OFFICE OF FAIR TRADING

Productivity and competition

An OFT perspective on the productivity debate

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1 EXECUTIVE SUMMARY

Introduction

1.1 Competition is an important driver of productivity. The Office of Fair Trading (OFT) is seeking to ensure that its resources are used most effectively to enhance productivity as well as addressing detriment to consumers.

Aims of the study

1.2 This paper seeks to add to the understanding of how a competition authority can build productivity analysis into its prioritisation. It has two key aims:

- To build an understanding of the link between competition and productivity by exploring the relevant literature, and subsequently demonstrate the OFT's role in promoting productivity.

- To determine how productivity analysis might help inform the OFT's prioritisation in terms of identifying areas of potential concern from across the economy - horizon scanning.

1.3 Aiming to improve productivity is consistent with our role of making markets work well for consumers. The benefits of increased productivity flow through to consumers in the form of lower prices, higher quality goods and innovative products. Hence productivity (or efficiency) improvements are good for consumer welfare.

Productivity in the UK

1.4 The backdrop for this work is the productivity gap between the UK and its closest international competitors. Whilst this gap is closing after strong productivity growth in the 1990s, the UK still lags behind France, Germany and the US, as the table below indicates.

Table 1.1: International productivity comparisons (Index: UK = 100)

International productivity comparisons (Index; UK = 100)				
	UK	France	US	Germany
Output per hour worked	100	129	116	116
Output per worker	100	111	127	100

Source: 2004 ONS data.

1.5 HM Treasury has identified five drivers of productivity, which form the basis of attempts to close the gap - skills, enterprise, investment, innovation and competition (HM Treasury, 2000). Competition's place in this list is suggestive of the important role that a competition authority can play in boosting productivity performance.

Summary of key points

1.6 Productivity gains will be most beneficial to consumers if competition ensures that reduced costs or increases in quality are passed on to them.

1.7 Empirical studies of product markets, and of deregulation provide strong evidence of the high level relationship between competition and productivity.

1.8 Competition drives productivity through three mechanisms

- Within firm effects
  - Competition places pressure on the managers of firms to increase internal efficiency (x-efficiency). There is a great deal of empirical evidence of this relationship.
  - This highlights the importance of competition enforcement to ensure that firms and their managers are subject to the rigours of the market. A number of diagnostics can be used to identify propensity for x-inefficiency.
- Between firm effects
  - Competition ensures that higher productivity firms increase their market share at the expense of the less productive. These low productivity firms may then exit the market, and are replaced by

higher productivity firms. There is strong empirical evidence of these processes and their effects on productivity

- Entry and exit are more prominent, and have greater productivity enhancing potential, at early stages of a product's life cycle.

- High productivity dispersion combined with low levels of entry and exit, suggest problems with competition. However, high productivity dispersion alone may suggest a highly innovative industry.

- Innovation

  - Innovation increases dynamic efficiency through technological improvements of production processes, or the creation of new products.

  - The relationship between competition and innovation is complex, and varies according to the kinds of competition and innovation involved. In many situations competition will be good for innovation, but there will also be circumstance in which innovation may be harmed if there is 'too much' competition.

  - Since markets will develop their own modes of competition and innovation, there is no universally applicable rule for maximizing innovation in a market.

  - Nonetheless, information concerning the levels and type of innovation, and the volatility of market shares can be used to refine a case-by-case approach.

1.9 Competition and consumer policy tools and productivity

- Assessing the impact of anti-cartel policy on productivity is difficult. Nevertheless, regression studies of the 1956 Restrictive Practices Act find that anti-cartel policy has a productivity enhancing effect.

- The literature on mergers reaches mixed conclusions regarding their effect on productivity. This emphasises the importance of considering mergers on a 'case by case' basis.

- There is strong evidence that regulatory and administrative barriers to entry have detrimental effects on productivity. This points towards an important role for market studies, which have the powers to address such entry barriers.

- Consumers drive competition through the choices they make. If they are unable to make or act on informed choices, then competition will be distorted. Consumer policy may empower consumers to drive competition, and therefore have productivity enhancing potential. However, very little empirical evidence has been produced to back this relationship.

2 INTRODUCTION

2.1 Competition can be a driver of both efficiency and innovation. Both of these factors lead to enhanced productivity – output per unit of input. This relationship may have two implications for the Office of Fair Trading:

- Where there are known competition problems the OFT could target its activity on sectors where improved competition will lead to the greatest productivity gains as well as reductions in consumer detriment.

- Where there are shortfalls in UK productivity the OFT could explore whether these are due to a lack of competition and, if appropriate, take action.

2.2 The purpose of this literature review is to explain the links between productivity and competition and to use the literature to inform the development of diagnostics that may help with the OFT's prioritisation.

3 THE PRODUCTIVITY POSITION OF THE UK

3.1 Productivity growth in the UK has seen real improvements in recent years, allowing us to gain ground on our major competitors. Competition is regarded as one of the five drivers of productivity that have contributed to recent improvements, and it is expected to deliver further benefits in future. Although it is not possible to isolate and quantify what part competition has played in the narrowing of the productivity gap, it is worth noting that improvements in growth rates have coincided with major reforms to regulation and anti-trust policy.

Trends in UK productivity performance – productivity growth

3.2 The post-war period saw relatively poor productivity performance in the UK. However, after a slow down in the 1970s, productivity growth began to pick up again slightly in the 1980s. Growth then accelerated further from the mid 1990s, as reflected in the figures for the 'first half of current cycle' in the table below. Projected figures that bring this picture up to date suggest that productivity growth has slowed down a little since the turn of the millennium. Nonetheless, the current cycle remains on course to represent an improvement on previous cycles.

Table 3.1: Labour productivity annual growth over economic cycles (per cent)

Labour productivity annual growth over economic cycles (per cent)			
		Output per hour	Output per worker
1970s to mid 1980s cycle	1974Q2-1986Q2	2.02	1.5
Previous cycle	1986Q2-1997H1	1.92*	1.93
First half of current cycle	1997H1-2001Q3	2.60*	2.13
Projection. To present	2001Q3-2006Q4	2.15	-

Sources: HMT Budget Report 2006

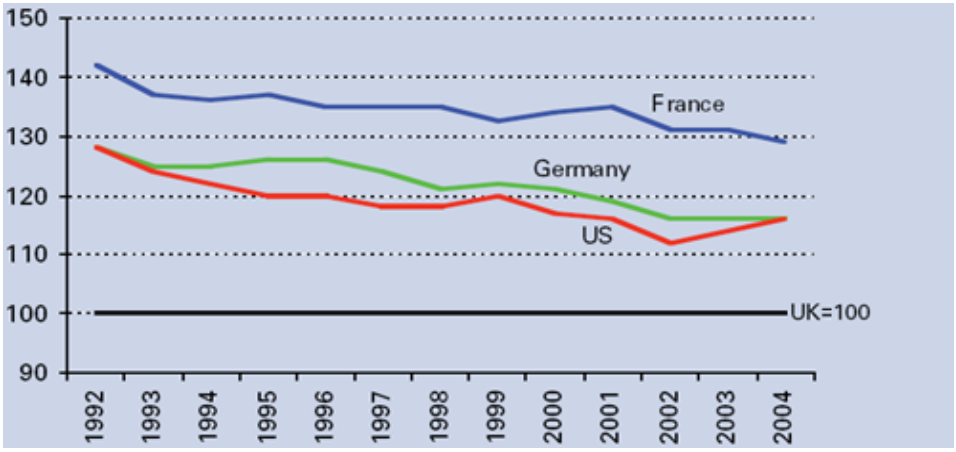
*HMT (2006) Trend Growth: new evidence and prospects

UK performance in the international context – closing the gap

3.3 Poor productivity performance for the first three quarters of the twentieth century led to the development of a 'productivity gap' between the UK and its main international competitors (HM Treasury 2004). However, the recent upwards trend in UK productivity growth has narrowed this gap.

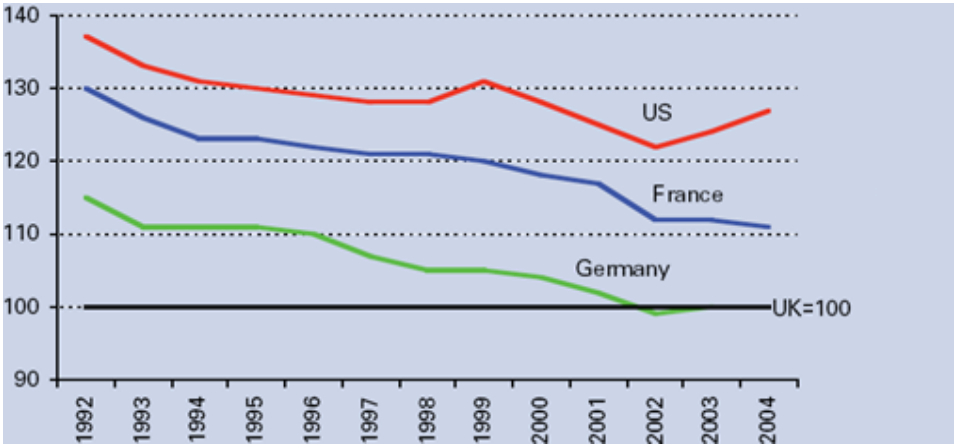
3.4 This is demonstrated by charts 3.1 and 3.2 below, which compare recent UK trends in output per worker, and output per hour against the performance of Germany, France and the US[1].

Chart 3.1: International trends in output per hour worked. (Index: UK = 100)



Source: ONS.

Chart 3.2: International trends in output per worker. (Index: UK = 100)



Source: ONS.

3.5 The fact that UK performance is stronger in relation to the US when measured in output per hour than output per worker suggests that some

[1] The economic cycles of these countries converged in 2002 and have since diverged. As such, the comparison since then is likely to be distorted given the procyclical nature of productivity. Since the US has been above, and Europe below trend since then, these data are likely to exaggerate the cross-cycle productivity performance of the US, and underestimate that of the European nations.

part of the US' productivity lead is caused by the quantity of the labour input (working hours) rather than its efficiency.[2]

3.6 Similarly, the weaker UK performance in relation to France and Germany when measured in output per hour reflects shorter working hours, and potentially greater technical efficiency in these countries. Thus, whilst the UK has caught up with Germany in output per worker, it remains 16 per cent behind in output per hour.[3]

3.7 These international productivity trends are positive from the UK's perspective, but it is important to emphasize that a considerable gap still exists. Furthermore, it should be noted that these are aggregate productivity trends and there is significant variation across industries.

What drives this productivity gap?

3.8 The Treasury has highlighted five main drivers of productivity: competition, innovation, investment, skills and enterprise (HM Treasury, 2000). Each has an important role to play in improving productivity, and they also interact with each other. Competition in particular is likely to affect each of the other drivers, although for the purposes of this report, only its interaction with innovation is explored in any detail.

[2] It should be noted that these measures are of labour productivity only and therefore it is not possible to rule out differences in capital intensity by country accounting for these differences.

[3] It is worth noting that Bourles and Cette (2005) construct a measure of 'structural productivity' which adjusts 'observed' hourly productivity levels in different countries to account for varying returns on the employment rates of different demographic groups. This shows clearly that the USA is still the productivity leader, but places the UK in a much better position on GDP per hour worked relative to Germany and France.

4 PRODUCTIVITY AND COMPETITION – CONCEPTS AND DEFINITIONS

4.1 Before examining the evidence on how and why competition enhances productivity, it is important to outline some of the concepts and definitions that will be used.

What do we mean by 'competition'?

4.2 Competition can be defined as a process of rivalry between suppliers that takes place either **in the market** or **for the market**. Firms compete to attract customers by offering lower prices, higher quality of products or services, or innovative products and services. When competition is working effectively, the market will send clear messages to firms (for example, in the form of the prices they can charge and the profits they can earn) about which goods and services consumers want to buy. Efficient firms offering the products consumers want at low prices will prosper, and inefficient ones will not.[4]

4.3 **Competition in the market** describes how firms already in a particular market compete on a day to day basis to gain market share. Examples are abundant including, for instance, most retail markets. For competition in the market to be effective, we would expect there to be a significant number of sellers, ease of entry and exit, and well informed, rational customers. For this reason, competition in the market is typically measured by the number of firms in a market, the mobility of market shares, concentration ratios and mark-ups (rents)[5] or by how readily consumers will substitute between products.[6]

4.4 **Competition for the market** describes how firms initially compete to supply a market. An example of this would be competition for contracts to exclusively supply a market for a period of time. Highly innovative markets may also be characterised by competition for the market, as the firm with the most successful innovation gains a high market share for a period of time until a competitor develops a more desirable product. In this way, dynamic competition can exist even where there is little static

[4] For an excellent discussion of competition and efficiency, see Vickers (1995).
[5] See for example Nickell (1996)
[6] See for example Syverson (2003)

competition. As a result, static measures of concentration or market share may not capture competition for the market, and more dynamic measures such as entry and exit rates, and market share volatility must be used instead. These considerations are particularly important to the debate on innovation.

4.5 Competition within and for the market need not be mutually exclusive, and both act as drivers of productivity.

Definitions of Productivity

4.6 Productivity measures output per unit of input. Since productivity increases can mean higher levels of output while input levels remain constant, it is the most direct route to inflation free economic growth, and higher standards of living.

4.7 It is instructive to look at both the **levels** and the **growth rates** of productivity, particularly for cross country comparisons of efficiency and competitiveness. The two are likely to capture slightly different aspects of the effect of competition on efficiency. For instance, low absolute levels of productivity may be indicative of x-inefficiency, or slow diffusion of technology, while low levels of productivity growth might indicate industries that are not particularly innovative or that there is decline in the drivers of productivity. The interaction of levels and growth rates is also significant. Countries starting at lower levels may experience higher relative growth rates as they 'catch up' to productivity leaders.

4.8 There are two main measures of productivity: labour productivity, and total factor productivity.

4.9 **Labour productivity** considers output per unit of labour input. These labour inputs can be constructed either as **output per worker**, or **output per hour worked**. High levels of labour productivity may reflect a high efficiency level and/or high capital per worker.

4.10 **Total factor productivity (TFP)** is based on the output from all factors of production. TFP growth is measured by the difference between output growth and the growth of inputs (labour and capital). An increase in TFP implies more output can be produced for a given level of labour and capital inputs. TFP growth incorporates the effects of changes in the

degree of factor utilisation, innovation and technological progress. Because the standard measure takes account of capital inputs, it identifies the role of technology, scale and organisation in contributing to labour productivity.

4.11 The measurement of productivity presents a series of challenges, which have been covered by an extensive body of literature.[7] Many of the issues concern how to derive accurate and consistent data on inputs and outputs. For example, for measurement purposes the value of output rather than the volume is sometimes used. With this measure high levels of prices, for example due to market power, can erroneously give the impression of high productivity. Annex A addresses measurement issues in more detail.

Consumer detriment and productivity gains

4.12 The relationship between reducing consumer detriment and improving productivity is not clear cut. An improvement in productivity will never be detrimental to consumers, but will only be beneficial if competition in markets ensures that some of the gains from increased efficiency are passed to consumers.

4.13 More specifically, real productivity improvement is likely to stem from a fall in unit costs, or an improvement in the quality of the goods produced.[8] The extent to which these falls in cost, or rises in quality are likely to benefit consumers, depends on the extent to which firms 'pass them on'. Effective competition should limit the extent to which firms can appropriate these gains for themselves, and is likely to ensure that productivity gains are indeed passed on to consumers.[9] When they are, the benefits to consumers can be significant. Nordhaus (2004) estimates that only two per cent of the social value of innovation in the post-war US economy has accrued to producers with 98 per cent going to the users of new technology.

4.14 However, measures that are good for consumers in the short term are not always good for productivity. For example, measures that reduce the

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[7] For example, see the annex of Pilat (1996).

[8] where productivity measures are able to capture quality adjusted outputs relative to inputs

[9] It is worth noting, however, that while productivity growth is likely to be welfare enhancing (in both total and consumer terms), it does not guarantee greater equity amongst consumers.

price of a newly developed product are good for consumers in the short term but can be detrimental to productivity and future consumers if this deters future product development. This potential divergence between consumer detriment and productivity comes when trade offs have to be made between static gains from lower prices and dynamic efficiency gains.

Efficiency and productivity

4.15 The terms 'productivity' and 'efficiency' are closely related. Productivity, often considered at an industry or national level, can be raised by increasing the efficiency of firms (and public bodies). Efficiency is more often the subject of economic analysis, and so for the purposes of this report we use the different types of efficiency to explain the mechanisms through which competition affects productivity.

- **Static efficiency** relates to how much output can be produced from a given stock of resources at a certain point in time. There are two main types of static efficiency – allocative and productive.
    - **Allocative efficiency** describes the situation in which a firm or an industry allocates its resources socially efficiently, which is achieved through the price of a product being related to its marginal cost of production.
    - **Productive efficiency** describes the situation in which a firm or an industry is producing at its lowest possible average cost. When a firm or industry is productively efficient, it operates at its production possibility frontier (PPF), producing the maximum output from a given set of inputs.
- **Dynamic efficiency** involves the development of new technologies or processes that can improve productivity. It is the rate at which firms reduce their real costs, or improve their product quality over time.

5 COMPETITION ENHANCES PRODUCTIVITY

5.1 There is a strong body of evidence that competition enhances productivity. Much of this evidence focuses on the way in which specific drivers of productivity work. Chapters seven, eight and nine discuss this in detail, but first we consider the literature which examines the empirical relationship between competition and productivity at a higher level. This broadly falls into two categories: studies which use micro-level data to examine the relationship between competition and productivity in product markets, and those which examine the experience of deregulation in OECD countries.

Evidence from product markets

5.2 A number of papers undertake traditional regression analysis that shows a positive relationship between competition and productivity growth:

- Haskel (1991) provides one of the first studies to exploit UK micro level data to explore the effects of competition on productivity. He uses UK panel data from 1980–86 to investigate the role that changes in the product market have on productivity growth. He finds that high levels of market concentration and market share have an adverse effect on total factor productivity.

- Nickell (1996) provides one of the most prominent surveys of competition in product markets based on micro-data. He employs a dataset of the published accounts of 700 British manufacturing companies between 1972-86 to measure how firm level production varies with different measures of product market competition (PMC).[10] He finds that high rent firms had consistently lower productivity growth than low rent firms. A ten per cent increase in price mark-ups resulted on average in a 1.3 – 1.6 per cent loss in TFP growth. This demonstrates a negative relationship between market power and productivity.

- Disney, Haskel and Heden (2003) find similar results. Where Nickell's (1996) data provided 835 observations, the ARD database employed

[10] PMC is measured using industry concentration, import penetration, market share, and returns to the owner of the company in excess of costs including the cost of capital ('rents').

by Disney, Haskel and Heden contained 60,000 observations, from 143,000 UK manufacturing firms between 1980 and 1992. The comprehensiveness of their data allowed them to capture the effects of exit. They point out that basing a study exclusively on either surviving firms or large firms biases results, since it misses the contribution of small, usually low productivity firms, and exitors. The results demonstrate that past falls in rents and in market share have the effect of increasing both current productivity levels, and productivity growth.

- Blanchflower and Machin (1995) measure competition as reported by participants in a market using data from the Workplace Industrial Relations Survey (WIRS). Their results prove largely inconclusive. Whilst they find a positive relationship between labour productivity and competition in Australian manufacturing, they are unable to show this result in Britain. These findings must be considered in light of the large amounts of subjectivity inherent in using management surveys to measure of competition.

Evidence from deregulation

5.3 Pilat (1996) argues that it is the effects of recent deregulation which have revealed most clearly the effects of competition on productivity. Griffiths and Harrison (2004) provide a good overview of studies which explore this connection. The list below is indicative of the findings in the area.

- Maher and Wise (2005) estimate that the liberalisation and regulatory reforms which introduced competition into the UK electricity, gas, and water industries resulted in 'phenomenal rates' of productivity growth: over ten per cent p.a. across the 1990s.

- Ehrlich *et al.* (1994) investigate 23 international airlines with varying levels of state ownership. They estimate that complete privatisation of an airline increases the annual rate of TFP growth by 1.6 – 2.0 per cent on average in the long run.

- Boylaud's (2000) analysis of the liberalisation of the road freight industry in OECD countries, and Olley and Pakes' (1996) survey of deregulation in US telecommunications, both identified productivity gains. Similarly, Gort and Sung (1999) were able to identify TFP

growth rates between seven and 14 times higher in competitive US telecoms markets than in regional telecoms monopolies, during 1985-91.

- Nicoletti and Scarpetta (2003) find that product market regulation (PMR) slows down catch-up growth. Specifically, aligning the regulatory stance in European countries with the most liberal OECD country would raise TFP growth over ten years by up to 1.1 percent.

- Nicoletti and Scarpetta (2005) suggest that some part of the international variations in productivity growth since the mid 1990s can be explained by differing degrees of PMR of between economies. The UK, along with the US and Canada, saw reduced levels of regulation accelerate productivity growth, whilst the more restrictive economies in large EU countries held it back.

- Alesina *et al.*(2005) find strong effects of deregulation on investment in utilities, transport and communications from 1975-98. The results suggest that if Italy had PMR similar to the US, investment would have been around three per cent higher in the late 1990s.

- The Australian competition reforms in the early 1990s provided a natural experiment that was reviewed by the Australian Productivity Commission (APC). These reforms to infrastructure resulted in cost savings to downstream markets. For instance:

  - Average real prices in the electricity sector fell by 19 per cent since the early 1990s.

  - Reductions in rail freight rates in the second half of the 1990s ranged from eight per cent for wheat, to as much as 42 per cent for coal traffic.

  - Real port charges fell by up to 50 per cent during the 1990s.

  APC modelling indicates that these price changes have boosted Australia's GDP by 2.5 per cent, and the average household's income by $7000 p.a.

6 THE MECHANISMS THROUGH WHICH COMPETITION IMPACTS ON PRODUCTIVITY

6.1 The literature outlined in chapters seven, eight and nine examines the **mechanisms** by which competition drives productivity.

6.2 Competition can:

- place downward pressure on costs
- force firms to be more focussed on meeting customer needs
- lead to more efficient allocation of resources between firms
- act as a spur to innovation.

6.3 To achieve such goals, competition drives productivity growth via three mechanisms:

- **Within firm effects**

  Competition places pressure on managers to push their firms closer to their own Production Possibility Frontiers (PPFs). Individual firms increase their productivity through internal changes, such as new technology, organisational change, and downsizing. The entry (or threat of entry) of a new firm into an industry, and the subsequent threat to incumbents' market shares, can trigger this process.

- **Between firm effects**

  Competitive pressures reallocate resources between firms in a way that pushes the industry closer to its PPF. Also described as the 'market sorting effect', this takes place two ways:

  - **Changing market shares**

  Market selection ensures that higher productivity incumbents increase their market share at the expense of the less productive. In this way, aggregate productivity can increase without any individual firm increasing its internal productivity.

- **Entry and exit**

  Low productivity firms exit and are replaced by higher productivity firms. These entrants have different levels of efficiency and scope to make profits, so the same process will recur - the least efficient among them will quickly exit, and the most efficient will remain.

- **Product and process innovation**

  Competition can provide firms with the incentives to innovate. Innovation can lead to both productive/technical efficiency gains (through the introduction of new and better production methods) and dynamic efficiency gains (raising the long term productivity level and growth rate), though the relationship is not a straightforward one (see chapter nine).

6.4 The significance of these mechanisms may depend on the exact nature of rivalry between the firms in question.

6.5 The next sections discuss these three mechanisms in turn. The basic mechanism involved in each case will be described, and the empirical evidence which tests this mechanism will briefly be surveyed. More detailed analysis then discusses various threads of the literature that may have direct implications for OFT prioritisation.

7 WITHIN FIRM EFFECTS

7.1 Both theoretical and empirical studies provide evidence that competition can reduce x-inefficiency. This will see firms moving closer to their PPF, thereby enhancing productivity 'within firms'.

Theoretical background

7.2 Under perfect competition inefficient firms are unable to stay in the market in the long run. Therefore managers will ensure there is no slack in the production process, and resources are configured most effectively. However, this is not the case under imperfect competition, where managers can reduce their efforts without the same risk of going out of business.[11] This is x-inefficiency.

7.3 There are three intuitive reasons to believe that increases in competition will reduce x-inefficiency:

- **Greater opportunities for comparison** make it is easier for owners, or the market, to monitor manager's performance, reducing principal agent problems.[12] Equally, managers are able to prove themselves more conclusively, and so have the incentive to work hard to build up a reputation (Nalebuff and Stiglitz, 1983; Vickers, 1995).

- **Higher demand elasticities** reward or penalise changes in price to a greater extent.[13] Firms with lower costs can capture more of the market through price decreases, while those with higher costs stand to lose much of their market. Technical slack therefore comes at a higher cost (Willig, 1987).

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[11] As Hicks (1935) famously said, "The best of all monopoly profits is the quiet life."

[12] The "principal agent problem" describes the situation where the managers of a firm do not have the same incentives to maximize profits as the owners. Where such problems exist, the profit maximizing behaviour predicted by classical economics does not occur. Rents are appropriated by managers and labour in the form of overstaffing and productive slack. This is x-inefficiency (moving firms away from their PPF).

[13] Although monopolist's scales of production tend to be larger, increasing their absolute reward from a similar cost reduction.

- **Lower profits place pressure on costs**, increasing the probability of bankruptcy. This induces the manager to improve the internal efficiency of their firm (Schmidt, 1997).[14]

Empirical evidence

7.4 Empirical studies produce strong evidence of a positive, albeit non-linear, relationship between competition and x-efficiency:

- Bloom and Van Reenen (2006) provide the most recent empirical work to focus on x-efficiency in their survey of management practice data across 732 medium sized manufacturing firms in the US, UK, France and Germany. They conclude that poor management practices are more prevalent when PMC[15] is weak (and/or when management passes down through *primo geniture*). In particular, it is revealing that the long tail of firms they identify as having 'surprisingly bad management practices' are heavily concentrated amongst firms in the low competition and *primo geniture* sample. The relatively low presence of poor management in competitive markets is indicative of the way that competition penalises x-inefficiency.

- Nickell, Nicolitsas and Dryden (1997) identify a mechanism through which competition drives x-efficiency by adopting the idea of competition as a form of pressure on managers (or 'disciplining device'). Their empirical survey of 580 UK manufacturing companies demonstrates that competition is substitutable with other disciplining devices – financial pressure[16] and dominant external shareholders[17] – in terms of their effects on productivity. The marginal influence of competition on x-efficiency is significantly

[14] Schmidt (1997) also identifies the possibility of factors pushing in the opposition direction at high levels of competition.

[15] Measured by a combination of import penetration, responses to the management survey, and the Lerner index.

[16] Measured by interest payments normalised on cash flow

[17] Dominant external shareholders are able to exercise a significant degree of control over the operation of the company and internalise higher rents, and high debt service payments create a risk of bankruptcy. They are defined as a case where the shareholder has a 90-95 per cent probability of winning a shareholder's vote.

weaker when it overlaps with one of these other disciplining devices[18].

- Griffith (2001) isolates the impact of competition on managerial effort by dividing her sample of UK firms into single establishments, which are more likely to be manager owned (no principal agent problem), and group establishments, which are likely to have a separation of management and ownership (principal agent problems). She finds that an exogenous rise in competition[19] increased the productivity of the firms likely to have principal agent problems, but not that of firms without these problems.

- Caves and Barton (1990), and Green and Mayes (1991) find that technical inefficiency creeps into the production process at high as well as low levels of competition. Competition increases efficiency up to a point after which its influence becomes negative, in what is described as an 'inverse U shaped', or 'curvilinear' relationship. Schmidt (1997) attempts to provide explanation of this inverse U shaped relationship. He argues that at high levels of competition, firms' profits – and so managerial incentives - will be reduced to such an extent that it can lead to less managerial effort. The inverse U shaped curve demonstrates that increases in competition are most beneficial to x-efficiency in markets where competition is low to start with. Broadly speaking, this is the kind of market into which OFT interventions are most likely.

Implications for the OFT

7.5 This evidence supports action by the OFT to address behaviour that insulates firms from the rigours of the market. It emphasises the need to ensure that firms are challenged by competitors. It therefore supports measures to prevent cartels and other illegal agreements that have the intention or effect of weakening competition, unilateral measures by dominant firms to prevent effective competition in their markets, and

[18] It is interesting to note that only in the case of dominant external shareholder that is a financial institution is there a positive effect on a firm's productivity growth. Where the dominant shareholder is internal, there is no effect on productivity growth, and where it is an external non-financial institution, it has a negative impact on growth.

[19] The introduction of the European Union Single Market Programme

tactics that prevent consumers from switching to the firm that provides the best price/quality of product for them.

7.6 It also highlights the need for OFT involvement in encouraging government to ensure procurement and subsidy activity is undertaken in a way that promotes competition, or at least does not drive a wedge between firms' actions in terms of making efficiency improvements and their rewards for this.

7.7 In merger control, the effects of changes in ownership on productivity could be considered. Changes in ownership, or the credible threat of changes to ownership, may lead to decreases in x-inefficiency and therefore increases in productivity. However, where a merger reduces competition, this may offset any gains in x-efficiency (see paragraphs 10.3–10.9).

Implications for prioritisation

7.8 We can develop diagnostic tests that provide some indication of whether taking action would lead to improvements to productivity through reducing x- inefficiency.

7.9 Two measures of ownership are found to be related to x-inefficiency:

- Categorising firms into those with separation between owners and managers, and those that are manager owned (Griffith, 2001).

- Categorising whether or not firms have 'dominant external shareholders' (Nickell, Nicolitsas and Dryden, 1997).

7.10 These tests approximate the levels of any principal agent problems existing in a market. Such tests may be useful, since the evidence from the literature suggests that in markets where there are principal agent problems, competition can act a strong disciplining device on managers that will lead to improvements in x-efficiency.

Timing of productivity gains from x-efficiency

7.11 When evaluating the productivity gains from reductions in x-inefficiency we could consider appropriate timing as the impact on productivity of greater managerial effort can occur in the short term unlike capital investment and innovation.

8 BETWEEN FIRM EFFECTS. MARKET SHARE REALLOCATION AND FIRM ENTRY AND EXIT

8.1 Empirical studies suggest that there is a considerable spread of productivity between firms, and that this spread can result in 'market sorting'. Market sorting is driven by competition, and can be an important source of productivity growth.

Theoretical background

8.2 Competition can lead to market sorting through a Darwinian mechanism. Efficient firms are rewarded with higher profits and/or market shares, at the expense of inefficient firms. These may be, eventually pushed out of the market, and replaced by new entrants.

8.3 Although part of the same process, 'entry and exit' and 'market share reallocation' involve slightly different considerations. Most notably, whilst barriers to entry will reduce sorting via entry and exit, they may have less of an impact on market share reallocation.

8.4 As more efficient firms become larger and the less efficient become smaller and fewer, net efficiency gains accrue to the industry at an aggregate level. These aggregate productivity gains do not require productivity gains within any individual firm (although it is likely that this process will be linked to internal productivity improvements).

Empirical evidence

The relationship between market sorting and productivity

8.5 Haskel's (2000) main findings (based on 158,000 UK manufacturing plants between 1980 and 1992) are a useful way of illustrating the processes involved in market sorting:

- Almost 45 per cent of manufacturing plants who start at the top of the productivity distribution are still there or one quintile lower a decade later. Nearly 50 per cent had actually exited, having moved down the productivity distribution.

- Over 70 per cent of manufacturing plants starting at the bottom of the productivity distribution exit within a decade. Most of the

remainder are still at the bottom ten years later. Less than one per cent of plants starting at the bottom ever make it to the top.[20]

- The productivity of each entering cohort rises and the variance of productivity falls as the poor performers exit.

The relative importance of between firm and within firm effects

8.6 There is broad consensus that between firm effects are an important driver of productivity growth. However, there is less agreement over whether their impact is greater or less than that of within firm effects.

8.7 A number of surveys find that between firm effects have a smaller effect on productivity than within firm effects:

- Scarpetta *et al.* (2002), suggest that market sorting accounts for 20-40 per cent of total productivity growth across ten OECD countries, for varying time periods in the 1980s and 1990s.

- Barnes and Haskel (2000) conduct a survey of UK manufacturing firms, using data from 1994-97. For this time period, between firm effects accounted for 33 per cent of productivity growth.

8.8 Other surveys find that between firm effects are more important than within firm effects.

- Baldwin and Gu (2006) conduct work on Canadian manufacturing over the period 1979–99. Their decompositions find a large role for between firm effects in productivity growth, attributing 70 per cent of this growth to changing market shares. They argue that many other researchers inadvertently capture the effects of market share reallocation in their within firm estimates.

- Disney, Haskel and Heden (2003)[21] reviewed UK manufacturing from 1980–92. They found that between firm effects ('external restructuring') account for roughly half of labour productivity

[20] Whilst this makes sense for individual manufacturing plants, it need not be true for small firms more generally.

[21] Rather than just looking at survivors, their use of panel data on manufacturing plants allows them to build an accurate picture of exit and entry.

growth, and 80-90 per cent of TFP growth. Over half of this latter figure comprises entry and exit.

8.9 Finally, there is also evidence to suggest that one effect need not dominate over the other.[22]

- Hahn (2000) finds that plant level entry and exit account for 45 per cent of productivity growth in an upturn and 65 per cent during a downturn, using mining and manufacturing data from Korea.

The relationship between entry and exit, and the product life cycle

8.10 The relative importance of entry and exit in driving productivity growth can vary according to where a market sits on the product life cycle. This cycle describes the process by which the introduction of a new product usually sees rapid net entry and innovation, followed by a period of contraction, and then a levelling off. (Gort and Klepper, 1982; Agarwal and Gort, 1996). During the early stages, firms compete over innovations and product designs. Once consumer preferences settle on a 'dominant design', competition shifts to price and costs. Entry is much easier for firms when competition is based on new designs rather than costs, and the entry of firms plays a crucial role at this stage in the cycle.

8.11 It follows that both entry and exit decline with age, and the latter stage of the cycle is characterised by mature firms with established economies of scale (Geroski, 1995; Caves, 1998).

8.12 The empirical findings of Scarpetta *et al.*(2002) and Brandt (2004) fit neatly with this model. They highlight the entry of firms making a higher than average contribution to productivity growth in high technology sectors, which remain at the early stages of the product life cycle. Entry and exit were found to have relatively lower effects on productivity in mature industries, and of the two it was exit that proved more significant. Mature industries rely more heavily on incumbents' investment in R&D to achieve productivity growth.

[22] See also Baldwin (1995) and Haskel (2000), both of which find that within and between firm effects each account for roughly half of productivity growth.

The relationship between entry and exit, and productivity dispersion

8.13 The relationship between entry and exit and productivity dispersion is not clear cut. High dispersion may indicate **either** a highly productive industry with competition for/in the market **or** a market with little competition. Evidence of high productivity dispersion would need to be combined with evidence of low entry and exit, or of low average productivity relative to other markets to provide an indication of low competition in an industry. There is literature that explores the relationship empirically.

8.14 High innovation levels amongst exceptional performers will result in a high dispersion caused by productivity leaders being significantly ahead of the field. Haskel and Martin (2002) and Scarpetta *et al.* (2002) provide evidence to back this possibility, observing that high productivity industries tend to have a wider dispersion of productivity levels.

8.15 Conversely, it is also possible that high dispersion could result from a long tail of inefficient firms, who are lagging behind the average levels of productivity. In this second scenario, one would expect firms at the bottom of a wide productivity dispersion to exit the industry if the Darwinian process was functioning efficiently.[23] Indeed, Disney *et al.*(2003), Oulton (1996) and Syverson (2003) provide empirical evidence suggesting that competition reduces productivity dispersion, as inefficient firms play catch up or exit.

8.16 However, high entry and exit rates of low productivity firms could maintain a long tail, but in fact be beneficial to productivity. The shedding of 'unfit' firms tends to be accompanied by the entry of new ones. Geroski (1995) observes that entry and exit involve the turnover of large numbers of firms without ever changing the total number of firms in the market significantly. Importantly, new firms deliver new technology to the market, and therefore bring the potential to increase productivity.

8.17 Nonetheless, the persistence of **the same firms** with very low productivity in an industry is likely to signify some distortion to the mechanism of entry and exit. Investigations of this kind of persistence already exist. Criscuolo, *et al.* (2004), find that 51 per cent of the firms in the lowest quintile of productivity were still there after three years for

[23] Although high sunk costs may be a significant barrier to exit.

all three years intervals between 1980 and 2000 indicating a degree of persistence across the economy. We are unaware of research to investigate whether sectors with high persistence have low overall productivity.

Implications for the OFT

8.18 The OFT consumer and competition powers help place consumers in a good position to influence the market through their spending decisions. Products that are less desirable because they are poor quality, expensive or do not perform their function properly should become unprofitable and exit the market. At the same time, firms with interesting new products or low cost technologies should be able to enter and gain market share. Anti-competitive behaviour on the part of firms could potentially prevent such beneficial entry and exit behaviour. The OFT is able to address such situations. Some tensions in tools for consumer protection and competition are highlighted in paragraph 10.18.

Implications for prioritisation

8.19 Two potential diagnostic tests that could be used for prioritising between known cases or identifying sectors for proactive work emerge from the literature.

Measuring entry and exit

8.20 Entry and exit are closely associated with both competition and productivity and can therefore serve as a useful diagnostic test for the OFT. It is possible to measure how much market penetration is achieved by entry and exit over a five year time period. It would also be valuable to assess relative rates of entry and exit against product life cycle. Unexpectedly low levels of entry and exit at early stages are potentially more costly in terms of lost productivity gains, and are more likely to be the result of a competition problem (rather than, say, high minimum efficient scales of production). Import penetration as an alternative measure of market penetration could also be used.

The impact of market sorting on survivors

8.21 It could be instructive to examine not only whether poor performing firms remain in a market over time, but whether they are able to maintain market share, or whether they are significantly marginalised.

8.22 Any decisions on prioritisation might take persistence findings into account. High productivity dispersion and long tails of inefficient firms certainly could identify problems. However, they need to be analysed further to identify whether the dispersion comes from high or low performers, and whether any tail of low performers comprises the same firms persisting over time, or high amounts of churn.

Timing of productivity gains from entry and exit

8.23 The evaluation of any intervention into a market could take into account the timing of productivity gains from entry and exit. It is widely agreed that entry and exit make minimal contributions to the productivity of an industry in the short run. This is because the productivity levels of those that exit and those that enter are usually similar before entrants get the chance to learn and grow (Caves, 1998). High rates of infant mortality show that exitors may also be recent entrants (Baldwin, 1995). Foster *et al.* (1998) note that the contribution of net entry to productivity growth varies directly with the period of time over which changes are measured. Five years is the minimum period over which a significant effect can be seen, and ten years provides an even stronger relationship (see also Baily *et al.* 1997).

9 INNOVATION

Innovation and productivity

9.1 Innovation encompasses both the technological improvements of processes (leading to cost reductions) and the creation of new products, which might displace existing ones. Innovation has traditionally been seen as the engine for growth and productivity. For example, Cameron (2003) finds that a one per cent increase in R&D (closely related to innovation) by UK manufacturing firms raised TFP by 0.2 to 0.3 per cent in the 1980s. Looking at an earlier period, Griliches (1980) finds that a one per cent increase in R&D raised TFP growth by 0.07 per cent.

Competition and innovation

9.2 The relationship between competition and innovation is complex, and conclusions differ depending on whether we are considering competition in the market or competition for the market. Competition policy has typically been characterised by a bias towards static competition. This is largely because the classic view of competition was competition in the market. Increasingly, however, competition in the markets for innovation, R&D and information/technology, and thus issues of dynamic efficiency, have played a greater role in competition policy thinking.

9.3 The challenge for a competition authority is to ensure there is sufficient incentive to innovate when (to the extent that this involves competition *for* the market) there is a risk that maintaining this incentive depresses competition *in* the market. This can be difficult, particularly in industries characterized by network effects[24] where measures such as market concentration might suggest low levels of competition, but where different systems compete rigorously to become the standard in an industry.

[24] Network externalities occur when the utility that a user derives from consumption of the good increases with the number of other agents using the good. A critical mass of users can "tip" the market to a monopoly provider. When switching costs are high, consumers can become "locked in" to a particular technology, which may represent a significant barrier to entry.

Empirical evidence

9.4 The relationship between competition and innovation involves a more theoretical debate than those concerning static effects within and between firms discussed above. Nonetheless, it should be noted that there is a wide range of empirical studies examining the links between competition, innovation and productivity.[25] On the whole these set out a positive relationship between the three, for instance:

- Looking at 4378 major innovations in the UK between 1945 and 1983, Geroski (1990) finds evidence against the hypothesis that increases in competitive rivalry decrease innovativeness.

- Blundell, Griffith, Van Reenen (1995) reveal a complex relationship between competition and innovation based on 375 firms listed on London International Stock Exchange between 1972 and 1982. Specifically, they find that dominant firms tend to innovate more and that industry concentration dampens innovative activity. However, to the extent that growing dominance increases industrial concentration the level of aggregate innovation will tend to fall.

- Griffiths, Harrison and Simpson (2006) look at the effect of the introduction of the single market in Europe on innovation and thus productivity. The single market had the immediate effect of changing mark-ups. This, in turn spurred innovation. The authors looked at industry-level effects. For example, they found that the single market programme increased R&D intensity by 0.9 per cent in the UK metal products industry, which was associated with a 0.4 percentage point increase in TFP growth. The study also indicates that, within an industry, the effect of increasing competition on innovation is larger in countries that are closer to the global technological frontier.

- Levin, Cohen and Mowery (1985) initially found a statistically significant inverted U relationship between market concentration and both R&D intensity and the rate at which innovations were introduced. However, the significance of these relationships was greatly reduced when the authors took technological opportunity and appropriability into account. These results suggest that whatever

[25] The OECD paper, Ahn (2000), is a good starting point for reviewing the theory and empirical literature up to 2000.

relationship may exist between concentration and R&D across an entire economy is largely overwhelmed by the differences among individual industries with respect to technological opportunities, demand, and the appropriability of inventions.

Pre versus post innovation rents

9.5 Schumpeter is the natural starting point for a discussion of competition and innovation. He argued that competition was not good for innovation (Schumpeter, 1942). If firms make no private gain (profit) from innovation because it is competed away they will have no incentive to undertake R&D. In order to ensure firms see a return to R&D effort, we need to ensure that other firms cannot simply copy an innovation and free ride on R&D effort. This implies that we need to guarantee a firm has a monopoly position post innovation, for instance, through a system of patents.

9.6 Arrow (1956) famously countered this idea by suggesting that the greater the pre-innovation rents, the lower the net gain resulting from any innovation. Therefore firms facing competition might be expected to have stronger incentives to innovate than monopolists who already gain monopoly rent without needing to innovate.

9.7 It is worth noting that Arrow and Schumpeter's arguments need not conflict. Schumpeter refers to competition in the post innovation market while Arrow refers to competition in the pre-innovation market. Thus, both could be true, and competition will have a different effect on the rate of innovation depending on at which stage in the innovative process is being looked at.

Models of competition and innovation

9.8 Building on the Schumpeter versus Arrow debate, a variety of models have been developed that introduce detail to the nature of competition and innovation. The models are based around the following concepts:

- **Imitation**, copying another firm's innovation, treated as one of the bases through which competition takes place, but not the only one.
- **Neck and neck competition**, in which innovation is characterised by incremental changes, known as **step by step innovation.** One firm

will make a small innovation, others will then copy, then another firm will make a small innovation.

- **Leapfrog competition,** in which innovation occurs through bigger steps through which any firm in the market can by-pass the technological leader.

- **Closeness to the technological frontier**, which considers how innovation incentives vary depending on how close firms, industries or countries are to the production possibility frontier.

9.9 Aghion, Harris, Howitt and Vickers (2000) considered the first three concepts and found an inverted U-shaped relationship between PMC and productivity.

- At low levels of competition innovation is low as there is no incentive to innovate (Arrow effect)

- At medium levels of competition innovation is high as firms try to escape competition by innovating

- At very high levels of competition innovation is reduced somewhat, as the potential gains from innovating are reduced by the number of potential imitators of any innovation (Schumpeter effect)

9.10 More specifically, in industries with neck and neck competition pre-innovation rents are low so firms innovate to escape competition. Their rivals will imitate this development and then may choose to make the next innovative step. As PMC increases the benefit to escaping competition increases so innovation rises. However, the effects of increasing ease of imitation are more complex. From a position where imitation is impossible, making imitation easier raises growth as firms can catch up with the technological leader and this forces a new innovation as they try to escape competition. When imitation is relatively easy, and continues to become easier, the incentive to innovate diminishes as the rewards from innovation will be very short-lived.

9.11 In leapfrog industries with big innovations, some competition raises growth through competition for the market and some imitation increases the pressure for change. However, high levels of imitation are detrimental

to growth, and when the market is highly competitive the Schumpeterian view of decreased incentive to innovate is thought likely to apply.

9.12 Aghion *et al.* (2006) develop a model which finds that competition in the form of the threat of entry has a positive effect on incumbent innovation incentives and productivity growth in industries initially close to the technological frontier, but not in those industries that are initially further behind the frontier.[26] The basic intuition behind this is that incumbents close to the technological frontier have incentives to innovate to escape entry while in laggard sectors the threat of entry reduces the incumbents' expected rents from innovating, as it stands little chance of winning against a potential entrant which is likely to be technologically advanced. When there is no threat of entry, firms further from the frontier are likely to grow more rapidly than firms close to the frontier in line with theories on convergence. This outcome is dependent on the existence of knowledge spillovers, including imitation.

9.13 Other models in the Arrow-Schumpeter debate separate process innovation and product innovation and predict slightly different results – competition is more likely to be good for process innovation but ambiguous for product innovation – as older product innovations still gain some monopoly profit due to product differentiation, whereas new process innovation supersedes previous innovations.

9.14 Industry characteristics and intellectual property rights such as patents can also influence these relationships. Policy to enhance competition can be positive for innovation unless a high degree of imitation is possible in the market.

Patents

9.15 Leap-frog and step by step models of innovation have differing implications for the role of patents. Schumpeter's focus on post innovation rents, and subsequent leapfrog models of innovation, provide a strong argument for intellectual property rights (IPR). The patent system aims to foster dynamic efficiency, if necessary over static

[26] The model controls for the fact that certain policy reforms such as the EU Single Market Program and competition investigations by the UK Competition Authority might have impacted the entry costs and effected the threat of entry as well as actual entry differentially across industries and time.

efficiency, by allowing for the existence and exploitation of market power within the patent in order to generate incentives for innovation.

9.16 However, there is evidence that IPR can stifle the positive effects that static competition has on innovation. Bessen and Maskin (2000) find that patents can be bad for innovation and that firms may welcome competition. The competition dissipating effect of having two (or more) firms in the market implies that patent holders will often refuse to license their innovation. This prevents other firms from competing and participating in the current market and thus from innovating in the next generation.

Implications for the OFT

9.17 The major implication from the literature is that there is no universally applicable rule for maximising the innovation in a market. Markets will tend to develop their own modes of competition/innovation. In general the policy of the OFT should be to consider whether the behaviour of incumbents is inhibiting the effective working of competition through innovation on a case by case basis, rather than imposing a view of how such competition should take place. Some of the OFT's tools can allow it to do this.

9.18 The Office of Fair Trading's submission to the OECD's Roundtable on Competition, Patents and Innovation, 2006 gave the following general principles:

- Competition policy should avoid intervention against holders of patent- protected innovation where intervention would pose a significant risk to dynamic efficiency and competition concerns are solely about static efficiency (that is, if there is no concern about the extension of market power into related markets or future periods). For example, an excessive pricing case which limited the rewards bestowed by the patent system could slow the rate of innovation, and could prove over-burdensome if the market power was temporary.

- Competition policy, conversely, should intervene if concerns are primarily about dynamic efficiency. For example, major innovations often come from small firms introducing disruptive technologies rather than from dominant firms who profit more from the status

quo. Therefore, to promote innovation, dominant firms should be prohibited from abusing their market power to impede smaller rivals who would otherwise overtake them.

- Lastly, competition policy should also be used to intervene in markets where there is no compelling dynamic case and an obvious short-run static case for doing so.

9.19 The literature also points to ways in which the OFT's work could be refined.

Information from levels of innovation

9.20 In general high levels of innovation will be indicative that a market is working well. If innovation levels are low this suggests either that the market is mature and there is little scope for innovation, or that the market is not working well. Measures of R&D expenditure, surveys of innovation activity and information on patenting allow for assessment of the level of innovation in a particular market.[27]

Volatility and innovation

9.21 Volatility of market share is considered to be an indicator that competition is working well in a market. Volatility resulting from competition for the market (through innovation) is particularly associated with productivity growth. Therefore a finding of low volatility might suggest looking at the market further could be worthwhile. If low volatility in a particular sector is combined with high dispersion in that sector, this might indicate persistence of low productivity firms, reinforcing that idea that the market is not working to cause them to improve or exit.

[27] However, there are a number of issues with different measures of innovation. R&D is only a measure of the input, and we would need to find out the productivity of the R&D itself. It must also be acknowledged that standard measures of innovative activity are considered less reliable for the service sector (NESTA, 2006). Furthermore, information on patenting needs to be used carefully as some firms use patenting strategically, and so the numbers of patents do not reflect the magnitude of innovation achieved. OECD note DAFCOMP(2006)22 discusses innovation measures and their limitations in detail.

Information on type of innovation

9.22 The literature suggests that different types of market behaviour and outcome are expected depending on whether firms are in a leapfrog situation or a neck and neck situation. Concern about a concentrated industry is lower if the market is characterised by leapfrog innovation. Indicators of leapfrog innovation include high dispersion of productivity growth rates between firms in the industry and high volatility of growth rates for individual firms.

10 EVIDENCE ON COMPETITION POLICY AND PRODUCTIVITY

10.1 As has been shown in the preceding sections, there is a voluminous literature linking competition to productivity. Far less has been done directly linking competition *policy* to productivity. This section surveys the available literature which relates directly to the tools at the disposal of the OFT.

Cartels and productivity

10.2 The impact of anti-trust policy on productivity is particularly difficult to measure because productivity effects arise over a long period of time, and it can be difficult to attribute changes in productivity to anti-trust action rather than other influences. However, the introduction of the 1956 Restrictive Practices Act has provided a neat natural experiment to test the impact of cartel policy in the UK:

- Broadberry and Crafts (2000) find that price fixing agreements were widespread prior to the 1956 Restrictive Practices Act and seem to have had an adverse effect on costs and productivity.

- Symeonidis (2003) finds strong evidence of a negative effect of collusion on labour productivity growth. Labour productivity grew more slowly in collusive industries than in non-collusive industries before the implementation of the 1956 cartel legislation. Once cartels became illegal, no significant differences between collusive and non-collusive industries existed in terms of rates of labour productivity growth.

Mergers and productivity

10.3 Assessing the impact of mergers is a complex area. The mergers that are analysed empirically are necessarily those that have been approved by a merger regime, rather than being a sample of all possible mergers. The literature provides evidence of mergers having both positive and negative effects on productivity. There is some indication that the reported effects of mergers can vary according to different types of merger, and the different methodologies used to study them.

10.4 Tichy (2001) provides a thorough review of the literature and draws common threads from it. He suggests that Merger assessment is conducted through two types of method:

- Event studies – these look at the stock market reaction to an acquisition announcement and the movement of the share prices of the separate and merged entities over a period of time. This approach was developed by Fama *et al.* (1969).

- Outcome studies – these look at the balance sheet position of the merging companies before and after the merger to quantify the impact of the merger on a number of different parameters including sales and profitability.

10.5 Event studies have generally concluded that mergers are positive for stakeholder value. Jensen and Ruback (1983) summarise 13 empirical studies and find that the targets' shareholders get abnormal returns of 20-30 per cent around the time of the announcement while bidders more or less break even. This supports the idea that acquisitions create wealth by allocating assets to more efficient management teams, thus reducing x-inefficiency and leading to productivity improvements. However, later work that extends the observation window for several years before and after the merger reaches less clear-cut conclusions. Tichy considers 43 merger studies that use extended observation windows and finds that the majority report negative abnormal returns to shareholders by 20 months after the merger. Event studies are now being developed to control for cash versus stock financing and differences in book-to-market ratio of targets.

10.6 Outcome studies have been even more sceptical of merger benefits. Tichy considers 36 outcome studies and finds,

- In most cases the target is no less efficient that the bidder, undermining the idea that the bidder will be able to 'turn the firm around' and thus improve efficiency,
- Profits are weaker post-merger for 58 per cent of studies and stronger for 11 per cent, and
- Sales are lower for 42 per cent of mergers (which suggests that the merged entity may have a degree of market power and choose to reduce output to push prices up).

10.7 These results suggest that in many cases mergers do not increase productivity. Cowling *et al.* (1980) studied the efficiency question directly for British manufacturing firms and found efficiency losses in two-thirds of cases.

10.8 However, there is also literature which finds mergers to have a positive effect. Where mergers are found to generate productivity gains, the benefits can be substantial. Baldwin and Gu (2006) survey Canadian manufacturing between 1979 and 1999. They find that on average, merger entry and divestiture exit account for 21.7 per cent of labour productivity growth over this period. Also Giandrea (2006) finds that mergers had a positive total impact on TFP, accounting for 0.36 per cent of TFP growth between census years. The efficiency gains from mergers (for instance, economies of scale, synergies in production, distribution, management and advertising) were found to outweigh the productivity costs of lessening competition (growth in x-inefficiency, greater market power).

10.9 There is also evidence which seems to suggest that the effects of mergers on productivity can vary between different types of merger. Baldwin (1995) studied Canadian firms and found productivity gains for related acquisitions and losses for unrelated ones. Furthermore, Ravenscraft and Scherer (1989) find that the most profitable mergers are between related businesses, followed by horizontal mergers and then vertical mergers with conglomerate mergers being the least profitable. As the first two types in particular carry competition implications this finding is of particular interest to the OFT.

Market studies, and productivity

10.10 As well as regulating the conduct of firms, the OFT can undertake market studies that can make recommendations to affect a wide variety of changes. Often, these studies concern entry barriers that are not erected by firms, for instance:

- The market study into taxis that found that restrictions on the number of taxi licences in certain areas significantly lowered the quality of service to customers.[28]

- Similarly, the market study into pharmacies proposed the deregulation of entry into this market to allow all registered pharmacies with qualified staff to dispense NHS prescriptions.

- The market study into public subsidies outlined the ways in which subsidies distort competition leading to reduced incentives for firms to be competitive and efficient.

10.11 This is highly significant in light of the body of literature which demonstrates that entry barriers created by government – licencing, administrative costs of startup and other regulation - have significant negative implications on productivity.

- Poschke (2006) employs a model of heterogeneous firms adopting technology on entry to explore differences in TFP between similar economies. He finds that small increases (for example, one percent of average firm output) in the administrative costs of entry, can explain 10-20 per cent of the differences in TFP between Europe and the US.

- Brandt (2004) investigates the correlation between indicators of the degree of regulation, and firm entry. Her results suggest that overly complicated licence and permit systems discourage entry. Equally, excessively long periods in which creditors have a claim over bankrupts' assets is an exit barrier, which further disincentivises entry in the first place.

- Scarpetta *et al.* (2002) arrive at similar conclusions, noting that the negative effects of product market regulation particularly hamper market access by small and medium sized firms.[29]

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[28] Although not explicitly discussed in the report, it would seem that these entry restrictions limit the scope and pressure for innovation in the sector.

[29] Indeed, they suggest that relatively lower levels of product market regulation may explain why firm entry in the US involves much smaller firms than in Europe.

10.12 With this evidence in mind, it is important to note that the UK is considered amongst the least regulated economies in the world (Card and Freeman, 2001; Nicoletti and Scarpetta, 2005). Consequently, where regulatory entry barriers do exist they are often specific to markets, rather than indicative of the general picture. Market studies are able to target such instances, and so provide an excellent tool for scrutinising their impact on consumers and competition.

Consumer policy and productivity

10.13 The link between consumer policy and productivity is less developed in economic literature, particularly from a quantitative angle. This is a notable gap in the literature, given that empowered consumers drive the competitive mechanism which, in turn, drives productivity.

10.14 One objective of competition is for firms to gain customers. Active, empowered consumers are essential to achieve the two way benefit of competition: low prices for consumers and rewards for efficient production of the goods consumers want to buy.

10.15 Consumers drive competition by choosing to buy from the firm that offers the best combination of price, quality and product style. Firms that offer the same goods at higher prices, or less innovative products lose business and are forced to change or leave the market. Consumers are thereby creating the incentives to produce efficiently and innovate.

10.16 There are a number of conditions that need to be met for this mechanism to work well:

- Consumers need to be able to enforce their contracts with producers, otherwise the confidence to make transactions will break down leading to detriment for both parties.

- Consumers need to have good information about the product that they are buying. For some products the effort required to gather information can be high and the benefit from better information uncertain so consumers do not consider it worthwhile to gather information. For other products and services consumers can only obtain information from the supplier. If this information is not credible and useful consumers either make incorrect decisions or choose not

to buy the product at all. Akerlof (1970) demonstrates how a market can break down when consumers cannot judge quality.

- The costs of switching product must not be prohibitive as suppliers know that they can mark up products significantly before it is worthwhile for consumers to switch. This dampens price competition in the market. It also becomes difficult for new firms to enter the market.[30] Cruikshank (2000) compares personal banking in which 6 per cent of consumers switched in a 12 year period with motor insurance in which 53 per cent of consumers switched. Industry concentration was significantly lower for motor insurance, as was profitability.

- On balance, consumers need to act rationally and investigate products and choose those that are the best for them. Consumers have limited ability to do this and, as a result firms that are most effective in manipulating consumers (for example, by making an offer that appears attractive and limiting consumers time to respond to it) rather than those that are most efficient, can succeed. Waterson (2003) found that in 15 months only 18 per cent of consumers had switched supplier of electricity. This behaviour by consumers (that could reflect inertia or confusion over the tariffs offered) allowed incumbents to keep prices up to £8 per month above that of an entrant without losing profit.

10.17 The OFT is able to address these issues to varying extents through its consumer law enforcement, and consumer policy activities.

Caution with consumer policy

10.18 Consumer regulation and effective competition are not always complementary. In particular regulations that set minimum standards can prevent low price/ low quality goods from being put on the market when some consumers would prefer this option. Licensing of suppliers with certain qualifications can create barriers to entry to a market which means that incumbents are placed under less pressure to be efficient.

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[30] Strictly speaking, high switching costs do not prevent consumers from making the optimal decision about what is best for themselves at a given point in time. However, significant switching costs inhibit competition in the market by deterring entry.

The OFT works with government to ensure that the effects of regulations on competition are considered when regulations are developed.

11 APPLICATION OF THE LITERATURE TO HORIZON SCANNING

Introduction

11.1 The OFT actively investigates markets that do not appear to be meeting the needs of consumers and publishes the results of these inquiries in the form of a market study.

11.2 Candidates for study are often identified through consumer complaints or OFT awareness through our enforcement activities.

11.3 As part of our work on productivity and competition we have investigated whether we can use data on this link to identify sectors which might be appropriate for further examination by the OFT.

11.4 The basic intuition is as follows:

- Effective competition should enhance productivity hence low productivity may be an indication of a lack of competition.
- Low productivity could also be as a result of constraints on the other drivers of productivity.
- We should identify low productivity sectors and test to see if they also display indications of a lack of competition.

11.5 From our research the only similar exercise that we are aware of was conducted by NERA.[31] This paper considered the use of low productivity as an indicator of a lack of competition but its empirical work was limited to comparing productivity between industries. Our intention is to take this kind of exercise further, by using a wider range of productivity indicators, and drawing on international comparisons.

11.6 This section outlines the methodology that we applied, briefly describing how we measured productivity, how we developed competition indicators and how we used this information to reach an initial view about the sectors that might warrant further examination. It then sets out some limitations with our approach.

[31] Empirical indicators for market investigations, OFT749a, 2004

Methodology

11.7 The literature reviewed for this report provides a wide range of insights into the ways in which competition, productivity and the interaction between them have been measured and analysed by researchers. We have used these insights to form the basis of a methodology which can be used to try to identify sectors which have indications of low competition and productivity.

Estimating productivity

11.8 Estimates of labour productivity and total factor productivity were generated for firms in both the manufacturing and the service sectors of the economy.

11.9 Labour productivity was calculated as either turnover per employee or gross value added at market price per employee, according to the dataset used. More sophisticated measures of labour input that take account of hours worked or skills, were not available from the datasets we were considering.[32]

11.10 Total factor productivity was calculated in the way described in Annex A. Total factor productivity allows differences in productivity levels to be considered once differences in capital and labour inputs have been taken into account. In some respects this gives us a more relevant figure for productivity as we are interested in competition driving the productivity gap, rather than differences in capital utilisation. However, competition is likely to be one factor influencing the capital stock, and so controlling for capital stock may mean missing some of the effects of competition on productivity, (though it is difficult to quantify this effect). Looking at labour productivity allows us to ask whether greater competition would effect productivity through changing the capital stock.

11.11 For the purpose of international comparisons (discussed below) we looked at productivity growth. Comparing growth rates eliminates the impact of differences in measurement of turnover and employment

[32] We have used Amadeus, a database of European financial returns, produced by Bureau Van Dyjk and the Annual Respondents Database, compiled by the Office of National Statistics, using the Annual Business Inquiry and the Inter-Departmental Business Register.

between countries.[33] It also takes out substantive differences between countries that remain the same over time. For example, if one country's working week is always shorter than another, its productivity level would appear lower, but its productivity growth could be compared. As these innate differences do not usually reflect differences in competition removing their effect from the productivity comparison is appropriate.[34]

11.12 With productivity growth comparisons over a set period, it is important to be aware that differences between countries can be driven by 'catch-up' if the productivity levels of sectors have different starting points in different countries.

11.13 Averages of labour productivity and total factor productivity were calculated for different industries. Industries were defined according to the 4 digit Standard Industrial Classification that each firm indicated was its primary business. The caveats with this definition are set out below.

Developing competition indicators

11.14 The following indicators of the level of competition in a sector were identified by our review of the literature, and employed in our data exercise.

- Market share variance
- Entry and exit
- Persistence
- Productivity dispersion.

These are discussed in turn.

11.15 **Market share variance** is measured as the average variance of firms' market shares over time, measured by sector. High variance is consistent with a story of competition for the market, with different firms winning this competition and hence market shares changing over time. Medium levels of variance could be consistent with neck-and-neck competition. This is unlikely to give rise to radical jumps in market share for most firms but should create a persistent degree of change.

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[33] A more technical discussion is included at Annex A.

[34] Looking at productivity growth could hide the effect of different productivity levels due to competition if competition in the sector remained the same in each country throughout the period. We are of the view that this is relatively unlikely.

11.16 **Entry and exit** are classical measures of competition. Low entry and exit may suggest that between-firm effects are not working to reduce inefficiency. This is because there is little entry to constrain the behaviour of firms in the market, and because incumbents are aware that the risk of being forced out the market is low. For entry and exit to be a credible threat to incumbents it needs to present a challenge of significant size.

11.17 To capture the entry and exit that is likely to have an impact on incumbents' behaviour we have used a measure of market share accounted for by entry and exit. It should be noted, however, that low entry does not always indicate a lack of competitive constraint on the firms in the market. The threat of entry, without entry actually happening, can exert some competitive pressure on incumbents. We therefore need to consider sectors identified for their low entry and exit carefully to ensure they do not experience the pressures of competition from the threat of entry.

11.18 The **persistence** of firms in the lowest productivity quintile of their sector is an indicator that the market is neither prompting within-firm growth nor causing inefficient firms to exit. For this measure we calculated the market share of firms that were in the lowest quintile for productivity two years in succession, in order to quantify the extent to which low productivity firms were able to continue as such.

11.19 **Productivity dispersion** measures the dispersion of productivity within a sector by comparing the productivity at the 90th percentile with the productivity at the 10th percentile. On its own it is an ambiguous measure, as high dispersion could be indicative of either an uncompetitive sector (where some firms have much lower productivity than others and still survive), or of a sector characterised by innovation (where the firm that has made an innovative leap has high productivity and others may make a similar leap in future). Measures of productivity dispersion are therefore useful to look at alongside market share variance and persistence to develop a view of what is happening in the sector.

11.20 As a measure for **concentration**, the Herfindahl index was computed (HHI) in the standard way (sum of squared market shares). Although this is a better measure than standard concentration indices (for example, the market share of the largest three or largest five firms in the sector) it still does not capture other dynamics within a market (for example, if new

entrants or firms exiting). In order to be able to compare HHI across industries and countries, the change in HHI averaged over the reference five years period was used.

11.21 We did not use some of the classical measures of competition such as profitability in the data analysis. Profitability is an ambiguous measure of a lack of competition because it accrues equally to highly competitive, innovative firms as well as firms benefiting from a lack of competition. We therefore considered that it could usefully be used in the more detailed analysis of sectors highlighted by the data work.

Indications of problem sectors

11.22 We developed a view of sectors where productivity might be constrained in two ways:

- We compared productivity growth between countries, and
- We looked at productivity change over time.

11.23 Bodies such as Eurostat, the Statistical Office of the European Communities and the University of Groninger compile international productivity comparisons. Productivity is measured at the more aggregate level of 2 digit SIC or higher. Ideally we would have drawn on such sources directly as they ensure consistency in the measures used and take into account relative price movements between countries. However, the information is too aggregate to infer anything about the relative productivity of the component markets, which is what we require.

11.24 To undertake international comparisons we have therefore used data from companies' accounts. Companies are required to submit returns for the countries that they operate in. We have used information on turnover, employment and tangible assets to calculate European averages for the productivity and competition variables.

11.25 By comparing a particular UK sector to its equivalent in other countries we can identify a list of sectors that the data suggests have relatively low productivity in the UK and some indications of a lack of competition. We take these sectors as a starting point for further consideration.

11.26 An alternative approach involves time examined trends in productivity and competition variables to look for adverse patterns. As previously

highlighted it makes little sense to look at snapshot of a sector without a reference point (because different industries intrinsically exhibit different levels of competition and productivity.

11.27 The next step is to look into the sectors identified by the data exercise in more detail. The link between productivity and competition is indicative that concerns might exist in these sectors, but it is important to test the results of the data exercise for two reasons:

- There may be a third factor that influences both competition and productivity in the sector. For instance, if the sector is in decline, then productivity will be low, entry will be low and there may not be much variation in market shares or market position, as firms focus on reducing costs and downsizing. Data work alone cannot place such trends into context.

- Although we have used the best data available for this work, it features a number of limitations. Reviewing the results allows us to identify instances where trends we have picked up are caused by data limitations rather than genuine productivity or competition problems.

Data limitations

11.28 We have used SIC codes as proxies for markets as this is the only way that firms associate themselves with similar firms in UK data. The main concerns arising from this are a) the SIC code may actually contain data on firms that produce different things, so are not in competition, or b) the firms that do compete in a market may be categorised into several SIC codes. Furthermore, firms may compete in international markets and UK SIC codes will only capture international competitors if they have a corporate presence in the UK.

11.29 A further problem with SIC codes is that firms have to select the code that best describes their primary activity. Some firms may be equally active in several markets but, by using primary SIC codes, all their turnover (employment and capital) is allocated to that SIC code. Further, their influence on competitors in their secondary SIC code is not taken into account in competition variables. This also raises problems if firms in the same sector are involved with different activities in other countries.

- The flow of services from firms' capital stocks is difficult to measure and there are limitations with existing measures. This may not bias our results in any particular direction, but will lead to inaccuracy in the measures.
- We have used the value of output (turnover or gross value added), rather than the volume of output in the measure productivity. This means that price rises, that do not reflect improvements in product quality, appear as increases in productivity. Conversely, price falls appear to be reductions in productivity. Clearly price rises or price falls could both occur as changes in the competitive environment. In theory it is possible to correct for this effect by dividing turnover by an index that reflects price changes for the sector. However, such indices are not available at the level of detail of our analysis.

ANNEXES

ANNEX A METHODOLOGY TO DETERMINE WHETHER PRODUCTIVITY IS LOW IN A SECTOR

ANNEX B BIBLIOGRAPHY

A METHODOLOGY TO DETERMINE WHETHER PRODUCTIVITY IS LOW IN A SECTOR

A.1 Theory suggests that if a sector exhibits weak productivity performance in terms either of productivity levels or productivity growth rates this may reflect a lack of competition. So productivity performance may be an important diagnostic for OFT. However, if it is to be of use, accurate measurement is required together with yardsticks to establish below-par performance.

A.2 Productivity can be measured in terms either of output relative to a single factor of production (most usually labour input) or relative to an aggregate of all factors of production. The latter concept, total factor productivity (TFP) can be regarded as a measure of the overall efficiency of a firm if all have access to the same technology or of technological level if all use inputs equally efficiently. Labour productivity performance may be quite closely correlated with TFP performance but is also affected by levels and rates of growth of capital per worker.

A.3 Output has to be measured in real terms. Its value measured at current prices has to be adjusted for differences in prices either over time or between countries by the use of an appropriate price index number. In principle, this should measure quality-adjusted prices. Similarly, measures of inputs should be in volume terms - for labour, numbers employed or better, if available, hours worked and for capital, a sum of past investments adjusted for depreciation and capital-goods prices.

A.4 In looking for productivity yardsticks, the aim is to establish what is a feasible productivity performance with which to compare actual productivity outcomes. Comparisons might be made within sectors, across industries or with the equivalent sector in other countries. Since capital intensities and technological possibilities differ across sectors, the best yardsticks are typically to be found by comparisons between producers within a sector or by finding international comparators for a sector.

A.5 Productivity performance is likely to be affected by short-term factors which affect the degree of capacity utilization or move the sector away from long-run equilibrium. Thus, apparently poor productivity performance in the short term may reflect inability to adjust fixed factors of production. Similarly, retention of labour in downturns may be

economically rational but will impart a pro-cyclical component to labour productivity.

A.6 This raises the issue of how to define a sector. In practice, this is determined by data availability and the finest level of disaggregation is typically 4-digit SIC. This may well be more highly aggregated than is really desirable both because it covers heterogeneous activities and also because it is broader than the appropriate definition of a market as defined for the purposes of a competition investigation. 4-digit SIC level is, however, a much lower level of aggregation than that at which analyses of productivity performance are usually conducted and data-availability constraints are quite serious. The main data sources at this level of disaggregation are AMADEUS based on company accounts and allowing some international comparisons and ARD based on establishment data from the UK Censuses of Production.

A.7 Imperfect competition poses severe problems for TFP measurement. This is clearly an important issue if TFP performance is to be a criterion for OFT investigations which will be into imperfectly competitive markets. The problem is not only that mark-ups of price over marginal cost inflate the value of output but that they also imply that factor shares will no longer be unbiased measures of the output elasticities.

Labour Productivity

a) Levels

A.8 Standard measurement at 4-digit SIC is in terms of gross output (sales) per employee or value added per employee. These calculations can be made using either AMADEUS or ARD.

A.9 Interpretation of the results is not entirely straightforward. High levels of labour productivity may reflect either high capital per worker and/or market power rather than a high efficiency level. Additionally high labour productivity measured in terms of gross output may reflect large use of intermediate goods. Conversely, low levels of productivity (even negative value-added) may be observed in the context of adverse shocks.

A.10 The problem of short-term disturbances implies that it is desirable to average over some years which has the disadvantage that productivity signals become clear only with a lag. The problem of variations in capital

intensity is best addressed by turning to measurement based on TFP. The problem of market power requires adjusting output for the mark-up of prices over costs. The mark-up can be defined as value added/(labour costs + capital costs) which can be calculated if an assumption is made about the normal rate of return and the size of the capital stock can be estimated (Griffith *et al.* 2006, pp. 114-5).

A.11 International comparisons of labour productivity levels require output originally measured in different currencies to be converted into a common monetary unit. It is generally accepted that a purchasing power parity exchange rates rather than the market exchange rate is the appropriate way to do this. It is also generally accepted that the purchasing-power-parity exchange rate is sector-specific. Such measures are not available for 4-digit SIC sectors. Constructing PPP exchange rates is a very time-consuming task which involves difficult judgements about quality of output and index number problems. So sectoral yardsticks for labour productivity levels are difficult to establish.

b) Growth Rates

A.12 Measuring productivity performance in terms of growth rates rather than levels has some definite advantages but requires appropriate price indices at 4-digit level to deflate current output. In particular, if sector rankings in terms of productivity growth are to be examined, it is important to recognize that prices have recently been falling in manufacturing and rising in services. Price-index information for service sectors is less complete.

A.13 If market power and use of intermediates do not vary much over time, growth rate calculations will be unaffected by these factors even when they matter for levels comparisons. Moreover, differences in sectoral labour productivity growth rates are likely to be closely correlated with differences in TFP growth rates. The relation between the two is as follows:

$$\frac{\partial\left(\frac{y}{L}\right)}{\left(\frac{y}{L}\right)} = (1-\alpha)\frac{\partial\left(\frac{K}{L}\right)}{\left(\frac{K}{L}\right)} + TFPgrowth$$

A.14 So TFP growth is a subset of labour productivity growth and the impact of differences in capital-deepening is multiplied by (1 - α), the elasticity of output with respect to capital (on average about 0.3).

A.15 Interpretation of differences in labour productivity growth rates by sector across countries ideally requires information on labour productivity levels measured at the PPP exchange rate in order to take account of the role of catch-up and convergence. Slower productivity growth than in the comparable sector abroad would generally be a poor outcome if the level of productivity is lower at home and there is scope to catch up the foreign country but not necessarily if the initial productivity level was higher and the foreign country is catching up. In the UK context, however, if comparisons are made with countries like France or the United States, we know that in general UK levels of real output per hour worked are lower, so a lower labour productivity growth rate in the UK industry is prima facie evidence of inferior productivity performance.

Total Factor Productivity

a) Levels

A.16 Total factor productivity is calculated taking into account all relevant measurable inputs. If output is measured in terms of value added these will include, at a minimum, capital and labour and, if output is measured in terms of gross output, inputs will also include intermediates. The key requirement to measure TFP apart from data on inputs and outputs is an estimate of the elasticity of output with respect to capital and with respect to labour - or put differently, TFP can only be estimated by specifying the production function.

A.17 The most common approach is to assume that the production function is Cobb-Douglas:

$$Y = AK^{1-\alpha}L^{\alpha}$$

which implies that A, the level of TFP, can be derived from the formula

$$log A = log Y - (1 - \alpha) log K - \alpha log L$$

A.18 If this formula is applied to a case with perfect competition and constant returns to scale, then factor shares (shares of profits and wages in income) are valid estimates of the output elasticities.

A.19 Disney *et al.* (2003) offers a full description of practical details of calculating TFP at the establishment level for manufacturing sectors from ARD using the equivalent formula for gross output. Establishments can then be summed to obtain industry measures. The main issues are how to obtain capital stock estimates (described in detail) and availability of price deflators at 4-digit level. Capital stock estimates rely on implementing a perpetual inventory method using data on investment from ARD, assumed depreciation rates and initial stocks. Replicating this approach for services may be more difficult.

A.20 Obtaining estimates of TFP levels from AMADEUS is more problematic and probably has to be based on value added. Capital stocks would have to based on 'tangible assets' and factor shares on employee compensation and value added minus employee compensation. Negative value added poses a problem at least at the firm level. International comparisons of TFP levels at SIC 4-digit level using PPP exchange rates are not available at present.

A.21 Imperfect competition poses severe problems for TFP measurement and this is clearly an important issue if TFP performance is to be a criterion for OFT investigations which in the nature of things will be in imperfectly competitive markets. The problem is not only that mark-ups of price over marginal cost inflate the value of output but that they also imply that factor shares will no longer be unbiased measures of the output elasticities, see below.

b) Growth Rates

A.22 Applying the standard Cobb-Douglas approach allows the rate of TFP growth, θ, to be derived from the formula

$$\frac{\partial y}{y} = (1-\alpha)\frac{\partial K}{K} + \frac{\alpha \partial L}{L} + \theta$$

where α and (1 – α) are, as before, the factor shares, $w\frac{L}{p}y$ and $r\frac{K}{p}y$, respectively. The data requirements to make this calculation are as before and can be met from the ARD database and AMADEUS subject to the qualifications discussed earlier.

A.23 However, in the presence of imperfect competition the above formula is biased. Following Oliveira-Martins *et al.* (1996) let marginal cost be approximated by the expression

$$\text{MC} = \frac{(w\partial L + r\partial K)}{(\partial y - \theta y)}$$

which can be rearranged as follows

$$\frac{\partial Y}{Y} = \left(w\frac{L}{MC}y \right)\frac{\partial L}{L} + \left(r\frac{K}{MC}y \right)\frac{\partial K}{K} + \theta$$

A.24 This shows that the standard formula is only valid if p = MC, that is, under perfect competition. More generally, the formula should be re-written as

$$\frac{\partial y}{y} = (1 - \mu\alpha)\frac{\partial K}{K} + \mu\alpha\frac{\partial L}{L} + \theta$$

where $\mu = \frac{p}{MC}$. So the factor share of labour needs to be inflated by the mark-up and that of capital reduced accordingly. Since, generally speaking the capital stock grows faster than the labour force, the implication is that under imperfect competition the standard formula tends to underestimate TFP growth, possibly quite substantially, because capital gets too big a weight.

A.25 Conventional measurement of TFP growth as above is by the primal method, (in terms of quantities of output and of inputs). TFP growth can also be calculated by the dual method, (in terms of prices of output and of inputs). The dual method standard formula is

$$\theta = \frac{\alpha\partial w}{w} + (1 - \alpha)\frac{\partial r}{r} - \frac{\partial p}{p}$$

A.26 If the information exists to compute both the primal and the dual measures, then comparing the two allows the derivation of a measure of the mark-up and thus correction of the conventional primal TFP growth calculation. Roeger (1995, p. 321) shows that

$$\theta_{\text{primal}} - \theta_{\text{dual}} = \frac{B\partial x}{x}$$

where B = $1-\frac{1}{\mu}$ and $\frac{\partial x}{x}=\left(\frac{\partial y}{y}-\frac{\partial k}{k}\right)+\left(\frac{\partial p}{p}-\frac{\partial r}{r}\right)$

A.27 In principle, this approach can solve the problem of estimating TFP growth under imperfect competition but in practice it is too data demanding at the 4-digit SIC level. This suggests that any correction factor applied to the factor shares may have to be imposed by assuming a normal rate of return to capital. This may also argue for caution in giving TFP growth more weight than labour productivity growth which can be observed using fewer assumptions.

B BIBLIOGRAPHY

Ahn, S. (2000), 'Competition, innovation and productivity growth: a review of theory and evidence', *OECD Economics Department Working Papers.*

Ahn, S. (2001), 'Firm Dynamics and Productivity Growth: A Review of Micro Evidence from OECD Countries', *OECD Economics Department Working Papers*, No. 297.

Agarwal, R. and Gort, M. (1996), 'The Evolution of Markets and Entry, Exit and the Survivalof Firms', *Review of Economics and Statistics*, 78(3).

Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2002), 'Competition and Innovation: An Inverted U Relationship', *NBER Working Paper*, No.9269.

Aghion, P. and Howitt, P. (1992), 'A model of growth through creative destruction', *Econometrica*, Vol. 60.

Aghion, P. and Schankerman, M. (2000), 'A model of market-enhancing infrastructure', mimeo. *CEPR Discussion Paper,* No. 2462.

Akerlof, G. A. (1970), 'The Market for 'Lemons': Quality Uncertainty and the Market Mechanism', *Quarterly Journal of Economics*, Vol. 84, No. 3.

Audretcsh, D. and Mahmood, T. (1995), 'New Firm Survival: New Results Using a Hazard Function', *Review of Economics and Statistics*, Vol. 73.

Baily, M. N., Bartelsman, E.J., and Haltiwanger, J. (1997), 'Labour Productivity: Structural Change and Cyclical Dynamics', *NBER Working Paper Series*, No. 5503.

Baldwin, J. R. (1995), *The Dynamics of Industrial Competition*, Cambridge.

Baldwin, J. R. and Gu, W. (2006), 'Competition, Firm Turnover and Productivity Growth, *Economic Analysis (EA)', Research Paper Series*, No. 042.

Barnes, M. and Haskel, J. (2000), 'Productivity in the 1990s: evidence from British plants', *mimeo*.

Bean, C. R. and Crafts, N., 1995. 'British Economic Growth Since 1945: Relative Economic Decline … and Renaissance?' *CEPR Discussion Papers 1092*.

Blanchflower, D. and Machin, S. (1996), 'Product market competition, wages and productivity: international evidence from establishment-level data', *Centre for Economic Performance*, Discussion paper No. 286.

Bloom, N. and Van Reenen, J. (2006). 'Measuring and Explaining Management Practices Across Firms and Countries', *NBER Working Paper,* No. 12216.

Blundell, R., Griffith, R. and Van Reenen, J. (1995), 'Dynamic count data models of technological innovation', *Economic Journal*, 105.

Boeri, T. and Bellmann, L. (1995), 'Post-entry behaviour and the cycle: evidence from Germany', *International Journal of Industrial Organization*, Vol. 13.

Bottasso, A. and Sembenelli, A. (2001), 'Market power, productivity and the EU single market program: evidence from a panel of Italian firms', *European Economic Review*, 45.

Bourles, R. and Cette, G. (2005), 'A Comparison of Structural Productivity Levels in the Major Industrialised Countries', *OECD Economic Studies*, 41.

Boylaud, O. (2000), 'Regulatory reform in road freight and retail industry', *OECD Economics Department Working Paper,* No. 255.

Brandt, N. (2004), 'Business Dynamics, Regulation and Performance', *OECD STI Working Paper Series*, DSTI/DOC(2004)3.

Broadberry, S. and Crafts, N (2001), 'Competition and Innovation in 1950's Britain', *Business History*, 43.

Caballero, R.J. and Hammour, M.L. (1996), 'On the timing and efficiency of creative destruction', *Quarterly Journal of Economics*, 111.

Cameron, G. (1998), 'Innovation and growth: A survey of the empirical evidence', *mimeo*.

Cameron, G. (2003), 'Why did UK manufacturing productivity growth slow down in the 1970s and speed up in the 1980s?' *Economica*, Vol. 70.

Card, D. and Freeman, R. B. (2002), 'What Have Two Decades of British Economic Reform Delivered?' *NBER Working Papers,* 8801.

Carlin, W. and Horváth, R. (2000), 'Competition, performance and policy in transition economies: what are the connections?', *mimeo*, UCL.

Caves, R. E. (1998), 'Industrial organization and new findings on the turnover and mobility of firms', *Journal of Economic Literature*, Vol. 36:4.

Cincera, M. and Galgau, O. (2005), 'Impact of market entry and exit on EU productivity and growth performance', *European Economy,* European Commission*,* Directorate General Economic and Financial Affairs, Economic Papers No. 222.

Cowling, K., Stoneman, P., Cubbin, J., Cable, J., Hall, G., Dornberger, S. and Dutton, P. (1980), *Mergers and Economic Performance,* Cambridge University Press.

Crafts N., and O'Mahony, M. (2001), 'A perspective on UK productivity performance'. *Fiscal Studies*, Vol. 22, No. 2.

Crafts, N. and Mills, T.C. (2001), 'TFP Growth in British and German Manufacturing, 1950-96', *C.E.P.R. Discussion Papers.*

Crafts, N. (2006), 'Regulation and productivity performance' Oxford *Review of Economic Policy*, Vol. 22, No. 2.

Cruikshank, D. (2000), 'Competition in UK Banking: A report to the chancellor of the exchequer', *HM Stationary Office.*

Davies, S. and Majumdar, A. (2002), 'The development of targets for consumer savings arising from competition policy', *Office of Fair Trading Economic Discussion Paper 4.*

Department of Trade and Industry (2003), 'Competing in the global economy. The innovation challenge', *DTI Economics Paper,* No. 7.

Department of Trade and Industry (2006) 'UK Productivity and Competitiveness Indicators 2006', *DTI Economics Paper,* No. 17.

Disney, R., Haskel, J. and Heden, Y. (2003), 'Restructuring and Productivity Growth in UK Manufacturing', *Economic Journal*, 113.

Doms, M., Dunne, T. and Roberts, M.J. (1995), 'The Role of technology use in the survival and growth of manufacturing plants', *International Journal of Industrial Organization*, Vol. 13, No. 4.

Ehrlich, I., Gallais-Hammono, G., Liu, Z. and Lutter, R. (1994), 'Productivity growth and firm ownership: an analytical and empirical investigation', *Journal of Political Economy*, Vol. 102, No. 5.

ESRC (2004), 'The UK's Productivity Gap: What research tells us and what we need to find out' *ESRC Seminar Series, Mapping the public policy landscape*.

Fama, E. F., Fisher, L., Jensen, M. C. and Roll, R. (1969) 'The adjustment of stock prices to new information', *International Economic Review,* Vol. 10, No. 1.

Foster, L., Haltiwanger, J.C. and Krizan, C.J. (1998), 'Aggregate productivity growth: lessons from microeconomic evidence', *NBER Working paper,* No.6803.

Geroski, P. (1990), 'Innovation, Technological Opportunity, and Market Structure', *Oxford Economic Papers*, Vol.42.

Geroski, P. (1995), 'What do we know about entry?', *International Journal Of Industrial Organization*, Vol. 13

Geroski, P., Machin, S. and van Reenen, J. (1993), 'The profitability of innovating firms', *RAND Journal of Economics*, Vol. 24, No. 2.

Giandrea, M.D. (2006), 'Industry Competition and Total Factor Productivity Growth', *BLS Working Papers*, No. 399.

Gort, M. and Sung, N. (1999), 'Competition and productivity growth: the case of the US telephone industry', *Economic Inquiry*, Vol. 37, No. 4.

Greene A. and Mayes D. (1991), 'Technical Inefficiency in Manufacturing Industries', *The Economic Journal*, 101.

Griffith, R. (2001), 'Product market competition, efficiency and agency costs: an empirical analysis', *IFS Working Papers, W01/12.*

Griffith, R., Harrison, R., Haskel, J. and Sako, M. (2003), 'The UK Productivity Gap and the Importance of the Service Sectors', *Advanced Institute of Management (AIM),* Briefing Note.

Griffith, R. and Harrison, R. (2004), 'The link between product market reform and macro-economic performance', *European Commission Economic Papers.*

Griffith, R., Harrison, R. and Simpson, H. (2006), 'The Link Between Product market Reform, Innovation and EU Macroeconomic Performance', *European Economy Economic Papers* No. 243.

Griliches, Z. (1980),'R&D and productivity: econometric results and measurement issues' in Stoneman, P. (ed.), (1995) *Handbook of the economics of innovation and technological change,* Blackwell Publishing.

Griliches, Z. and Regev, H. (1995), 'Firm productivity in Israeli industry, 1979-1988', *Journal of Econometrics*, Vol. 65.

Hahn, C.H. (2000), 'Entry, exit, and aggregate productivity growth: micro evidence on Korean manufacturing', *OECD Economics Department Working Paper,* No. 272.

Haskel, J. (1991), 'Imperfect Competition, Work Practices and Productivity Growth', *Oxford Bulletin of Economics and Statistics*, vol. 53(3).

Haskel, J. (2000), 'What raises productivity? The microeconomics of UK productivity growth', *Queen Mary, University of London Research Paper,* draft paper.

Haskel, J. and Martin, R. (2002), 'The UK Productivity Manufacturing Spread', *CeRIBA*.

Hay, D.A. and Liu, G.S. (1997), 'The efficiency of firms: What difference does competition make?', *The Economic Journal*, 107.

Hicks, J.R. (1935), 'Annual Survey of Economic Theory: The Theory of Monopoly', *Econometrica*, Vol.3.

HM Treasury (2000), 'Productivity in the UK 1: the evidence and the Government's approach', *HM Stationary Office*.

HM Treasury (2004), 'Productivity in the UK 5: benchmarking UK productivity performance', *HM Stationary Office*.

HM Treasury (2006), 'Budget Report', *HM Stationery Office*.

HM Treasury (2006), 'Trend Growth: new evidence and prospects', *HM Stationary Office*.

Høj, J., Kato, T. and Pilat, D. (1995), 'Deregulation and privatisation in the service sector', *OECD Economic Studies*, No. 25.

Hopehayn, H.A. (1992), 'Entry, exit and firm dynamics in long run equilibrium', *Econometrica*, 60(3).

Hortaçsu, A. and Syverson, C. (2006), 'Cementing relationships: Vertical Integration, foreclosure, productivity and prices', *Center for Economic Studies research paper*, CES06-21.

Jensen, M. and Meckling, W. (1976), 'Theory of the firm: Managerial behaviour, agency costs, and capital structure', *Journal of Financial Economics, 3.*

Jensen, M. C. and Ruback, R. S. (1983), 'The Market for Corporate Control: The scientific evidence', *Journal of Financial Economics,* Vol. 11.

Jovanovic, B. (1982), 'Selection and the evolution of industry', *Econometrica*, Vol. 50, No. 3.

Klepper, S. (1996), 'Entry, exit, growth and innovation over the product life cycle', *American Economic Review*, Vol. 86, No. 3.

Levin, R., Cohen, W. and Mowery, D. (1985), 'R&D Appropriability, Opportunity and Market Structure: New Evidence on Some Schumpeterian Hypotheses', *American Economic Review Proceedings, 20*.

Mata, J., Portugal, P. and Guimarães, P. (1995), 'The survival of new plants: start-up conditions and post-entry evolution', *International Journal Of Industrial Organization*, Vol. 13.

Machlup, F. (1967), 'Theories of the Firm: Marginalist, Behavioural, Managerial', *American Economic Review, 57.*

Maher, M. and Wise, M. (2005), 'Product Market Competition and Economic Performance in the United Kingdom', *OECD Working Paper.*

Møllgaard, P. and Lorentzen, J. (2005), 'Competition policy and innovation', *Copenhagen Business School Working Paper,* 9-2005.

Nalebuff, B. and Stiglitz, J. (1983), 'Information, Competition and Markets', *American Economic Revue, Papers and Proceedings,* 73.

NERA (2004), *Empirical indicators for market investigations*, OFT749a.

NESTA (2006), 'The Innovation Gap: Why Policy Needs to Reflect the Reality of Innovation in the UK', *NESTA*.

Nicoletti, G. & Scarpetta, S. (2005), 'Product Market Reforms and Employment in OECD Countries', *OECD Economics Department Working Papers, 472.*

Nickell, S.J. (1996), 'Competition and Corporate Performance ', *Journal of Political Economy*, Vol. 104.

Nickell, S.J., Nicolitsas, D. and Dryden, N. (1997), 'What Makes Firms Perform Well?', *European Economic Review*, Vol. 41.

Nicoletti, G. (2001), 'Regulation in services: OECD patterns and economic implications', *OECD Economics Department Working Paper,* No. 287.

Nicoletti, G., Scarpetta, S. and Boylaud, O. (1999), 'Summary indicators of product market regulation with an extension to employment protection legislation', *OECD Economics Department Working Paper,* No. 226.

Norbäck, P., Persson, L. and Vlachos, J. (2006), 'Entrepreneurial Innovations, Competition and Competition Policy', *Research institute of industrial economics Working Paper*, No. 670.

Nordhaus, W. D. (2004), 'Schumpeterian Profits in the American Economy: Theory and Measurement', *NBER Working Paper,* No. 10433.

Office of Fair Trading (2006), 'UK submission to the OECD's Roundtable on Competition, Patents and Innovation'.

OECD (2002), *Economic Outlook,* No. 72.

OECD (2003), *The Sources of Growth in OECD Countries*.

Olley, S. G. and Pakes, A. (1996), 'The Dynamics of Productivity in the Telecommunications Equipment Industry', *Econometrica,* 64(6).

Oliveira-Martins, J., Scarpetta, S. and Pilat, D. (1996), 'Mark-Up Pricing, Market Structure and the Business Cycle', *OECD Economic Studies*, 27(2).

O'Mahony, M. and de Boer, W. (2002), 'Britain's relative productivity performance: Updates to 1999', *National Institute of Economic and Social Research.*

Oulton, N. (1996), 'Competition and the dispersion of labour productivity amongst UK companies', *NIESR discussion paper,* no. 103.

Oulton, N. (1999), 'A tale of two cycles, Closure Downsizing and Productivity Growth in UK Manufacturing, 1973-89', *NIESR Discussion Paper,* 140. (August 1998, revised October 1999).

Pilat, D. (1996), 'Competition, productivity and efficiency', *OECD Economic Studies,* No. 27.

Poshke, M. (2006), 'The regulation of entry and aggregate productivity', *EUI Working Papers,* ECO No. 2006/21.

Ravenscraft, D. J. and Scherer, F. M. (1989), 'The profitability of mergers', *International Journal of Industrial Organisation,* Vol. 7.

Roeger, W. (1995), 'Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures ? Estimates for US Manufacturing', *Journal of Political Economy*, 103.

Romer, P.M. (1990), 'Endogenous technological change', *Journal of Political Economy* 98(5), Part 2.

Scarpetta, S., Hemmings P., Tressel, T. and Woo, J. (2002), 'The Role of Policy and Institutions for Productivity and Firm Dynamics: Evidence from Micro and Industry Data', *OECD Economics Department Working Papers,* No.329.

Schmidt, M.K. (1997), 'Managerial Incentives and Product Market Competition', *Review of Economic Studies*, 64.

Schumpeter, J.A. (1934), *The theory of economic development*, Harvard University Press.

Symeonidis, G. (2003), 'The effects of competition on wages and productivity: evidence from the UK', *mimeo*.

Syverson, C. (2003), 'Product substitutability and Productivity Dispersion', *Review of Economics and Statistics*, 86.

Tichy, G. (2001), 'What do we know about success and failure of mergers?', *Journal of Industry, Competition and Trade,* 1:4.

Vickers, J. (1995), 'Concepts of Competition' *Oxford Economic Papers*, vol.47(1).

Vives, X. (2004), 'Innovation and Competitive Pressure', *CEPR Discussion Papers,* 4369.

Warzynski, F. (2001), 'Did tough antitrust policy lead to lower mark-ups in the US Manufacturing industry?', *Economics Letters,* 70.

Waterson, M. (2003), 'The role of consumers in competition and competition policy', *International Journal of Industrial Organisation*, 21.

Wolff, E.N. (1999), 'The productivity paradox: Evidence from indirect indicators of service sector productivity growth', *Canadian Journal of Economics,* 32 (2).