheep, and 40% among pigs. But mortality rates are low among mature animals, between 1% (cattle and sheep) and 8% (pigs).[i] Most infected animals (except the young) would recover eventually, and build up some immunity to the infecting strain as a consequence. However, the virus mutates and animals can be re-infected with new strains. In those countries where the disease is endemic (for example, much of South America, Asia and Russia), the disease shows a typical cycle of quiescent periods punctuated with epidemics of virulent infection. Infected animals lose weight because it

is painful to eat and move, young animals suffer increased mortality, while abortions and breeding failures increase and milking cows dry off. In addition, the increased stress caused by the disease tends to exacerbate other latent diseases and conditions. Animal husbandry and animal welfare is very substantially and adversely affected by this nasty and highly contagious disease. As a consequence, most developed countries take very good care to prevent its occurrence and control it, if and when it does appear.

THE OUTBREAK

Britain has followed its present slaughter policy, aimed at eradicating the disease as and when any outbreak occurs, since 1892. Outbreaks can only occur when the disease is imported, in spite of controls to prevent the import of potentially infective material. When these controls break down or are bypassed, our domestic animals have no immunity and quickly become infected. The last serious epidemic in Britain occurred in 1967, as a consequence of import of infected meat. It lasted about nine months until the disease was fully and finally eradicated. There were 2,364 outbreaks amongst herds and flocks in Lancashire and Cheshire, and over half a million animals were slaughtered. As now, animal movements were then restricted immediately the disease was identified. These restrictions were more successful in geographically containing the disease in 1967 than is apparent now. The full reasons must await more systematic investigation. Part of the reason seems to be that the 1967 epidemic began in dairy herds, rather than in the more mobile sheep and pig sectors as with the present epidemic. It also seems that a key feature of the present epidemic is that its early existence was

undetected for a significant period, during which time it was spread rapidly through animal movements, and via infestation of vehicles. So far, neither wind nor wildlife appears to have been a major transmission route in the present epidemic, though there are obviously serious worries about these possibilities.

The most plausible hypothesis about the source of the 2001 epidemic is that, first, some infective material (meat product) was imported either illegally or unwittingly. Some (or all) of this material then found its way into food wastes which were collected for processing into pig feed. Sustained cooking of this swill at high temperatures (four hours at a minimum of 93 degrees centigrade is the current regulation) is supposed to deactivate the virus. But the virus survived and contaminated the pig farm at Heddon. It was transmitted to at least one neighbouring farm, possibly via a contract slurry spreading vehicle or on the wind, infecting sheep. Some of these sheep were then sold through Longtown market in Cumbria, and moved to Devon, infecting both the market and the lorries used to transport the animals. Meanwhile, the infected sows were sent to Essex for slaughter, this being an abattoir specialising in the processing of cull sows. Unfortunately, the initial infection was not identified before these movements occurred, the incubation period being about two weeks. Consequently, the disease was already widely dispersed by the time of the first positive identification and consequent animal movement restrictions.

The original infection could hardly have occurred in a more suitable situation and context to ensure rapid spread. The disease is especially difficult to

identify in sheep in its early stages, where the incubation period between infection and exhibition of clinical symptoms seems to be rather variable. Sheep are almost congenitally lame and frequently suffer from foot-rot in any event. Spotting early symptoms of FMD amongst clusters of sheep milling about in confused flocks is notoriously difficult, even for highly skilled flockmasters. Furthermore, sheep (and beef animals) are traditionally moved around the country to a far greater extent than dairy cattle or pigs. The main breeding flocks are kept and raised on the poorer hill country, with store lambs and breeding replacements being moved to the lowland areas for fat lamb production and finishing. These animals are sold through traditional markets, because that has proved the most effective and economical way of bringing the buyers and sellers together with the stock involved. The stock need to be seen, and even felt, for the buyers to judge their potential effectively.

But why are there dealers at all? Because buying store and breeding animals which will prove both reliable and good value is a skilled business. It takes genuine expertise, learned through practice. Dealers who survive and prosper do so because they are good at their job - they get better stock at better prices, and spend less doing so, than the end users could manage themselves. If these dealers did not provide such a service, then they would not be able to earn a living. And, if they are careless about the way they move these animals, stressing them and maltreating them, then they arrive in poor condition and perform badly in their new pastures as a result. Dealers who operate like this cannot expect to maintain their business for long. This business has been going on for generations. Current livestock routes are

pretty similar to the ancient droving roads of our ancestors. Of course, long practice does not necessarily make it right or appropriate for modern conditions.

It was a major misfortune that the source outbreak should have occurred in a place where the two key sectors in this outbreak - the pig and sheep sectors - were in such close conjunction with each other. The source outbreak happened in one area of the country especially characterised by more or less traditional mixed farming. It happened in an area of the country where traditional markets have the reputation of providing reliable stock in viable quantities, and are still used to a very substantial extent, in contrast to other areas where the importance of the traditional livestock mart has substantially declined. In short, a chapter of accidents (or worse) coupled with near ideal dispersal conditions has generated a major catastrophe.

But the scale should not be exaggerated. There are 11.5 million cattle, 44.5 million sheep and 7.3 million pigs (as of June 1999) in the UK. 105 thousand agricultural holdings are classed as cattle and sheep farms, while 86 thousand holdings have some sheep and 123 thousand have some cattle. The average weekly slaughter of animals for meat in the United Kingdom runs at about 640 thousand head. Against these totals, the present infection (350 holdings and 300,000 animals slaughtered) involves only a tiny fraction of the total population. Farming is a big business. This infection, which looks huge, only directly affects a small part of it, although it has temporarily stopped much of the rest of the industry from doing what it normally does: February slaughterings were down this year compared with last by 620 thousand head.

In other words, the total slaughter because of the foot and mouth infection in the first month only amounted to half a week's normal kill, and twice as many livestock were still alive after three weeks because of the movement restrictions than were actually killed in the attempt to control the infection.

THE CURES?

As now, there were fears during the 1967 epidemic that the slaughter policy would not be able to contain the spread of the disease, and the Government then prepared (but did not in the end use) an emergency vaccination scheme to limit the spread of the disease[ii]. In the aftermath of the 1967 epidemic, the Northumberland Committee of Inquiry prepared and examined an alternative control policy: a general prophylactic vaccination scheme. Under that scheme, all cattle sheep and goats (though not pigs) over 3 months old would be vaccinated annually (with two vaccinations being required in the first year). Vaccinations would be carried out under controlled and supervised conditions. Vaccinated animals would then become immune to the strains of the virus included in the vaccination. However, this strategy cannot completely eliminate outbreaks of the disease. The virus mutates and becomes immune to the vaccination. Any subsequent outbreak then needs to be controlled through slaughter of infected animals, immediate movement restriction in the infected area, and re-vaccination of adjacent animals (within a five mile radius). Such a policy would control the clinical presentation of the disease, but would mean that the disease would be endemic in the whole country - continuously present in at least some animals. It is not, so far, practical to distinguish between infected and vaccinated animals.[iii]

SOME ANALYSIS

The benefits of some form of FMD control

Why not simply let the disease run its course? Animals won't usually die of it, and it doesn't harm people, so what's the problem? Well, for a start, the disease is certainly extremely unpleasant for the unfortunate animals that catch it, which is most of the exposed populations because the disease is highly infectious, with infection rates of 80% or more. Animal welfare considerations alone demand that something be done about this nasty virus. We might also worry, in the light of the BSE experience, that this nasty virus might not forever stay specific to only cloven-hoofed mammals. It might mutate to become infectious to an adjacent host - us - and in so doing, we cannot be sure that the symptoms of its infection would remain as at present.

Secondly, doing nothing would increase the costs of animal production, and thus of the foods we get from them. The direct benefits of controlling this disease through any means, assuming that the controls are perfectly effective, can be estimated by considering the increased costs of animal production in the event that the disease was endemic. Notice, here, that it is not simply the producers who benefit from such reduced costs of production. Because costs are lower in the absence of the disease, our food is cheaper (and probably more wholesome) without the disease than it would be with it.

Thirdly, in addition to the benefit of lower livestock product prices, the loss of export sales also needs to be considered. Because the disease is so nasty, most developed countries follow the same policy as Britain - eradication and preservation of FMD-free status by strict prevention of imports of potentially infected materials or animals. If we chose not to try and control this disease in this country, our trading partners would certainly take all possible steps to prevent our contagion infecting them. Our export trade would be eliminated.

Would this matter? You may take the view that such exports (especially of live animals) are not very nice in any event - we might well be better off without them. But, consider this: the nature of the economic system is inter-dependence. If someone is not exporting something, the rest of us cannot afford to import other things, or take foreign holidays. Our exports are necessary to pay for our imports. If more people are trying to import than export, the price of our own currency in terms of other countries currencies would deteriorate, and imports would become more expensive.

Of course, we can always export other things than meats and animals, and we do. But what are the people and resources currently used to export livestock and their products going to do instead? Are they going to export other things? If so, what? And what will happen to the land that is currently used to grow and feed these animals? 30% of our sheep flocks and their shepherds depend on the export trade for their existence. Sheep (and beef cattle) are a very effective means of managing traditional hay meadows, lowland and upland extensive grazings and heather moorlands. These would become much more expensive to manage and maintain if the sheep and cattle used to produce

them have no final market or use. In conclusion, the value of our livestock exports is a legitimate and sensible part of the benefit we all derive from control of FMD.

Table 1 shows some estimates of these direct benefits, based on the production costs of the disease estimated after the 1967 epidemic[iv] and including the 1999 export value (almost entirely within the European Union, which is presently FM free and would therefore prohibit imports from an infected country).

Over and above the animal welfare considerations of control of this disease, the economic value of control is, according to these estimates, £1.2 billion each and every year. This is a reasonable estimate of the benefits we all get, through lower food prices and increased ability to buy imports and foreign holidays, from control of FMD. The simple economic implication of these estimates is that it is worth spending, say, £1 billion a year, every year, to control this disease.[v] How much are we actually spending?

Table 1: Estimated Annual Benefit of being FMD Free in the UK (£m, 1999 base)

	Production Costs	Export Sales	Total Benefit	% of total output value
Milk	304		304	11
Beef	191	5	196	9

Sheep	88	275	363	32
Pigs	130	190	320	35
Total	**712**	**470**	**1182**	**17**

Notes:

1. The saving in production costs shown here are estimated on the basis of the cost estimates made by Power and Harris (1973, p.583, Table 2) as follows. The 1973 figures in this article are revalued from 1967/8 prices using the GDP deflator, to account for inflation between 1967 and 1973, and are expressed as a percentage of the total output values of each class of livestock in 1973 (from the MAFF annual aggregate accounts for the UK agricultural industry). The resulting percentages are then applied to the current (1999) output values for each livestock type (less the export sales - see below) to produce the figures in the production cost column of this table.[vi]
2. The export sales figures are taken from the Meat and Livestock Commission data (MLC web site: http://www.mlc.org.uk). Milk product exports are not included here, although dairy product exports have been suspended during the current epidemic. Including these products, however, would require that their value be discounted by the extent of the export subsidies necessary for their export. The resulting loss is relatively small and is ignored here. Export subsidies should also be accounted for in the livestock exports. However, 1999 market prices were unsustainably low, and it is assumed here, for convenience, that the subsidy is offset by the temporary depression in market prices below trend levels. The same comment applies to the estimate of production costs.
3. The total benefit is then the sum of the production cost saving and export sales figures.
4. The final column shows the total benefit as a percentage of the 1999 farm output value of each livestock type.

The Costs of Control via the Slaughter Policy

The answer for the present epidemic must be speculative at this stage, but perhaps an educated guess can be made. For instance, the NFU are reported as suggesting that the present outbreak might cost agriculture and related businesses £775m if not brought under control within three months.

The costs of the 1967 epidemic were estimated after the event as £610m in today's money[vii]. That epidemic involved ten times as many individual

outbreaks as the present total (15.3.01) for the current epidemic, and slaughtered twice as many animals, though the present total is still rising rapidly. The estimate of the total cost of the 1967 epidemic included the direct costs of actually slaughtering the animals (20% of the total) and the compensation paid for the slaughtered animals (30% of the total). The remaining half of this total estimate was for the consequential losses incurred within the livestock and food sector.

Neither the 1967 estimate nor the NFU figure, however, include any allowance for the disruption of tourism and other non-agricultural rural activities. Estimates of tourism losses associated with the present epidemic are reported in the press as being around £100m per week and rising as the main tourist season approaches towards £250m per week (as suggested by the English Tourist Council). Accepting these estimates as reliable, they clearly dominate any uncertainty about the costs to the farm sector. Presuming that the current epidemic takes as long to eradicate as the 1967 case (30 weeks), and that 25 of these are during the high tourist season, the total tourism losses might be as high as £7billion. These costs clearly very substantially swamp the costs being incurred in the farm and food sectors, tragic though the latter are in individual cases.[viii] The total cost of the present epidemic, including second-round effects on upstream and downstream sectors, might then approach £10billion.[ix]

In fact, this estimate very substantially over-estimates the real net cost to the economy and nation as a whole. Income which is currently not being spent in rural hotels and guest houses, shops and pubs etc. is not completely lost,

though this is little comfort to the rural businesses affected. People who are not visiting the countryside and spending their money there are necessarily spending their time and using their money somewhere else, doing something else. The people and businesses supplying their goods and servicing their needs somewhere else are benefiting. Restaurants, cinemas, DIY stores, pubs and so forth in the towns and cities are presumably doing more business than otherwise as people avoid visiting the countryside. Nevertheless, all these something else's are necessarily thought of being 'second best' alternatives - they are not what people would have chosen to do in the absence of the FMD epidemic. However, the chances are that the rest of the economy is benefiting to a substantial extent from the reduction in spending in the rural areas, and also from the extra spending on the slaughter policy itself.[x] Who, for instance, is supplying all the railway sleepers for the funeral pyres? Who is doing all the earth moving and so forth? A full analysis of all the costs and benefits of the present disaster would need to trace and account for all these re-adjustments and responses. The final account would, no doubt, reveal some very surprising gainers as well as a number of other losers. But, for the moment, the £10 billion is a ball-park estimate of the potential cost of the epidemic to the rural areas most seriously affected. What is clear is that the effects are most certainly not simply confined to the farming industry, desperate though many farmers' conditions now are.

Is it worth it?

With no control at all, the disease would cost an estimated £1.2billion per year. So, the simple answer is that the country as a whole could afford a

£10billion epidemic once every ten years and still come out ahead in purely monetary terms. In fact, there are already unidentified gainers of some, if not most, of this £10 billion somewhere else in the economy. We might expect these gainers to be keeping rather quiet at present. It is unlikely they would willingly volunteer to give back some or all of their extra revenues to help those most seriously affected. We will return to some important implications of these observations below.

Is there a better way?

Surely we could vaccinate animals and prevent the disease from erupting in its nasty clinical state? Yes, we could. But if we did, we would have to live with the consequences - we would never be free of the disease, which would become endemic throughout the country, with substantial reservoirs built up amongst wild deer and being carried by wildlife. The disease would inevitably erupt from time to time as the vaccines break down. Each time there was an eruption, we would have to kill the newly infected stock as we developed the new vaccine to cope, and re-vaccinate adjacent flocks and herds to contain the new outbreak.

The last time this option was examined seriously (after the 1967 epidemic), it was estimated that we could expect to see some 16 outbreaks a year under such an option.[xi] In the 34 years since 1967 that we have been free of this disease, we would have seen 540 outbreaks and their consequences. The present epidemic has 'only' generated 330 outbreaks so far (19.3.01), though more can confidently be expected. And vaccination is not a free option - it costs time, effort and resources. Based on the costs estimated after 1967, the

total capitalised cost of a vaccination programme run for the 34 years since then would be about £5 billion in today's money.[xii] At first sight, this seems a cheap option compared with the possible £10 billion associated with the current policy. But, as with the 1967 estimates of the disruption costs of slaughter, this estimate ignores the disruption of the local rural economy associated with each outbreak. As we have already seen, these rural economy disruptions swamp the costs of the agricultural industry directly. The actual costs of the vaccination policy would probably be much more substantial than this estimate suggests. Furthermore, these simple economic costs totally ignore the trauma associated with the permanent infection of wild deer populations, or the costs of trying to immunise these populations should the trauma prove impossible to bear.

There would be another very important effect of the vaccination policy, which was not considered by Power and Harris. Because prophylactic vaccination does not eradicate the disease, our export trade would also be severely compromised under this option. In the last 34 years our exports have generated a cumulative sum of £56 billion.[xiii] Unless we can also persuade most of the rest of the world to accept that vaccination is a reliable way of controlling the disease, and hence accept our exports, we would lose most, if not all, of this trade. Vaccination would thus be an extremely expensive option. It would have cost us something like £60 billion had we chosen to follow it since 1968, rather than rely on the prevailing prevention and eradication policy.

To be sure, the people making a living from these exports could and would have found something else to do if the export business was not available, so the full value of the foregone exports might be an overestimate of the real opportunity cost of the vaccination option. Furthermore, the value of these exports has been artificially increased by the agricultural support policies of the CAP. However, the real opportunity cost of these foregone exports only needs to be some 10% of the total value for the vaccination policy to look at least as expensive as the slaughter policy. Furthermore, given that some 30% of the sheep output of this country is destined for export markets, one has to ask what the land used for sheep production might otherwise have been used for. It is a fact that most of our uplands are used primarily for sheep grazings, which is why our hills look the way they do. Without sheep, these uplands would look very different.

The conclusion is clear: these calculations strongly suggest that the control option of vaccination is likely to prove even more costly than the present slaughter policy. It should be clear, though, that this conclusion depends on:

- there being infrequent epidemics (less than one every ten years);
- each epidemic costing no more than £10 billion in total loss;
- the rest of the world continuing to believe that vaccination is not a sufficient control of the disease to prevent its transmission through international trade in livestock and livestock products.

It ought to be possible to ensure that our regulations and practices are such that we can be reasonably sure of continuing our recent performance of FMD

prevention (one epidemic every 30 years or so), especially if we learn the lessons of the current crisis and its generation. To believe otherwise is to suppose simply that we have just been incredibly lucky not to have had a serious outbreak since 1967, and that there is nothing we can do to preserve and bottle this luck. Such a position seems unnecessarily pessimistic and fatalistic. As already outlined above, the cost of the present epidemic is extremely unlikely to approach the £10 billion 'benchmark' in net terms: there will be gainers from the present crisis whose gains will offset, to some presently unmeasured but certainly substantial extent, the £10 billion losses suffered by the losers. It is possible that future scientific advance in vaccines and vaccination procedures might invalidate the third of the conditions. It is also possible that the present epidemic will prove to have spread sufficiently widely and uncontrollably over the continent of Europe to force the widespread use of vaccination programmes to contain the disease, at least in the short term. In either event, the conclusion on vaccination would need to be re-visited.

SO WHAT FOR THE FUTURE?

Some general lessons

There can be little doubt that the present epidemic has taken us all by surprise and found us singularly unprepared to deal with it and its consequences. Between 1951 and 1967, the UK suffered 17 occurrences of the disease,

averaging about 225 outbreaks (farms affected) per year. In the 34 years since 1967, we have avoided any outbreaks until now (apart from one very minor one in the 1980s). We have certainly become far too complacent and too indifferent to the risks and the costs of risk management. As consumers, taxpayers and electors, we are all to blame for that. We have assumed that since it is other peoples' jobs to look after these problems, we don't have to worry, still less pay for their proper care. We need to wake up and take more notice, and be willing to pay for a quality food chain. We clearly need to be a lot more vigilant than we have been about importing infected material and closing off the possibilities that such infected imports can get anywhere near our own livestock. We can be a lot more careful about tracing animal movements. We can do better at reducing the risks of unwittingly spreading the infection. The rapid introduction of electronic tagging of animals seems an obvious step which could ease and simplify the tracing of animal movements, which is critical in coping with an epidemic of this sort.

We can almost certainly improve the speed of response and necessary culling. The eventual official inquiry into the causes and consequences of this epidemic will almost certainly need to examine carefully the present procedures used to deal with suspected and confirmed outbreaks. It is easy to suspect that rather cumbersome and bureaucratic procedures have resulted in considerable delays and logistical problems which can only have contributed to the spread of the disease. In emergency situations such as this, it is important that the people directly concerned on the ground should have executive authority to take tactical decisions quickly on the basis of local knowledge and familiarity with the conditions and contexts. It is impossible

to make generalised rules which will cater properly for systems which are inherently chaotic (formally unpredictable and highly sensitive and responsive to specific local conditions and circumstances). In such emergency conditions, the application of experienced and knowledgeable judgements is vital. The command structure in such circumstances needs to be decentralised and delegated, and the local commanders need to be given both the direct authority and access to all necessary resources to take and implement judgmental decisions rapidly and effectively. This requires appropriate training and appropriate resourcing. Military training and logistical procedures are more appropriate to these conditions than traditional bureaucratic procedures. Preoccupation with forms, formal requisitions, formal documentation etc. should take a long second place to effective and rapid actions. The review of and justifications for those actions can wait until the outbreaks have been contained. Provided that the local commanders have been properly selected and trained, and are as well informed as possible: "shoot first, ask questions and settle bills later" is the most appropriate tactical rule of thumb in an extraordinary and emergency situation.

THE CRITICAL PUBLIC POLICY QUESTION: TO INSURE OR NOT TO INSURE?

The critical public policy question arising from the present epidemic is "Who should cover the costs?" The *Economist* argued (Foot, mouth, farm, subsidy, 17.3.01) that the case for compensation for farms and others affected by the present foot and mouth disease control measures is weak. It said that plenty of other people and businesses have to put up with various forms of dislocations and market collapses without compensation. "Neither farmers,

nor those involved in tourism or sporting events, should have any right to special treatment. Governments can and should step in when a malaise threatens to damage the whole economic system, but not otherwise. The right way to protect farmers is insurance, not subsidy."

Professors Oswald (Economics, Warwick University) and Thomson (Agricultural Economics, Aberdeen University) broadly agree (Times, 19.03.01), arguing that foot and mouth dislocations are just like motor accidents - insurable but not worthy of public support or subsidy. They say: "Commercial insurance ensures a hard-headed approach and avoids the dangers of political decision-making. A parallel can be drawn with car insurance." They conclude that foot and mouth insurance should be compulsory. These respected commentators echo Simon Jenkins of the Times, who argues that it is wrong for the public purse to be asked to bear the costs of disease control. The essential rationale for this point of view is that costs are incurred as a consequence of either individual accident or unlawful activities, and that those who are affected could and should provide for their own insurance against the possibility of breakdown, disruption or dislocation. If these people and businesses choose not to spread these risks via formal insurance contracts, then they should be deemed to be self-insured and they should have no claim on public resources.

To many, these arguments represent the classic free market solution. As a result, they tend to be accepted uncritically by many economists, who are professionally committed to free market solutions wherever possible.

Obvious, isn't it? Well, not quite so obvious. There is a rather different, and more relevant economic analysis.

Put very simply, disease free status is a **public good**: we are either free of it, or we are not. If we are, we all benefit, through lower food prices and increased export earnings, which allow us all to enjoy higher levels of imports and more foreign holidays than otherwise. The annual benefit is of the order of £1.2 billion a year, each and every year we are disease free. My benefits from being disease free are not diminished by your enjoyment of the same benefits. You cannot exclude me from benefiting until I have paid my share of the cost. The costs of this public good are the ones we are experiencing just now - the market dislocations caused by the eradication policy, necessary to preserve the disease free status. These costs, though still unknown in detail for the present outbreaks, have been shown above to be very considerably cheaper, year in year out, than the alternative of a prophylactic vaccination programme.

Public goods are known to be inefficiently provided by the market place, insurance or otherwise. We do not pay for our national defence (another public good) [xiv] with private insurance contracts, even though we should, according to the apparent principles of these "hard-headed" economists' arguments. The insurance solution, though, obliges the losers to pay the costs, while the gainers (all those actually benefiting from the present crisis - the suppliers of the railway sleepers, the digger operators, the tourist and leisure businesses in the towns etc.) get away scot-free. And all the rest of us are gainers from being disease free. This doesn't sound like economics, it

sounds like theft. Which is why, economically, we pay for national defence, and should pay for FMD free status, through public subscription through our taxes.

So, why do people currently pay for insurance policies against the incidence of these costs (some 10% of farmers, for instance)? They are simply insuring against the possibility (indeed, probability) that the beneficiaries of the product (disease free status) will refuse to pay and default on their social contractual obligations. It makes obvious business sense for them to do so. But this spending is a deadweight cost to society - it is bred of the inefficiency of the contractual market. Nor does it help one bit to keep us disease free. It may be good business, but it is bad economics.

Perhaps you are still not convinced. Then you should consider the economic logic in more detail.

First, exactly what sort of insurance is suggested? Two forms, presumably:

- contingent (third party) liability insurance for all those capable of introducing the disease in the first place, however unwittingly;
- consequential damage insurance for all those potentially susceptible to the consequences of disease outbreaks and the control measures taken to eradicate it.

Suppose we had such a system in place now, with the government killing livestock but farmers being entirely individually responsible for the consequences - no compensation at all. These economists would,

presumably, be happy with this. So would the insurance lawyers, with claims and counter-claims about ultimate responsibility all over the place, including against the government for killing livestock which would have recovered anyway. Even presuming that the ultimate responsibility could be pinned down - the farm at Heddon? the importer of the original infected material? the customs official who failed to spot it? the organisation or institution which used it and threw some out with the food waste? - what happens when, as is quite likely, the person or business responsible turns out to be uninsured and to be quite incapable of paying the contingent damages? Too bad, I suppose these hard-heads would say. Just one of those things which we all have to put with from time to time - just bad luck. Or would they have the government underwrite the insurance policies? On what grounds? And how would they propose to do this, without compromising the supposed market signals to efficiency? And, anyway, what are these market signals supposed to be?

How does the insurance solution help us stay free of the disease? People and businesses who are insured will take more care not to introduce or spread the disease? People and businesses will be more likely to report outbreaks and kill infected livestock as soon as they show signs of infection? According to what particular economic logic would you expect these responses? All our simple economic motives suggest exactly the opposite responses. Putting the necessary clauses into the insurance contracts to ensure such responses, and then policing behaviours to ensure that the provisions are followed, would prove virtually impossible or impossibly expensive. What sort of solution is this?

It is a solution to the wrong problem, which is why it makes no sense. Standard cost benefit analysis shows, pretty conclusively, that we are all better off without this nasty disease than with it. We are all better off by about £1.2 billion a year if we can keep clear of this disease, quite apart from the rather serious animal welfare considerations should we try to live with the disease instead of eradicating it. So long as we collectively spend less than £1 billion a year to be disease free, we are better off. The present slaughter and eradication solution has obviously been less expensive than this over the last 34 years that we have been free of the disease. It is also reasonably clear that it is, even now, proving substantially less expensive than the possible alternative - a prophylactic vaccination programme.

So, we quite rightly have government regulations and eradication policies to eliminate the disease. The consequences of this eradication, as and when it is necessary as now, fall rather capriciously on individuals, businesses and regions, depending on the accidental circumstances of the particular event. The full costs of these dislocations are the costs of being disease free. They are owed to those who bear them by those who ultimately benefit from being disease free, which is all of us.

In addition, we can agree that economic stability is a good thing, and also a public good. Stabilisation implies public spending and taxation to offset local or national economic depressions, so far as is sensible and practical. The consequences of the eradication policy is potentially rather severe economic depression in particular localities and business sectors, offset, no doubt, by

windfall booms in other sectors. So how should we stabilise this economic dislocation? By taxing the winners and supporting the losers. The winners should be taxed anyway, through income and expenditure related taxes. The losers should be compensated, as they will partly be through paying less tax.

Admittedly the precise design of the compensation schemes, to avoid duplicate or unjustified compensation, and to encourage rather than discourage disease prevention, is tricky. But it is certainly no more tricky than drawing up (inappropriate) insurance policies. Appropriate due diligence clauses, requirements for documented evidence of significant net loss, and substantial penalties for devious or mendacious claims on public support should do the trick. Compensating losers from this disease epidemic is not subsidy, and it is not social security. It is simply paying the price for being and continuing to be disease-free. The winners from being disease free are all of us.. We all should pay.

But, those in favour of insurance would argue, the costs of insurance will eventually be passed on through the market system to the final consumers, so we all will end up paying. Providing that competitive insurance markets are efficient, this is true. [xv] Markets will adjust so the costs of the insurance policies are passed on to consumers. They are also passed back to the owners of the resources used in the industry. The incidence of this effective tax on food will depend on the elasticities of demand for food and supply of food. The insurance solution, providing that all markets work competitively, pays for disease control via an effective tax on food. Present government policy is that the food sector should bear the costs of tighter regulations and improved health and safety measures. What is the consequence? Our food is

more expensive than otherwise. In effect, we are already paying part of the costs for disease free status through a tax on food.

How much economic logic is there to this decision? None. The economic welfare justification of this distribution of costs and benefits only applies to private goods. The appropriate provision of public goods demands a different aggregation of individual preferences than is provided by market transactions. The value of a public good involves the sum of each individual's willingness to pay over the given and fixed quantity of the public good (disease-free status). The benefits of being disease free arise because the economy as a whole has a greater capacity to produce *anything and everything*, and thus earn *greater real incomes*, than if we let the disease be endemic. To be sure, we have *estimated* this increased capacity in terms of the food markets, but this does not mean that the benefits arise only in the food markets. A general equilibrium analysis of the benefits of being disease free would not produce a result confined or specific to the food markets, it would produce a result in terms of national income and output. According to the logic of the circular flow of income and general equilibrium, we would expect our partial equilibrium estimate of annual benefit of £1.2 billion to be an underestimate of the general equilibrium effects by the order of the multiplier. As we have already seen, the effects of becoming disease ridden, and then trying to eliminate it again, involve far broader and wider sectors of the economy than simply the food sector.

How much might we be willing to pay for this public good of increased economic capacity? It is worth an estimated £1.2billion a year. Who should

pay for this increased capacity? Those who value it most. Who are they? We do not know and our market mechanisms cannot tell us.[xvi] It is typically believed that the rich should pay more than the poor for public goods for equity rather than efficiency reasons. But there is no known economic logic which can justify equity - that is left outside the economic calculus.[xvii] But equity is one important reason why we try to make sure (with rather limited success) that our tax systems are progressive - the rich pay more than the poor. We might also suppose that the rich are likely to value public goods at a higher price than the poor. But food taxes are necessarily regressive - the poor pay proportionately more than the rich - which is why we usually tend to resist putting taxes on food.

In short, hard-headed economics, in favour of insurance and sceptical of the role and responsibility of the public purse, turns out to be wrong-headed economics. And this is not a conclusion which depends in any way on the estimates we might make of the costs and benefits - it is not an empirical question or conclusion - it is a conceptual issue.

CONCLUSIONS

Disease control is a public good - not a private consumption item we can choose or decline. We all benefit, one way or another, from being disease free. Furthermore, economic systems are such that breakdowns in disease control will have inherently unpredictable consequences - the consequences will depend critically and specifically on the precise conditions and circumstances of the breakdown, and on the particular and unique responses

to such breakdowns. The responses are particular and unique because they are context and circumstance dependent. The consequences can only be traced, if at all, after the event. They cannot be predicted before the event. In the same way, the benefits of being disease free cannot be predicted before the event, or confined to any particular sector or set of goods in the economy as a whole. The benefit of being disease-free is an increased capacity of the economy as a whole to produce and deliver the things we want, and to generate income and employment as a consequence. This benefit, in the case of foot and mouth disease, is worth £1.2 billion per year. It is not specific to the food and agricultural sector. It is a general, national and economy-wide benefit.

These two inherent and fundamental characteristics of the FMD issue are critical to any sensible understanding of the problem and possible solutions. The decision to control or not to control the disease is necessarily and fundamentally a collective public decision. It depends on an assessment of the costs and benefits of disease control by one measure versus another, including the option of no control. The present evidence strongly suggests that the current slaughter policy is the least bad option under most plausible circumstances, and also that the costs are well worth paying to secure the benefits of disease free status. There may be future conditions which would undermine these conclusions, but these are neither relevant at present, nor likely in the future.

Having taken such a collective decision, we then need to decide how to cover the costs of any breakdown in the control policy. We have already concluded

that it is worthwhile for society as a whole to bear these inevitable but containable costs in the interests of being FMD free. The subsequent decision on the appropriate distribution of these costs amongst society is, essentially, a political (collective) decision. There is no simple economic calculus which can be used to judge the distribution of the costs. Conversely, whatever decision we make about who bears the costs will necessarily affect peoples' behaviours and reactions both to our control measures, and to the steps we take to eradicate the disease when our control systems break down. The more specific we make the incidence of the costs, the more dramatic we can expect these responses to be. If we are to argue for specific incidence of cost (to farmers and the food chain, for instance), we need to be very sure that the cost burden will produce the behaviours we want - behaviours that will lead to more efficient and more effective control of the disease.

The standard solution to the provision of public goods is to provide them from the public purse - obliging those most able to pay to foot the bill through the tax system. Such a solution minimises the effects on behaviours and reactions elsewhere in the economy (both good and bad). For instance, we pay for national defence as a public good. As a consequence, suppliers of defence goods and services face a single buyer - the government - and may be tempted to increase the price and costs of such provision unnecessarily. But it is not a solution to this problem to suppose that each of us could buy our share of national defence separately, with those of us choosing not to being considered self-insured. Nor is it a sensible solution to suppose that the defence industries could provide the public good with their own resources,

out of their own sense of duty, responsibility and social concern, through their ability to sell by-products separately or through exporting any surplus.

To argue that disease control is a special case of the general public good problem, to be funded by the particular operators of the public good supply chain, requires that the reasons for special treatment be identified. What is it, if anything, which makes FMD-free status different in principle from national defence? Private markets are not generally sensible means of providing public goods. This is not a conclusion which depends on empirical evidence. It is a logical consequence of the inherent nature of the phenomenon.

The present policy recognises this. Governments have taken on the responsibility for prevention of the disease on our behalf. We have used governments to do our insurance for us. We might complain that they do not do a very good job, that they shed the costs onto people and businesses who should not be asked to pay, that they raise the premia from the wrong people too, and that they are hostage to powerful and selfish interest groups and lobbies. But much more research and careful thought is needed to provide sensible proposals about what to do about these democratic deficits. One possible benefit of the present crisis is that it might encourage us all to do just that.

It is clear that we have to think much more carefully about how we exercise collective responsibilities and encourage public obligations with respect to such public goods. Markets only do so by default and accident. The present foot and mouth crisis more than adequately demonstrates that default and

accident leads to mass slaughter and mass hysteria, as well as to massive individual trauma. It is no good to complain about 'industrial' agriculture or the arm-locking power of supermarkets. If you buy their products, you are responsible. The current and long running fashion for denying collective responsibility and public service in favour of the worship of individual rights and opportunities is as nasty a virus as the foot-and-mouth disease itself. We would do well to be rid of both.

In the end, this is the lesson we seem to be learning from the present epidemic - that we were thoroughly unprepared for the infection, and have responded out of habit, or panic. The quality of the present debate about the epidemic seems to neatly match the quality of the production and management systems which started it. We can and should do much better than this.

Endnotes

[i] These data are taken from A.P. Power and S.A. Harris (1973) 'A cost-benefit evaluation of alternative control policies for foot and mouth disease in Great Britain', *J.Agric.Econ*, XXIV, 573-596.

[ii] This paper does not deal with the pros and cons of vaccination as a tactical disease eradication measure, so-called ring vaccination directed against the spread of the disease. The Northumberland Committee concluded "for ring vaccination to be successful it should be carried out immediately an outbreak occurs" (para 206). The Committee cautioned "the adoption of ring vaccination as a policy after an epidemic had become established would contribute little towards control and would probably lead to a policy of general vaccination" (para 208).

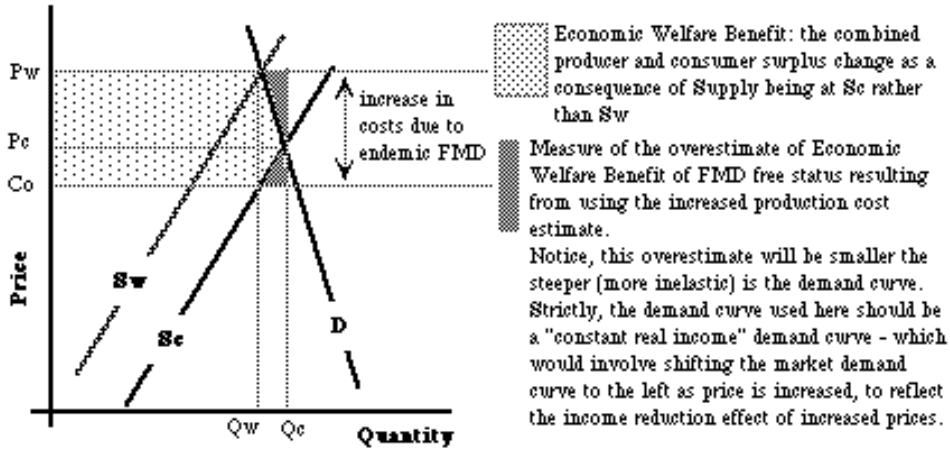
[iii] Apparently science is progressing on this front, and it may now be possible to make such a distinction, though at what cost, with what reliability and with what delay is not yet clear (Daily Telegraph, letters, 16.03.2001).

[iv] Power and Harris (1973) , *op. cit*.

[v] It should be recognised that this estimate involves a considerable short-cut. The 'true' estimate of the annual benefit of disease control would involve a conceptual re-adjustment of the whole economy to cope with the increased costs of domestic livestock production and the prevention of (most of) our livestock and meat product exports. If such a situation were really to occur, we would expect people and businesses to adjust to this new reality. The final consequences of all these re-adjustments for the level of national income and output is the 'true' measure of the economic benefit (or cost) of disease control. It is possible to use general equilibrium models of the economy (suitably related to the rest of the world via trade and capital flows) to estimate these consequences, but the results, of course, depend on the realism of the models used to represent the complex economic interactions and behavioural responses. I am currently seeking both the time and resources to use an existing general equilibrium model system (GTAP) to explore the possible full adjustment effects of FMD control for the UK. But I seriously doubt that the results will substantially invalidate this short-cut estimate. What the results are likely to show is that the effects are more widely distributed throughout the economy than these simplistic estimates might suggest.

[vi] Studious students who refer back to the Power and Harris article will note that they spend some time discussing the appropriate measure of the economic welfare effects of the disease. Their discussion, however, is not particularly enlightening. The simple explanation of what is being done here is contained in the following diagram.

Economic Impacts of FMD control:



[vii] This estimate is derived as follows. The 1967 costs (shown in column 2 of table A below) are taken from Power and Harris, 1973, pages 583 to 587. These costs were derived on the basis of fairly detailed consideration of:

1. the direct costs of the slaughter programme: vets fees, costs of killing and disposing of carcasses, administrative costs, etc. (£9 million in 1967)
2. the costs of compensating farmers for the livestock which were compulsorily killed (£27 million in 1967)
3. a detailed estimate of the disruption and consequential losses (adjusted for the benefit to farmers of the consequential increase in livestock prices as a result of the shortfalls in supplies) - £16 million in 1967.

These costs are then simply revalued to today's prices using the GDP deflator between 1967 and 2000 as a reasonable estimate of the effects of inflation since 1967.

It might well be objected that this is a particularly crude estimate of the costs of the current outbreak. In particular, the costs of compensation depend very much on the number and types of livestock involved. The 1967 outbreak killed over 500,000 head, 53% of which were cattle (mostly valuable dairy cattle), and only 30% were sheep. By 14th March, 2001, 250,000 livestock had been identified as infected, of which only 19% were cattle (mostly beef cattle) and nearly 80% were sheep. The final outcome for compensation costs might not be very different, presuming that the present outbreak can be brought under control reasonably soon. By 19th March, a government spokesman is reported to have said that compensation actually paid on slaughtered livestock so far amounted to £50 million. The estimate here, then, appears likely to be an upper bound rather than a lower bound. The disruption costs of the present outbreak are likely to be very substantially greater than shown in this table, however. The geographical spread of the 2001 epidemic is already very much wider than that of 1967, so the consequential farm losses (including re-routing and delay of marketings etc.) will likely turn out to be rather

higher than shown here, even if the epidemic itself turns out to be no greater in terms of livestock slaughtered or duration than the 1967 epidemic.

Finally, Power and Harris went to some trouble to estimate the increase in livestock and product prices due to the temporary reduction in supplies, arguing that this increase in price offset some of the other consequential losses suffered by the agricultural sector. This is certainly true for the agricultural sector. However, as consumers and users of livestock and products, this price increase effect is an extra cost associated with the control of the disease, and should be counted as part of the costs experienced by the farm and food sector as a whole. In the present epidemic, the situation is actually rather different. British exports of both livestock and products have been suspended, incurring a loss not accounted for here, and unknown until the epidemic is finished, but could be some £500m if a whole year's exports are lost. On the other hand, these products are now building up on the domestic market, with the effect that domestic prices for meats and livestock will actually be depressed, producing an offsetting gain to consumers (though, of course, a further cost to producers). These effects are ignored in these figures, but should be identified in a more complete analysis. In round figures, the total cost to the farm and food producers of the epidemic might rise towards £1 billion, though with an offsetting gain for domestic meat consumers of perhaps a similar amount. Suspension of exports increases domestic supplies of these products by around 7%. If the price elasticity of demand for these products is low, as we typically imagine, then the domestic price reductions (on £7 billion farm sales) may be substantial.

Table A: Costs of the Slaughter policy in 1967, re-calibrated to 2001. £ million.

	1967	**2001**
Direct costs	9	98
Compensation	27	309
Consequential Farm	16	185
Food price increase	3	18
Total (Farm & food Sector)	**54**	**610**

However, as discussed in the main text, it not simply the farm and food sector which is affected by the slaughter and movement restriction control policy. Currently suggested costs of the movement restrictions elsewhere in the rural economy appear to swamp the farm and food sector effects.

[viii] Many of the costs already being incurred by farmers are not covered either by insurance or by compensation for slaughtered animals. In the latter case, for instance, it is difficult for disinterested valuers to put appropriate values on the pedigrees and histories of some flocks and herds, especially where rare breeds are concerned, or of the value of particular hill sheep flocks 'hefting' to the hill and local terrain. These sheep survive and prosper in their own territories, harsh though they are, because the animals know their own habitats - where to find food and shelter. Killing them and replacing them (eventually) with similar sheep will result in some (currently unmeasured) additional costs as the new flocks take time to accumulate and spread the knowledge of their new territory.

[ix] Escalating the direct costs of £7.6 billion to £10 billion is justified by the following logic. The direct disruption of the rural economy (loss of immediate income) will have second-round effects on other businesses. The economist's term for these second round effects is known as the 'multiplier' - the amount by which an initial shock to an economy is multiplied in generating final effects on national income and output. There is considerable uncertainty about how big or small the value of the multiplier is. The value implicit in the Treasury model of the macroeconomy is probably not much more than 1.1. On the other hand, studies of regional or local multipliers frequently suggest local multiplier values of the order of 5. These estimates, though are rather perplexing, since the logic of the multiplier process strongly suggests that the value should be larger the larger is the economy considered, whereas the estimates in the literature suggest that smaller economies (local or regional rather than national) have much larger multipliers than the national economy. A value of 1.3 is used here as an reasonable approximation.

[x] It should be noted, however, that the fraction of tourism and recreation losses due to reduced foreign tourism would constitute a net loss to the economy and British society as a whole, following the same reasoning as already outlined for the gain to society from the export of meats and livestock.

[xi] Power and Harris (op cit., p. 591) say: "The best estimates made available to us are that such a scheme would ultimately reduce primary outbreaks by about 50% and secondary spread by some 90%. Compared with the weighted average annual level of outbreaks of 175 (for both types of outbreak combined) assumed for the slaughter policy, the additional assumption regarding immunity would yield a weighted average number of outbreaks of 16 annually under the vaccination policy".

[xii] Power and Harris estimated (p 592 - 593) that a vaccination policy would have cost £250m, in today's money, in the first year (1968), including both the costs of the vaccination programme itself, and an allowance for slaughtering immunity breakdown outbreaks and re-vaccinating the ring around these outbreaks. They estimated that this cost would fall to about £120m per year by 1985 (again, in today's money), as a consequence of reduced vaccination costs and reductions in breakdowns. It is also plausible to suppose that, had we followed a vaccination policy, that we would have been able to get better at it over time, so further reducing the cost, say at about a 2% improvement rate per year. If we assume that we had followed such a policy since 1968, what would it have cost in total by now? Today's present value (2001) of this sort of vaccination spending, compounded at an annual real interest rate of 2.5%, amounts to just over £5billion.

[xiii] This estimate is derived by first converting the annual export values for cattle and sheep (and products) to current prices using the GDP deflator, to remove the effects of inflation. These annual values in today's prices are then compounded at an annual real interest rate of 2.5%.

[xiv] You may be tempted to jump to the obvious conclusion - disease free status is obviously very different from national defence. But, as far as function and essential economic character is concerned, they are exactly equivalent. Both involve freedom from external domination and threat (in one case by a virus, in the other by malevolent foreign powers) which, once provided for one is provided for all. In economic jargon, both "goods" are *non-rival* in consumption - my enjoyment or benefit of disease-free status does not diminish you enjoyment or benefit. In neither case is it possible for individuals or groups within society to opt out of or choose not the enjoy the benefits. In economic jargon, both are *non-excludable*, I cannot be prevented from enjoying the benefits. As a result, I cannot be denied the benefit even though I might refuse to pay my share of the cost. These are the two key characteristics which define public goods as being different from private goods, and which make it effectively impossible for private suppliers to provide public goods.

[xv] More sophisticated economics raises several potential problems with the free market private insurance solution. Among the most important of these potential insurance market failures are as follows.

Moral Hazard: According to the self-interest rationale of economic behaviour, those who have taken the decision to insure against future loss might be expected to take fewer precautions against such losses being incurred. Insurers are alive to this problem, and accordingly take care to add conditions to their insurance contracts to oblige the insured to practice all due care and diligence to avoid damage or loss. Formal analysis of this problem quickly becomes rather complicated. But the consequence is that marketable insurance contracts tend to be rather restricted as to the conditions under which damage or loss will be covered. Markets, though, are said to fail if they are incomplete - if they do not cover all relevant options and opportunities.

Transactions Costs: The costs of defining and implementing formal market insurance contracts reduce the provision of such contracts. The more difficult it is to make formal provision for risk and risk minimising behaviours, the less likely it is that the market will be able to provide appropriate insurance contracts. Markets fail when information is restricted and costly.

Adverse Selection: Only those who both consider themselves most at risk and are sufficiently wealthy will be willing to pay for insurance. The less well endowed and those who consider themselves less exposed to risk will not buy insurance policies. The consequence can be that the insurers are faced with the problem of covering and spreading most of the risk but over less than the total exposure. Commercial policies are more expensive than otherwise, and fewer contracts are written as a result. Insurance markets are necessarily incomplete since they exclude part of the relevant population, and thus,

according to the conventional yardstick of market efficiency, they necessarily fail. Hence the typical recommendation that insurance should be compulsory.

For these market failure reasons, there may be a sound conventional economic case for collective action (public intervention) in the disease insurance market. For instance, it may be that there are sufficient economies of information and scope to make a regulated monopoly provision of insurance substantially less costly and more effective than the freely competitive alternative.

[xvi] All our market mechanisms can do is adjust who produces what and who consumes what according to the existing distribution of the ownership of the raw materials and productive resources (land, labour, capital and management), taking the overall productive capacity of the economy as given. Those areas of the economy which suffer from important and costly technical constraints on particular capacities will, it is true, be prepared to pay more for relief of these constraints through technical improvement. So we might hope that our market mechanisms will signal what sorts of technical improvements should be made, and encourage their invention and adoption. But any of these initial inventions, wherever they happen, will then trigger adjustments throughout the economy in response. Any of them increase our total capacity to do what we like, regardless of the sector in which they materialise. They are all public goods in that sense. The argument here about being disease free is simply an instance of the general conclusion from our economic system: knowledge, and application of knowledge, is a public good. The strong, and mostly unrecognised implication is that privatisation of all such public goods (patents, intellectual property rights, and so forth) is inherently biased, and thus restrictive, and therefore inefficient for the system as a whole.

[xvii] There are, though, major efforts being made to explore the empirical consequences of more versus less equitable distributions for economic performance and efficiency. Such explorations also include the benefits of democracy versus other governance systems for economic performance See, for example, the World Bank: World Development Report, 2000, and also The Quality of Growth, 2000.