

Competition and Concentration: Charting the Faultlines

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This work addresses the widespread concern that the forces of competition are weakening worldwide. Much of the evidence for this comes from traditional concentration indices which are notoriously flawed: conceptually they derive from static theory and cannot discriminate between efficiency and market power; empirically, they employ over-aggregate market definitions and ignore international competition. This paper is the first in a programme of research with the objective of resolving some of these problems. The first part of the paper provides a succinct picture of the facts on the HHI index for over 300 UK industries at the 4-digit-level; given data constraints, these refer to producer concentration, ignoring imports and exports. We find that, on average, concentration rose steadily 1998-2011 and remained high thereafter, 2011-2018. About 30% of industries, defined at the 4-digit level, can be classified as “concentrated” or “highly concentrated” using traditional competition authority definitions. In the second part, we provide some indications of how this picture will likely change if we could recompute concentration indices at the more appropriate Anti-Trust Market level and incorporating information on trade competition and exports. High concentration is likely to be even more prevalent at the ATM level, but results might look very different for the sub-set of trade-intensive industries, if we could incorporate trade data into the concentration measures. In the third part, we turn to the major conceptual problem: how to measure competition avoiding the identification problems associated with concentration indices and incorporating a richer dynamic vision of competition as a process. Using an admittedly primitive measure (based on the persistence of leadership rankings within an industry), our early results suggest an increasing tendency for the largest firms to retain their leadership positions over this period. This points to reduced churn in market shares and weakening competition, especially as leadership persistence is found to be more pronounced in more concentrated industries.

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Abstract

This work addresses the widespread concern that the forces of competition are weakening worldwide. Much of the evidence for this comes from traditional concentration indices which are notoriously flawed: conceptually they derive from static theory and cannot discriminate between efficiency and market power; empirically, they employ over-aggregate market definitions and ignore international competition. This paper is the first in a programme of research with the objective of resolving some of these problems. The first part of the paper provides a succinct picture of the facts on the HHI index for over 300 UK industries at the 4-digit-level; given data constraints, these refer to producer concentration, ignoring imports and exports. We find that, on average, concentration rose steadily 1998-2011 and remained high thereafter, 2011-2018. About 30% of industries, defined at the 4-digit level, can be classified as “concentrated” or “highly concentrated” using traditional competition authority definitions. In the second part, we provide some indications of how this picture will likely change if we could recompute concentration indices at the more appropriate Anti-Trust Market level and incorporating information on trade competition and exports. High concentration is likely to be even more prevalent at the ATM level, but results might look very different for the sub-set of trade-intensive industries, if we could incorporate trade data into the concentration measures. In the third part, we turn to the major conceptual problem: how to measure competition avoiding the identification problems associated with concentration indices and incorporating a richer dynamic vision of competition as a process. Using an admittedly primitive measure (based on the persistence of leadership rankings within an industry), our early results suggest an increasing tendency for the largest firms to retain their leadership positions over this period. This points to reduced churn in market shares and weakening competition, especially as leadership persistence is found to be more pronounced in more concentrated industries.

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1 Introduction

Recent years have seen an upsurge of research/policy interest, initially in the US but increasingly worldwide, in the question of whether the intensity of competition in markets has been waning. The majority of the literature suggests that it has, although this is contested by a significant minority. There has been similar interest in the UK and this has alerted the attention of Government Departments and Agencies. For example, the Competition and Markets Authority (CMA) produced a report (2020) on “The State of Competition in the UK”, and it seems likely that this will become a regular event.

However, there are serious doubts, both technical and conceptual, about one of the key metrics used to measure and represent “competition”, namely the traditional index of concentration, such as the HHI index or a concentration ratio.

Some of these doubts relate to largely technical/practical data problems: here we will focus on two - each can be viewed as a dimension of market definition, broadly defined. The first is an aggregation question: although public databases in the UK and elsewhere are vastly more detailed and granular than they were even 10-20 years ago, the level of industry definition for which data are published is generally far too aggregate to correspond to the finely defined Anti-Trust Market (ATM) in which competition does or does not take place. The second is a blurred distinction between the industry and the market. Typically, data relate to firms’ turnover from domestic output – production at the “industry” level, but competition takes place within the market rather than the industry. Especially for trade-reliant countries, competition from imports matters, and quite often a sizeable proportion of the home firms’ turnover is exported and therefore has no direct impact on competition within the domestic market. Ideally, we need to know about **seller** concentration in the home market, rather than **producer** concentration in the home industry.

While the above problems would disappear in a world of perfect data, there is another conceptual, and bigger, problem which is whether concentration, even appropriately measured, can ever accurately reflect the intensity of competition in a market? This more fundamental issue recalls, in part, the familiar endogeneity problem issue which first appeared with the Structure-Conduct-Performance/Chicago debates of 50 years ago and has remained ubiquitous ever since. Is high concentration necessarily indicative of competition-dampening market power, or is it instead the consequence of intense rivalry with large market shares the reward for innovation and efficiency? Either way, it is now widely accepted by IO economists that concentration should be handled as an endogenous variable, and one which does not necessarily map monotonically into levels of

competition. But there is another dimension, which in some ways calls for a more radical re-think. This derives from the view that competition cannot be captured satisfactorily by a snapshot of concentration taken at a point in time, or even comparison of a sequence of snapshots taken at different points in time. Rather, what matters is the process of competition and how it impacts on the “churn” of market shares and persistence, or otherwise, of leadership/dominance within the market. Viewed in this, perhaps Schumpeterian, way, evidence of healthy competition would be a continual rise and fall, ebb and flow in the market shares of different firms within the industry, as well as entry into/exit from it. Although such doubts are neither new nor seriously contested in the academic literature of competition policy, they have been largely ignored in most of the recent empirical studies assessing the state of competition both in the UK and elsewhere.

The present paper is the first of a sequence within a research programme designed to address the above problems. It is not motivated by any sub-text or priors, designed to undermine or support the view that the forces of competition have been on the decline. On that big question, we have an open mind. Nor shall we argue that measures of concentration are totally irrelevant metrics. However, what is true is that they are not really fit for purpose as currently used in this debate. So the ultimate objective of this programme is to design empirical methodologies and structural measures capable of providing a more focussed and nuanced picture of the state of competition. While this objective is general and applicable to any country in any time period, it will be illustrated using evidence from the UK since 1998.

Given the largely ground-clearing role of this first paper, its tone is non-technical and the evidence is presented in a descriptive way, pending more analytically framed future papers. Section 2 surveys the relevant recent literatures. Section 3 presents our results on the current state and evolution of concentration in the UK 1998-2018. This is based on the ONS Business Structure Database (BSD) and parallels similar recent studies using the same database, albeit with minor differences in sample selection and a wider set of questions we ask of the concentration data. In a nutshell, we find that typical industry concentration rose steadily up until 2011 and remained broadly unchanged thereafter. In itself, this is not a new finding, although we go further than previous studies in showing that increased concentration appears to have occurred typically at the expense of smaller firms, while middle sized firms largely maintained their share. We also show, applying yardsticks conventionally associated with “concentrated” and “highly concentrated”, that a significant and increasing number of industries are exceeding these yardsticks. This is true even for the very aggregate 4-digit industry definitions used here, which will likely under-represent concentration at the ATM level. (see below.)

This establishes the “facts” regarding concentration in the UK, without addressing any of the above problems. Sections 4 to 6 present our initial explorations of what these results might mean, respectively: for concentration measured at a more appropriate ATM level; the concentration of sellers, taking account of international trade; and more dynamic measures of competition. These sections are necessarily speculative pending the collection and analysis of more appropriate data, but preliminary results suggest future findings are likely to be revealing. Almost certainly, concentration levels will be typically be much higher at the ATM level (section 4). On the other hand, we cannot exclude the possibility that this picture may be reversed by the impact of imports and exports, at least in the trade-intensive industries (section 5). In section 6, using an admittedly primitive dynamic indicator, it appears that this too points to declining competition and, at least for a significant subset of industries, high concentration goes hand-in-hand with the absence of much churn in the rankings of leasing firms. Section 7 concludes and sketches out future plans.

2 Survey of Literature

In essence, this research is motivated by two controversies, one dating back to the 1960s but still not satisfactorily resolved to date, the other very topical and of intense policy relevance. Both relate to one of the fundamental questions in Economics: how should we conceptualise and measure competition? In particular, is the extent of concentration of firms within a market a defensible measure of the intensity of competition?

The older controversy first emerged in the field of competition economics and industrial organisation (IO) as early as the 1960/70s. According to the Structure-Conduct-Performance paradigm, high concentration (with a few large suppliers dominating the market) leads to soft competition and perhaps collusion. The counter claim of the Chicago school was that concentration is often the result of intense competition where winner(s) acquire dominant shares because they are more efficient. The Game Theoretic revolution of subsequent decades reinforced our understanding that the level of concentration is endogenous to the oligopoly game and is therefore not an unambiguous indicator of competition. The ambiguity remains to this day, with a widespread unease about how to interpret concentration, although it is still frequently used in practice, for example as an initial screen by competition authorities when conducting case investigations. Perhaps the consensus view is that high concentration is indeed, in some cases, a signal of dominant firms who have successfully dampened competition, but, in others, the concentration is a consequence of cutthroat competition between firms involving innovation (broadly defined) as well as price. This is not to deny that concentration is potentially an important indicator, but that it should be combined

with some other indicator which enables us to distinguish between these two polar alternative explanations. Demsetz (1973) famously advocated the use of intra-industry comparisons of margins as a tie-break: if high concentration is associated with collusion, all firms in the industry should enjoy high margins, but if it is driven by efficiency then only the largest firms should enjoy the higher margins. However, this was never completely persuasive because high margins for only the biggest firms may merely reflect their abusive dominance, designed to foreclose smaller rivals. To anticipate our own view, elaborated later, other tie-breaks are necessary, involving measuring whether leading positions are long-lasting, or constantly changing hands with large churns in market shares.

The more recent controversy was instigated by a number of influential studies, not just confined to IO, which claimed to show that the intensity of competition has declined in the USA². This has spawned a large and still growing literature, but notwithstanding the ambiguities highlighted by the older controversy, an important part of the evidence-base of these claims was high and increasing concentration levels across the world. Various commentators, including notably Philippon (2019) have interpreted this as evidence that markets and competition authorities are not functioning well, especially with respect to lax merger control. Others (Autor et al, 2017) argue, on the contrary, that evidence points to the emergence of a new breed of firm - revolutionising markets and competition - the superstar firm. Shapiro (2018) and Berry et al (2018) offer critical reviews which recall, to some extent, the older literature.

Competition Authorities around the world have taken an increasing interest. In the UK for example, the CMA (2020) published a report reviewing the evidence on the state of competition, and a large part of its evidence base was information on trends and levels of concentration. There have also been a number of other recent UK studies including Resolution Foundation (2018), Social Market Foundation (2017, 2018) and Aguda et al (2021). These mostly employ the Business Structure Database (BSD) which includes administrative data on the full population of UK firms from the Office of National Statistics (ONS). The Social Market Foundation's studies were case study driven, using primary sources. The consensus (although not unanimous) finding of these studies is that average levels of concentration increased somewhat in the first decade of this millennium before levelling off (and perhaps declining slightly) in the years after 2011/2012.

² Early studies were, *inter alia* Furman and Orszag (2015), The Economist (2016), De Loecker and Eeckhout (2017, 2018) and Gutierrez and Philippon (2018). OECD (2018) includes a comprehensive survey.

3 The Evolution and Current State of Concentration in the UK

3.1 The Business Structure Database (BSD)

Our own work is also based on the BSD used by CMA. This is administered by the Office of National Statistics (ONS) and includes all businesses in the UK which are registered for Value Added Tax or operate a Pay As You Earn Scheme. This is available for the years 1997-2018, although the data in some of the earlier years, especially 1997, is considered to be less reliable.

Some of the required data were taken from ONS's online summaries, and some was derived from tabulations provided indirectly by the CMA³. Thus, the underlying database is identical to that used by the CMA (2020). However, our analysis of the data goes beyond that employed by CMA, so most of our findings add to the picture portrayed by the CMA.

CMA (2020, especially chapter 2 and Annex 2), provides a full discussion of the dimensions and properties of the BSD. As mentioned, it is a firm-level dataset, consisting of two million firms each year. The data are collected for tax purposes. Firms are allocated to industries within the UK Standard Industrial Classification (SIC). This comprises 614 4-digit industries, each of which belongs to one of 84 2-digit sectors, each belonging, in turn, to one of ten 1-digit sectors. (See Appendix Tables A1 and A2.)

At the outset,, we wish to highlight four features of the data which have a direct bearing on the following analysis.

First, the most granular level of industry disaggregation is the 4-digit. Although this identifies over 600 industries, it is still considerably more aggregate than the Anti-Trust Market (ATM). The ATM is the level of disaggregation at which the market is defined in most Anti-Trust and Merger investigations (see Appendix tables A1 and A2), and it would be the ideal in any study examining the state of competition in UK markets.

Second, the UK SIC was revised twice over this period (2003 and 2007), and this leads to non-comparabilities in a subset of industries over time. These are dropped from most of our analysis.

³ Our access to the BSD has been limited at this stage to authorised, albeit indirect, access via the CMA in a manner which respects the privacy and confidential constraints required by the ONS. The generous help from Richard Havell in facilitating this access is gratefully acknowledged.

Third, like most administrative databases, the BSD allocates “business establishment” to the 4-digit industry in which its principal product lies. Where the establishment produces products from more than one 4-digit industry, this will lead to over-estimated turnover in its principal product industry, but under-estimated in the turnovers of the industries in which it produces its secondary products. Moreover, in some cases where establishments are diversified more or less equally across 4-digit industries, quite small changes in the establishment’s product portfolios can lead to significant year-on-year reallocations across industries. In turn, this can lead to a certain degree of spurious volatility in the aggregate turnovers and concentrations of industries.

Fourth, the treatment of international trade in BSD is a little ambiguous in the case of imports and non-existent for exports. As competition economists, our interest in concentration relates to the distribution of **sellers** in the UK market; ideally, we want to include, as separate entities, all individual importers into the UK and exclude exports from the turnovers of UK based firms (see section 5 below). However, the BSD records the turnovers of UK registered firms. Particularly for industries in the manufacturing (and primary extraction) sectors this means that competing importers are not included in the industry, although they may appear in the wholesale and retail industries which they supply. We are unsure therefore, for example, whether importers of VW cars are allocated to the wholesale or retail car industries, and whether or not they are recorded as a single entity or as multiple entities, corresponding to individual retailers. What is clear however is that firms importing cars are **not** included in the Car Manufacturing industry. (See section 5.)

3.2 The trend in Concentration

Figure 1 and Table 1 present an opening picture of how concentration at the 4-digit level has evolved over this period, and it leads fairly obviously to:

Fact 1: Typical 4-digit concentration increased rapidly, by about 30%, between 1998 and 2011, before levelling off at its new higher level, 2011-2018.

Fig 1 here

This headline result is shown initially for the median industry Herfindahl-Hirschman index (HHI). Unsurprisingly it corroborates qualitatively similar findings in the previous UK studies.

However, the magnitude of the increase is somewhat more pronounced and the trend cleaner than in some of the previous studies.

We suspect that this is because of three main methodological differences from the previous studies. First, we use the Hirshman-Herfindahl index (HHI) as our standard measure of concentration. This is preferred to concentration ratios because it takes account of potentially key size asymmetries amongst the largest firms in the industry⁴.

Second, we employ a balanced sample of 4 digit industries rigorously excluding all industries which were only reported post the 2007 revision of the SIC, or whose definitions changed significantly drastically in the 2003 and 2007 revisions, or with a significant number of redacted annual observations, or which are clearly non-market (typically publicly owned) or in the financial sector. We also exclude the financial sector because its recorded turnover is disproportionately high relative to non-financial industries. Table A1 provides more detail. This reduces the sample size to 361 industries, but these still account for 85% UK turnover exclusive of the financial and non-market sectors.

Third, we prefer the median to the arithmetic mean as the indicator of typical values. Casual inspection of the data on arithmetic means reveals unlikely year-on-year variations in all concentration indexes including the HHI. This is presumably because some large firms are re-allocated to different industries from year to year. This is almost certainly a consequence of the principal product criterion used in assembling the BSD, as described above. This feature of most administrative international registers internationally reflects changes, at the cusp, in the principal product of larger diversified firms. Such year to year variability in the turnovers and concentration of individual industries impacts more obviously on arithmetic means than on medians.⁵

Table 1 here

Table 1 provides some simple robustness checks. It shows that the picture is qualitatively similar using arithmetical means and/or concentration ratios, although the magnitude of the increase up to 2011 is most pronounced for median HHI.

⁴ For example, CMA's (2020) analysis is conducted using C10, the ten-firm concentration ratio, which simply compares the combined shares of the 10 largest firms with that of the rest of the industry

⁵ The obvious alternative might seem to be to use (turnover) weighted means, but this is distorted by attaching disproportionate weight to high turnover, but low value added, industries e.g. in the retail sector. Useable data on the other obvious alternative – means weighted by value added – is thwarted by unavailability of value added data for the whole period.

3.3 The Gainers and Losers

Table 2 and Figure 2 employ the published data on 5, 10 and 20 firm concentration ratios to establish a fairly striking picture of which firms have typically gained, and which have lost, market shares over this period.:

Fact 2: Within industries, increasing concentration was fuelled typically by increased market shares for the very largest (5) firms at the expense of the smallest (outside the top 20). Shares of middle sized firms, on the other hand, have increased but only moderately.

Fig 2 & Table 2 here

This feature in the data appears to have gone unnoticed in previous studies and merits further investigation with interest for the conditions of entry into UK industries, given that new entrants will typically first appear outside the top 20.

3.4 How widespread is high concentration?

Most of the emphasis in the recent literature has focused on the trends in concentration, as portrayed in figure 1. However, another equally important question which has been left unasked: whatever the trends, are the prevailing levels of concentration in UK industry particularly high?

While the definition of “high” concentration is inevitably arbitrary, we do have the suggestions which have traditionally been included by competition authorities in their guidance notices (for example, for merger cases: These differ slightly between the two main jurisdictions:

Concentrated:

EC/UK: $HHI > 1000$; US: $HHI > 1500$

Highly concentrated:

EC/UK: $HHI > 2000$; US: $HHI > 2500$

Apart from the plausibility of this precedence, these yardsticks also have the intuitively attractive property of plausible numbers equivalents. The reciprocal of any HHI value, multiplied by 10,000 converts that value into a hypothetical number of symmetrically sized firms which would register that value. This is often referred to as the numbers equivalent of the HHI.

So an industry with just 10 firms, each with 10% of the market, would record $HHI=1,000$; a market of 5 equal sized firms would record $HHI=2,000$, and 4 equal sized firms would secure $HHI=2,500$. These numbers equivalents suggest that these HHI yardsticks are not implausible for present purposes.

This leads to:

Fact 3 By 2018, 30% of 4-digit industries were “concentrated” using traditional guidelines, of which 14% were “very concentrated” (up from 26% and 7% in 2000)

Table 3 here

These percentages can be derived from the size distribution Table 3 by applying the UK/EU yardsticks. Alternatively, using the higher US yardsticks, the percentages are 20% and 9% respectively, and again rising over the period.

The cross tabulations shown in Table 4 delve further into the dynamics, comparing 2018 and 2000, first using the EU/UK and then the US yardsticks. Reading down the main diagonal shows the number of industries whose concentration class did not change over the period, while cells above(below) the diagonal show industries which have moved up (down) the concentration classes. Applying the UK/EU yardsticks, nearly 30% of industries changed class, with those increasing (roughly 20%) outweighing those decreasing by 2:1. Applying the US yardsticks, roughly 20% changed class, and again those increasing outnumber those decreasing by a ratio of 2:1.

Table 4 here

This feature of the data has not attracted the attention it merits in previous studies, especially as we shall argue below that 4-digit concentration typically seriously underestimates concentration at the ATM level.

Thus far, the purpose of the first part of this paper has been to muster the data to provide a picture of **concentration** at the 4 digit industry level in the UK. We have refrained from drawing any conclusions about **competition** in the typical ATM market. In the remainder of the paper we turn to the three problems outlined in the introduction which must be addressed before anything about the latter can be deduced from statistics on the former.

4 The Aggregation Problem

Nearly all studies in the recent literature have employed data for industries which is more aggregate than is ideal, using official sources which define industries at the 4, or at best 5 or 6-digit NACE/SIC

levels or, equivalently, 6 digit NAICS. For example, Philippon (2019) disaggregates the manufacturing sector into 360 NAICS level 6 industries; The Economist (2016) disaggregates the economy to 893 NAICS level 6 industries. CMA's (2020) analysis, like ours, is based on UK SIC 4-digit industries; Koltay et al (2020) disaggregates to 156 ISIC categories. Bajgar et al (2021) is based on only 37 2-digit aggregate sectors.

But there are far, far more anti-trust markets than this. A typical NAICS/SIC/NACE industry will comprise many different antitrust markets. In the example in Table A2, 4-digit industry 2751 (manufacture of electric domestic appliances) comprises 24 different product markets each of which might refer to one or more ATMs. In the literature, Werden (1988) and Werden and Froeb (2018), provide compelling evidence from samples of US cartel and merger cases that the market turnover in the typical ATM market may be less than 1% of the aggregate SIC industry to which it belongs. A similar picture emerges, qualitatively if not quite so dramatic quantitatively, from a database recently constructed by Affeldt et al (2021), which showed that a sample of 2,000 EC(DGCOMP) mergers (1995-2014) covered 20,000 product/geographic antitrust markets. They calculate that the typical HHI in this sample is about 3000, which, they claim, is about 10 times greater than the typical HHI reported in most studies of SIC industries.

Returning to our estimates in the first part of this paper, we draw a:

Plausible deduction The estimates here (Table 3), even the often high concentration observed at the 4-digit level, almost certainly vastly understates the prevalence of high/very high concentration at the ATM level in UK

Of course, the disparity between SIC and ATM is unsurprising - it is well known that the more narrowly one defines a market, the fewer firms will be found in it. This leads us on to the traditional defence of continuing to rely on 4-digit concentration data. This is the argument that estimates at the 4-digit level are probably *representative* (albeit drastically scaled down) of concentration in constituent ATMs. If true, and if the relationship were stable across industries and over time, we might continue to confidently employ 4-digit data to shine a light on potential concentration hotspots and trends over time.

To test this defence, there is clearly an urgent need for more research and more data, and we will return to this in our own research in the near future. With the data currently at our disposal, there is little more that we can add, except the following observation which may be suggestive:

Fact 4 2-digit concentration provides a very imprecise picture of concentration in

constituent 4-digit industries

Figure 3 here

Of course, 2-digit data are even less likely to reveal much about constituent ATMs, but the comparison between 2-digit and 4-digit in Figure 3 is revealing of the sort of imprecision that is involved in aggregation of industries.

As can be seen, there is considerable dispersion around the 45° line when HHI in 4-digit industries are plotted against 2-digit HHI for the to which they belong. Most observations lie above the 45° line, but the scatter is sufficiently dispersed to confirm the absence of any stable predictable relationship across different 2 or 4-digit industries⁶.

Table 5 here

This is confirmed numerically by the cross-tabulations in Table 5. Using 2-digit HHI to predict 4-digit HHI, would lead to many errors. For example:

- 2-digit HHI substantially over-estimates the probability of low concentration. Comparing the 1st row and 1st column totals, 94% (340/361) of 2-digit, as opposed to 70% (250/361) of constituent 4-digit industries are unconcentrated.
- 2-digit HHI under-predicts the classification class in 28% (100/361) of cases. (Cells above the main diagonal.)
- Even when 2-digit HHI records concentration or high concentration, in 40% (9/21) of cases it over-predicts the 4-digit level.

Clearly, more research is needed, but these statistics do underline just how unreliable 2-digit estimates can be of even 4-digit magnitudes, let alone concentration at the ATM level. This suggests that particular caution should be attached to concentration studies based on levels of aggregation broadly equivalent to the SIC 2-digit⁷. Beyond this, if the “fogginess” in moving between 4- and 2-digit-levels of aggregation is indicative of similar “fogginess” between 4-digit and ATM levels, then caution will always be needed in attaching undue credibility to 4-digit studies.

To anticipate the direction of our future research, it will show that concentration at an aggregate level depends upon not only the average concentration in constituent industries, but also the

⁶ The OLS line of HHI4 against HHI2 records a low R squared of 0.147.

⁷ Two recent examples are Bajgar et al (2021) and Koltay et al. (2020).

number of constituent industries and the diversification of firms across those industries, Future case study research will formalise and calibrate this relationship.

5 Incorporating Foreign Competition

A common limitation of most concentration measures computed from business registers is their failure to account for the impact of imports or exports. This is because firm size is typically measured by turnover from production or employment within the country concerned. Therefore, any concentration index computed from such data will measure **producer concentration** rather than **seller concentration**. Although some academic studies have attempted to “correct” for the impact of trade⁸, there have been no such UK studies.

In this case, as discussed earlier, the BSD appears not to include data on either exports or imports in the key manufacturing industries⁹. This limited the CMA’s discussion of the impact of foreign trade to an aggregate comparison (2020, Annex A, pp. 14-16) between concentration and import penetration at the sector level. It notes that only when import penetration is high are imports likely to have any disciplining role on concentration.

In a trade-intensive country such as the UK, there is an obvious need to delve more deeply to correct estimates of concentration for exports and imports. It should be recognised however that any such corrections are likely to be localised to certain manufacturing industries: in the UK, the services sectors account for roughly 80% of GDP, but less than 25% of imports.

Notwithstanding the last sentence, it remains true that correcting for trade, where it occurs, may have a major impact on concentration. Concerning the direction of the correction, we believe the picture is more complex than implied by the CMA. Its general presumption is that more imports means greater competition, and implicitly exports have no role to play. In fact, neither of these is necessarily true and there is no clear-cut predictable effect of trade on domestic concentration. To see some of the complexities, we can illustrate using the UK car manufacturing industry (SIC 2910) as an example - given the strategic importance of this industry, an unusual amount of individual firm level data are freely available in the public domain for this industry. The five largest producers in the

⁸ Gutierrez and Philippon (2017), Autor et al (2017) and Feenstra and Weinstein (2017).

⁹ Clarification from ONS is required on this. What seems clear is that the data for manufacturing industries does not include any information on imports of competing manufactured imports; however, it is possible that such imports are included in the corresponding wholesale or retail industries. (It appears that this might be so for the car industry.)

UK, JLR, Nissan, PSA, BMW, Honda and Toyota, are all subsidiaries of foreign owned multinationals, and over 80% of their production is exported. Within the domestic UK market on the other hand, most cars are imported; and only three of the top ten models are actually produced in the UK. The top five selling firms, VW, Ford, BMW, PSA and Mercedes account for 62% of the market and the HHI of sellers is 967. However, the BSD records this industry's $HHI=1837$ and $C5=78.8$. So, in this case, the BSD concentration statistic would significantly over-estimate the concentration of sellers. But, note that this is not because of a large competitive fringe of small importers which will pull the concentration down. On the contrary, they are themselves large oligopolists with potentially considerable market power. Rather, the case illustrates an important, although not as obvious, role for exports – although domestic production is highly concentrated, most of it is exported and the domestic producers have only small market shares of the UK market.

Unfortunately, firm-level data of this detail are not routinely available for most industries, although it is hoped that significant progress will be made in the near future in combining data from the BSD with firm-specific HMRC data on imports. Further case studies are also planned. In the meantime, the present paper has more modest objectives. We first formalise (in Appendix 2) how to incorporate trade into the measurement of concentration, and then illustrate the possible magnitudes of error which might be involved if trade is ignored. To do this we use two convenient but extreme assumptions.

In Appendix 2, we show that the correction needed to convert an HHI of producer concentration into an HHI of seller concentration HHI requires information on:

- (i) The **share of imports** in the domestic market
- (ii) The **concentration of importers** relative to the concentration of domestic production
- (iii) The **share of exports** in domestic production
- (iv) The **concentration of exporters** relative to the concentration of domestic production

At this stage, we have no available data on importer concentration (ii) or on whether larger firms tend to be more export-intensive (iv) - these are future data priorities.

Indeed, there is not even any comprehensive concordance available which provides data on exports and imports at the 4-digit SIC level, therefore the matching of production and trade data at the 4-digit level for all industries is a non-trivial task. However, we have been able to make our own

concordance for a subset of manufacturing industries¹⁰, and extract trade data from the UK HMRC Trade Statistics unit (HMRC 2018) for a number of SITC Rev.4 industries up to the 5-digit level of disaggregation (See U.N., 2008 for information on SITC). The data ranges from 1996 to 2018 and contains information on the total value of imports and exports, broken down by industry and place of origin/destination. In the event, we were able to match the trade and BSD data for 122 manufacturing industries. These account for a combined turnover equivalent to about 8% of the UK economy, just under half of UK total manufacturing and roughly a third of all UK imports. So we are unable to make any claims about how representative this sample of industries is.

These data allow us to calculate the shares of imports and exports ((i) and (iii) above) and under extreme assumptions, in turn, to estimate the correction for trade. In the Appendix we show that if:

- i. importers are totally unconcentrated
- ii. all domestic firms export the same proportion of their production,

$$HHI^{DS} = HHI^{DP}(1-m)^2$$

Where HHI^{DS} is the HHI of seller concentration, HHI^{DP} is the observed HHI of domestic production and m is the share of imports in sales to domestic consumers. Since $m < 1$, in this special case, (observed) HHI over-estimates (unobserved) trade-adjusted seller concentration.

It should be stressed however that these are indeed extreme assumptions: assumption (i) is equivalent to assuming that imports merely play the role of a competitive fringe, and (ii) ignores the (very likely) possibility that larger firms will tend to have a greater propensity to export than smaller firms. These are both in the nature of bounds assumptions – in most markets importers will have non-trivial market shares, and generally we would expect the export propensity to increase with firm size. But note also that they are offsetting in that (i) leads to a downward bias while (ii) leads to an upward bias.

Fig 4 here

There is an obvious need for more data, but with the above caveats, Figure 4 makes the above correction to the observed HHI for the subsample of manufacturing industries described above. The results are striking: the corrected series for HHI is substantially lower, and falling over this time period. The reason is that both import penetration and export intensities were relatively high and

¹⁰ For this, grateful thanks are due to Joe Carr.

rising over this period. Clearly, these results do not have the status of being “facts”, but they do give rise to a:

Speculation. In industries with significant exposure to international trade, it is possible that the concentration of sellers is typically lower than, and with an opposite time trend, to producer concentration

We should stress again, that this might be overturned if importing is typically concentrated, and it would only be applicable to a small subset of trade-intensive industries in the manufacturing sector. Nevertheless it underlines the urgent need for a comprehensive matching of UK data on production and trade at the 4-digit level.

6 Towards a more Dynamic Representation of Competition

Thus far, the focus of this paper has been on how to measure concentration most appropriately. We have deliberately refrained from equating concentration with competition, and recalling the discussion of our opening sections above, there are important reasons for this. This is not to say, however, that the pursuit of better ways of measuring concentration is pointless – properly interpreted, information on the concentration of sellers is necessary if we are to understand the competitive environment of any market. On its own however, it is not sufficient. As we argued earlier, we need additional information if we are to avoid the fundamental identification problem: is high concentration the cause or soft competition or the consequence of intense competition?

In this section we turn briefly to this question by presenting some early findings on an alternative more dynamic measure of the competitive process: the churn of market shares amongst the leading firms in the market. The underlying idea is that where competition is intense, as rivals sometimes win but sometimes lose the competitive race, we might expect to observe “churn” in the market shares of the competing firms in the market. This points to an obvious empirical tie breaker – high concentration coupled with low churn does indeed point to weak competition, but, if coupled with significant churn, the high concentration might actually signal a dynamically competitive market. This dynamic depiction of competition is not new of course, but it is dispersed in the literature. It owes its origins to Schumpeter, but there are also relevant streams of literature on stochastic firm growth, as well as more mainstream neo-classical models exploring the relative incentives of laggards and leaders to innovate. The author contributed to this debate a quarter of a century ago (1997), and much of the relevant literature of the time was summarised by Caves (1998). More

recently, Philippon (2019) captures this neatly with his distinction between “good” and “bad” concentration.

Here we employ a simple inverse indicator of churn: **leadership persistence**, measured by **the number of current leaders, defined as top 10 firms in the market, that were also leaders 3 years previously**. This is admittedly limited, and future work will employ alternatives based on explicit modelling of the dynamic process, but here our choice is frankly pragmatic: CMA kindly supplied us with ready-estimated observations on this measure for all industries in our database. Figures 5 and 6 and Table 6 depict two key features of this variable – changes over time in typical leadership persistence, and the relationship between leadership persistence and static concentration.

Fact 5 Typically, leadership persistence has increased throughout the period, especially up to 2012

Fig 5 here

This is shown in Figure 5 by both the sample means and medians – changes in the median appear more marked but this merely reflects the integer nature of the median. Coupled with our earlier finding of high static levels of leadership, this may be provisionally early evidence of softening competition in the UK economy.

Fact 6 Leadership persistence is positively associated with higher concentration (Figure 6) and the persistence is higher in concentrated or very concentrated industries (Table 6)

Fig 6 & Table 6 here

Thus, figure 6 shows that the mean HHI for industries with n leaders increases monotonically with n , and table 6 shows that nearly 70% of all industries with high or very high concentration also have high leadership persistence ($n=8-10$), as opposed to less than half of unconcentrated industries having high persistence.

These results come with a “health warning” – the index used is fairly primitive and its theoretical underpinnings merit scrutiny. Further robustness tests are called for. But at first blush, the evidence points to declining churn and in particular, the absence of much churn in the most concentrated industries. If these results are robust to further more formal analysis this would suggest close policy scrutiny of the subset of industries which are both highly concentrated with and without much churn.

7 Conclusions and future research

The main findings of the paper are highlighted in the text of sections 3-6. On the basis of data on 4-digit industries, concentration levels increased steadily during 2000. In the typical market, this was fuelled by increasing shares of the 5 largest firms at the expense of the smallest firms (outside the top 20.) Using traditional UK policy definitions: 30% of industries were “concentrated” in 2018, of which roughly half were highly concentrated. These statistics almost certainly understate the presence of high concentration at the more policy-relevant level of the Anti-Trust Market (ATMs) It is likely, moreover, that 4-digit concentration is a poor indicator of the presence of high concentration in constituent ATMs. These results, along with those from previous studies, fail to incorporate the impact of either import competition or exports by leading firms outside their domestic UK markets. This is due to an absence of any comprehensive matching of trade data with production data for the UK. It is hoped that this gap in the data will be addressed in the near future. In the meantime, using admittedly extreme simplifying assumptions for a sub-set of manufacturing industries, we show that the facts on the concentration of sellers in UK markets (i.e. including imports and excluding exports) may turn out to be very different from those reported for the concentration of production.

We have stressed that caution is needed before interpreting facts on concentration, no matter how perfectly measured, as evidence on the state of competition. We believe that it essential to look beyond purely static evidence on market shares at a point. If the essence of competition is to be captured, we also need evidence for the existence of dynamic rivalry between firms which is more likely to be reflected statistically by indicators of the churn of incumbent’s market shares over time. Using one such indicator, our preliminary results suggest that the magnitude of such churn lessened throughout this period. Moreover there was a distinct tendency for the industries which are most concentrated to be those with the lowest churn in market shares.

Finally, the preliminary nature of these results needs repeated emphasis. We have tried to use the data currently at our disposal to provide the most accurate picture possible of the facts at the 4-digit level. However, to provide a more defensible picture, some of the developments discussed here need to be pursued: more disaggregated industry definitions (at least for a sample of the population); matching trade data with production data to give a cleaner idea of seller concentration; and further experimentation with more dynamic modelling and measurement of competition as a process. These are demanding objectives, but we envisage reporting further results in three future working papers over the coming months.

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Tables and Figures

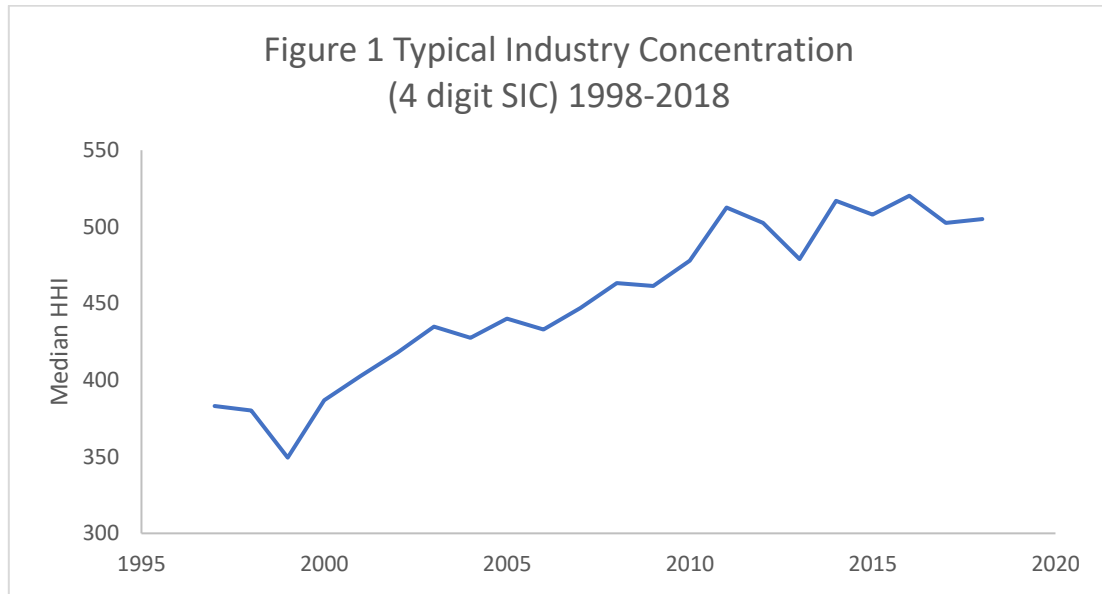


Table 1 Alternative concentration measures (2000=100)

year	HHI	HHI mean*	C5	C10	C20
1998	98.2	97.0	98.7	97.2	97.9
2011	132.5	127.9	118.2	113.6	115.3
2018	130.6	122.8	116.1	114.4	113.3

*Note: * All statistics are medians except this simple arithmetic mean*

Table 2 Disaggregation of concentration ratios (%)

Shares of:	Top 5	Firms 6-10	Firms 11-20	Firms outside top 20
1998	33.7	10.8	11.2	44.3
2011	40.3	11.7	13.6	34.4
2018	39.6	12.7	12.2	35.5

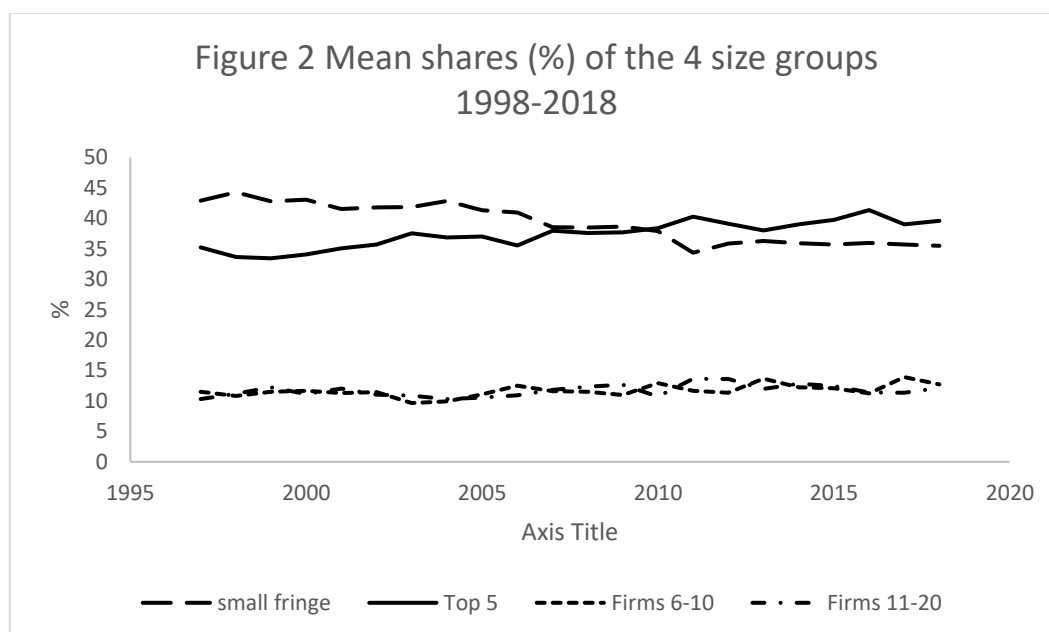
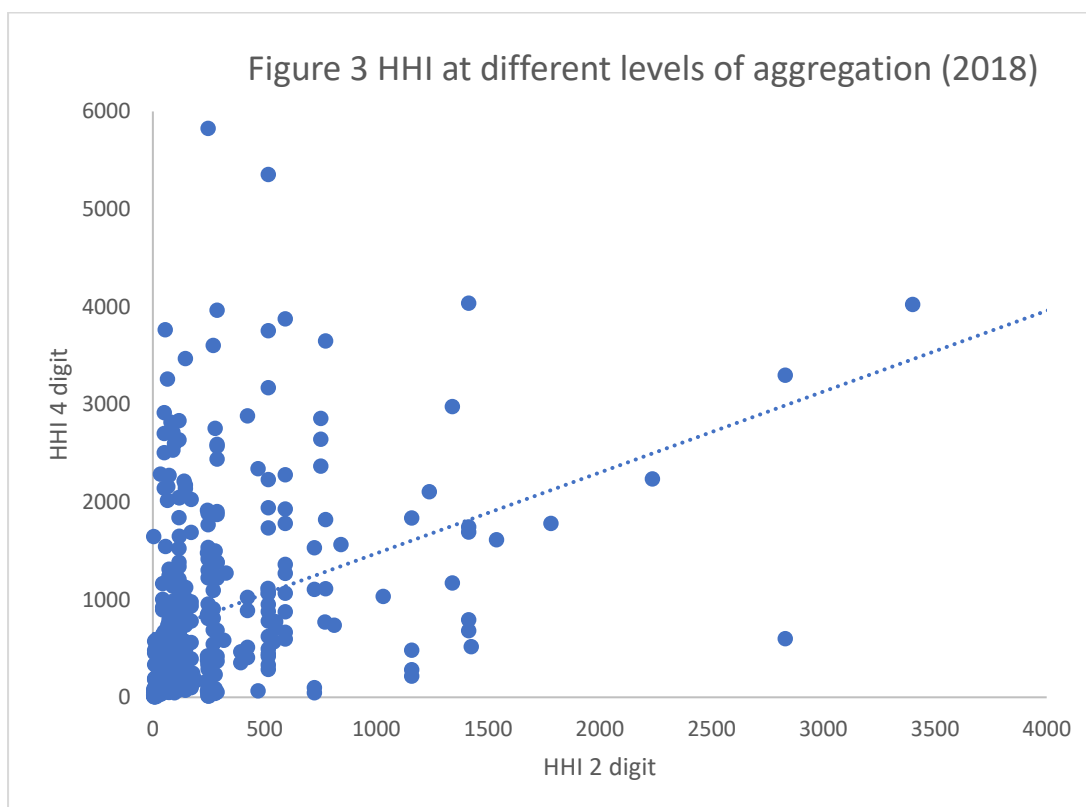
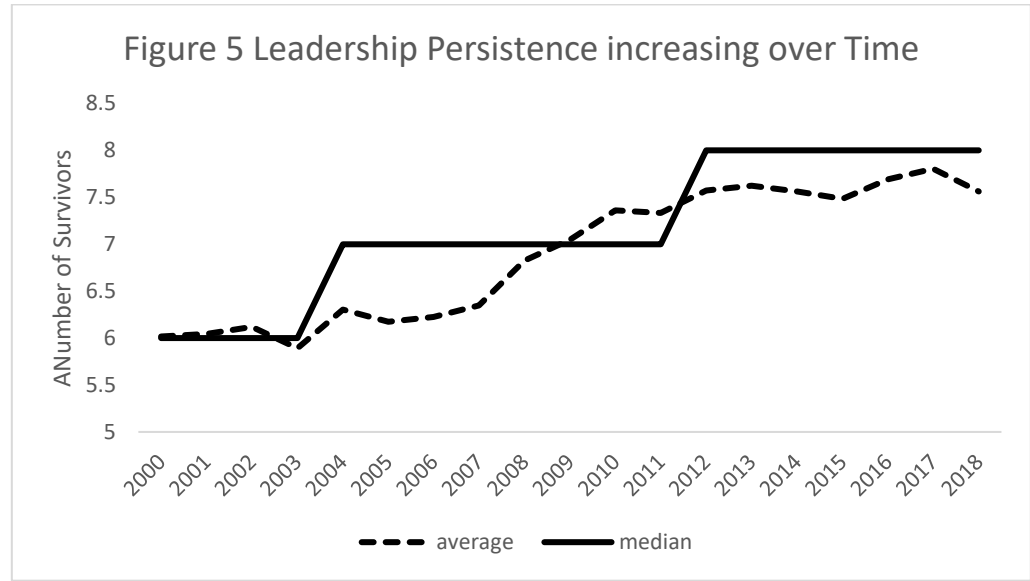
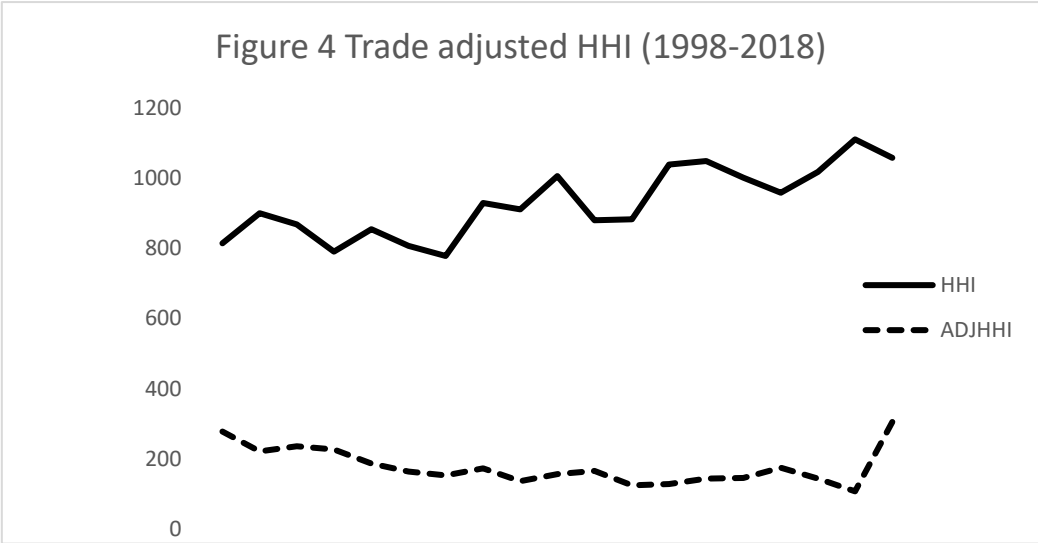


Table 3 Size Distribution of industries by HHI			
4 digit HHI range	2018	2011	2000
0-1000	250	244	266
1001-1500	38	42	46
1501-2000	24	24	24
2001-2500	18	16	9
>2500	31	35	16
total	361	361	361

Table 4 Transition percentages					
(i) EU/UK definitions		HHI 2018			
HHI 2000		Unconcentrated	Concentrated	Highly Concentrated	All
Unconcentrated	<1000	61.2%	8.0%	4.4%	73.7%
Concentrated	1001-2000	6.6%	6.6%	6.1%	19.4%
Highly Concentrated	>2000	1.4%	2.5%	3.0%	6.9%
All		69.3%	17.2%	13.6%	100.0%
(ii) US definitions					
Unconcentrated	<1500	74.2%	6.9%	5.3%	86.4%
Concentrated	1501-2500	4.2%	2.8%	2.2%	9.1%
Highly Concentrated	>2500	1.4%	1.9%	1.1%	4.4%
All		79.8%	11.6%	8.6%	100.0%

Table 5 HHI by concentration class 4 digit v 2 digit (2018)				
	4 digit HHI range			
2 digit HHI	<1000	1000-2000	2000+	total
<1000	243	55	42	340
1000-2000	6	5	3	14
2000+	1	2	4	7
total	250	62	49	361





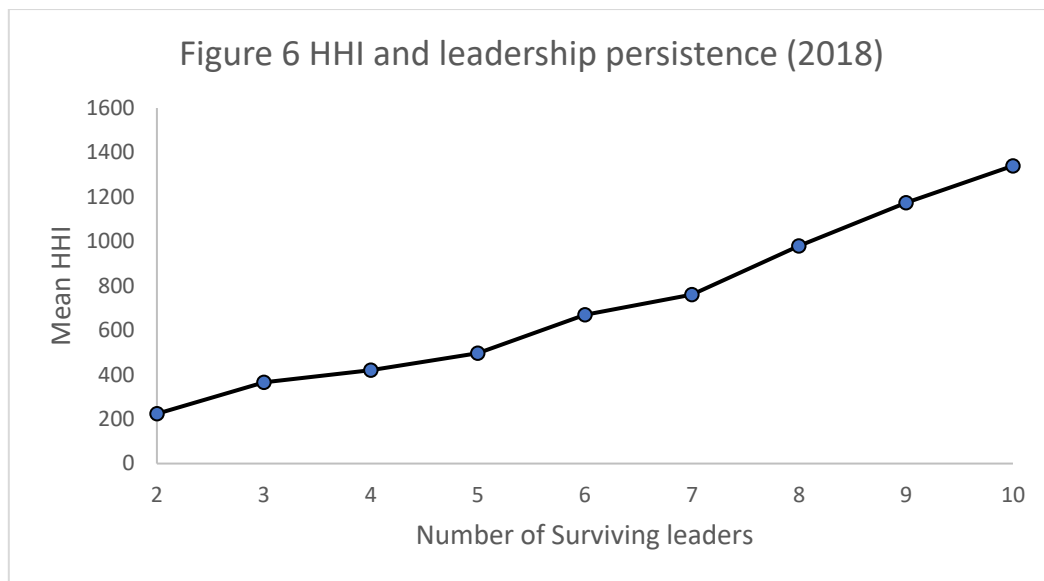


Table 6: Leadership Persistence by concentration class (2018)			
Number persisting in top 10	Highly concentrated	Concentrated	Unconcentrated
1-5	2 (4%)	5 (8%)	30 (12%)
6-7	13 (27%)	14 (23%)	105 (42%)
8-10	34 (69%)	43 (69%)	115 (46%)
	49	62	250

Appendix 1 The sample Industries

Table A1 Coverage of Samples		
	no.	% turnover (2018)
4-digit	614	100
2-digit	84	100
1-digit	10	100
Exclusions from all analysis (175)		
<i>(i) industries with little or no data</i>	47	
no uk industry	12	0
all years totally redacted	3	0
most years redacted	32	0
<i>(ii) industries excluded by choice</i>	64	39
non-market/public owned	45	6
fuel wholesale	1	4
finance sector	17	29
central banking	1	0
Potentially useable (503 – 61%)		
<i>Only partial data</i>	142	9
some years (up to 6) redacted	33	3
full data only from 2008 onwards	91	5
only from 2008 onwards, some years redacted	18	1
Full data*	361	52
<i>Alternative samples</i>		
Fully balanced	361	52
Fully balanced from 2008 onwards	452	57
Full period with a few missing obs	394	55
2008 with a few missing obs	503	61

* All time series results in the paper are based on this sample of 361 industries

Table A2 Illustrative Example from UK SIC 2007 of Levels of aggregation

1-digit		C	Manufacturing
2-digit	Division	27	Manufacture of electrical equipment
3-digit	Industry	27.5	Manufacture of domestic appliances
4-digit	Class	27.51	Manufacture of electric domestic appliances which includes:

- manufacture of domestic electric appliances:
 - refrigerators
 - freezers
 - dishwashers
 - washing and drying machines
 - vacuum cleaners
 - floor polishers
 - waste disposers
 - grinders, blenders, juice squeezers
 - tin openers
 - electric shavers, electric toothbrushes, and other electric personal care device
 - knife sharpeners
 - ventilating or recycling hoods
- manufacture of domestic electrothermic appliances:
 - electric water heaters
 - electric blankets
 - electric dryers, combs, brushes, curlers
 - electric smoothing irons
 - space heaters and household-type fans, portable
 - electric ovens
 - microwave ovens
 - cookers, hotplates
 - toasters
 - coffee or tea makers
 - frying pans, roasters, grills, hoods
 - electric heating resistors etc.

Appendix 2 Incorporating foreign trade into producer concentration

Consider the relationship between the HHI of sellers in a market of two groups of sellers: domestic and importing firms. It is easy to decompose an HHI into two parts and show that:

$$HHI^S = HHI^{DS} \cdot (1-m)^2 + HHI^M \cdot m^2 \quad (1)$$

where HHI^S is the HHI of all sellers in the home market; HHI^{DS} is the HHI of domestic sales of domestic producers, HHI^M is the HHI of importers, and m is the import share of the domestic market, defined by

$$m = M / (DP - X + M) \quad (2)$$

where M is imports, X is exports and DP is domestic production

Now define HHI^{DP} as the HHI of production of domestic producers, and note that this is the HHI which is observed in the BSD data. Then the ratio of HHI^S to HHI^{DP} shows the magnitude of correction (ϵ) needed to convert the observed HHI into a trade-corrected HHI of sellers:

$$HHI^S / HHI^{DP} = (HHI^{DS} / HHI^{DP}) \cdot (1-m)^2 + (HHI^M / HHI^{DP}) \cdot m^2 = \epsilon \quad (3)$$

The first thing to note is that ϵ may be less than or greater than unity: it all depends on the relative concentration of importers and exporters, and the extent of market penetration and the export share of domestic production (which indirectly as a determinant of m .)

So, on the imports side, there is no unambiguous algebraic relationship between the correction and the import share: it depends on the relative concentration of the importers. In an industry with a high import share, this may increase seller concentration but only if the importers themselves are highly concentrated.

For exports, there are also two impacts: (i) the larger is the share of their output that domestic firms export, then from (2), the larger is m , and (ii) if the largest firms account for a disproportionately large share of total exports, then $HHI^{DS} < HHI^{DP}$, and this will tend to reduce seller concentration.

However, now consider the special case employed in the main text, where

- iii. importers are totally unconcentrated, $HHI^M = 0$
- iv. all domestic firms export the same proportion of their production, $HHI^{DS} = HHI^{DP}$

In this special case, (3) simplifies to:

$$HHI^S / HHI^{DP} = \varepsilon = (1-m)^2 \quad (4)$$