Product Market Concentration and Productivity: Evidence from the UK *

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Abstract

We measure product market concentration and business dynamism in the UK from 1997 to 2020. We document this with administrative data on the population of UK firms from the Business Structure Database (BSD). Our results show that concentration in the UK is increasing among narrow industries on average, but for a broad market definition concentration and business dynamism are stable. Lastly, we document a negative relationship between concentration and productivity.

Key words: Product market concentration, productivity, business dynamism, UK economy, Business Structure Database (BSD).

JEL Classification: D2, D4, E2, L1, L4, O4

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We provide a web app to analyse our data further https://asavagar.shinyapps.io/UK-market-structure/.
Disclaimer: *This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.*

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1 Introduction

In many countries product market concentration is rising, but there is limited evidence on concentration trends in the UK. Some economists argue that rising concentration indicates rising market power which is responsible for poor outcomes across a range of macroeconomic variables, including productivity. The aim of our paper is to document product market concentration in the UK and to examine the relationship between concentration and labour productivity. The relationship with labour productivity is important in the UK because of the so-called 'productivity puzzle'. Figure 1 depicts the UK productivity puzzle.

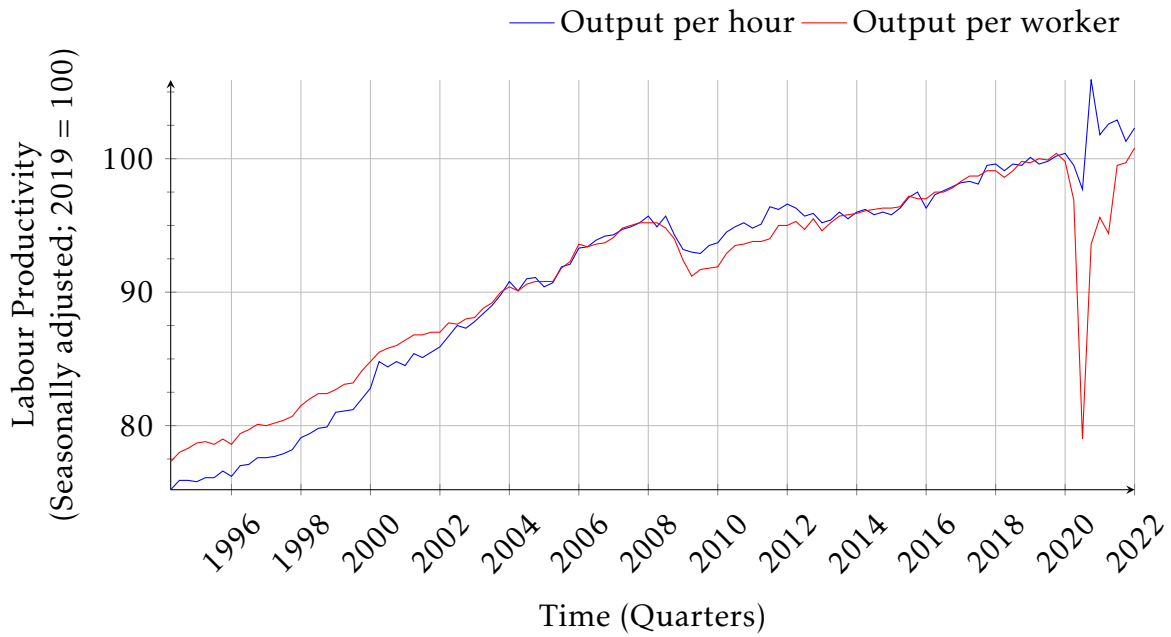

Figure 1: UK Labour Productivity
Source: ONS; Series 1994-2007 come from LPROD01 (Mackenzie 2022) and series 2008-2021 come from (Newman and Cockford 2022)

There are two features to the UK Productivity Puzzle. First, in 2008 there is a severe short-run decrease in productivity levels. Labour productivity fell 5% from 2008 Q1 to 2009 Q1 and only recovered in 2016. Second, there is a stark decline in the growth rate of productivity after 2009. For example, from 1998-2002 there is roughly a 10% increase in productivity, whereas from 2014-2018 there is a 4% increase. Our paper focuses on low productivity levels and the extent to which this relates to higher market concentration.

The paper makes three contributions. First, we document product market concentration in the UK. We find that concentration for a broad market definition has been stable over the sample period 1997-2020, but there was an increase in concentration up to 2016 for a sub-sample that excludes financial services. For a narrower

market definition (SIC 5-digit) we find that concentration is increasing on average. Secondly, we document firm entry and exit levels (business dynamism) in the UK. We find that levels of entry and exit have been stable over the long-run sample period 1997-2020 and fluctuate, counter-cyclically, with the business cycle in the short run. Finally, we analyse the relationship between concentration and labour productivity. We find a negative relationship between product market concentration and labour productivity. Ceteris paribus, high concentration industries have lower productivity. These contributions are particularly timely as product market concentration has gained widespread attention based on trends in the US and Europe, but there is little evidence on concentration behaviour in the UK. However, the UK has population-wide data at the firm-level which records firms' sales and sector allowing a thorough analysis of market concentration. This coverage is more representative of the whole business economy than popular proprietary datasets that are biased towards limited liability businesses, but exclude unlimited companies such as sole traders.

Theory

A key aim of ours is to document concentration trends across markets in the UK. Therefore, it is natural to ask: *Why are concentration measures useful, particularly aggregate measures?* Concentration is often used as an indicator of market power and an inverse measure of competition. In practice, aggregate concentration measures are closely correlated with purer measures of market power such as price markups (Diez, Leigh, and Tambunlertchai 2018). Hence growing concentration may indicate greater market power and weaker competition which can weaken productivity, for example if a firm restricts production and operates with excess capacity or if less productive firms are able to survive under weak competitive pressure. Our results are consistent with the hypothesis that concentration indicates weak competition and in turn low productivity. Strictly speaking, industrial organization theory shows that concentration is an equilibrium outcome of firm entry and production decisions that depend on industry structure and supply and demand conditions, therefore competitive environment determines concentration, not vice-versa. Hence concentration is not a pure measure of competition. We review this in the literature review below. However in order to study aggregate macroeconomic questions, across broad industry datasets, we need a universal measure rather than a specific indicator of competition, such as number of competitor firms in a geographic area, that might be admissible in the study of a particular industry. A further advantage of documenting aggregate measures of concentration is that they offer a perspective on underlying changes in the structure of an economy that are not obvious at the industry level. Recent research on the US economy has investigated broad factors causing concentration across in-

dustries. These factors include changes in technology (Autor, Dorn, Katz, Patterson, and Van Reenen 2017b; Lashkari, Bauer, and Boussard 2019; Bessen 2020); changes in antitrust (Grullon, Larkin, and Michaely 2019); changes in federal regulation (Gutiérrez and Philippon 2017); levels of intangible investment (Aghion, Bergeaud, Boppart, Klenow, and Li 2019; Ridder 2019) and population dynamics (Hopenhayn, Neira, and Singhania 2018). Distinguishing between causes is important because it determines whether concentration is 'good' (improves productivity) or 'bad' (harms productivity) (Covarrubias, Gutiérrez, and Philippon 2020). Aggregate concentration may also have implications for the effectiveness of policy or the beneficiaries of an aggregate policy change. Lastly, there are political economy considerations related to more aggregated measures of market concentration. Firms with greater market share may have stronger political influence and lobbying power. Hence documenting trends in concentration can inform research in political economy.

Related Literature

Concentration

Global Concentration Trends: Recent research finds that product market concentration is rising in many advanced economies. Grullon, Larkin, and Michaely (2019) and Autor, Dorn, Katz, Patterson, and Van Reenen (2017a) show rising concentration in the US. Bajgar, Berlingieri, Calligaris, Criscuolo, and Timmis (2019) show rising concentration in Europe using Multiprod and Orbis data.[1] Gutiérrez and Philippon (2018) show stable concentration in Europe using Orbis data. Diez, Leigh, and Tambunlertchai (2018) show rising concentration for a range of countries. They show that there is a positive correlation between concentration and markups. They use Thomason Reuters Worldscope data across 74 countries. Rossi-Hansberg, Sarte, and Trachter (2018) find that in the U.S. local markets are de-concentrating whilst national markets are concentrating.

UK Concentration Trends: There are two recent contributions on product market concentration in the UK. Both papers are written for policy purposes.[2] Bell and Tomlinson (2018) analyse UK concentration data based on the BSD data that we use. They analyse 608 5-digit SIC sectors. They omit sectors in 'financial services', 'wholesale of fuels' and sectors with high public sector employment. They find that UK concentration increased 2004 to 2016 which is consistent with our results if we drop the same

[1] Grullon, Larkin, and Michaely (2019) use CRSP-Compustat merged database on publicly-listed firms. They also incorporate information on private firms from the U.S. Census Bureau and the U.S. Bureau of Labor Statistics. Autor, Dorn, Katz, Patterson, and Van Reenen (2017a) uses data from the U.S. Economic Census.

[2] A third policy report by the Social Market Foundation (Corfe and Gicheva 2017) focuses on consumer industries and finds rising concentration (https://www.smf.co.uk/publications/competition-not-concentration/).

sectors and years. They show that the market share of the largest 100 firms in the BSD increased from 18% to 23% between 2004-2016 and that – across 608 5-digit sectors – the weighted-average CR5 increased from 39% to 42%, whilst the weighted-average HHI increased 880 to 940 units.[3] Aquilante, Chowla, Dacic, Haldane, Masolo, Schneider, Seneca, and Tatomir (2019) cover market concentration in a broader study of UK market power, with a focus on price markups and monetary policy. They use Worldscope data on listed firms and show modest increases in the market share of the largest 100 firms 1998-2016 and exclude financial services. Similarly to us, they conclude that *'there is no clear trend [in aggregate concentration]'*. Recent work by Davies (2021) also uses the BSD dataset to analyse concentration in the UK. Davies (2021) reports rising concentration and high concentration levels for a subset of 4-digit industries in the UK 1997-2018.

Concentration & Productivity: Bighelli, di Mauro, Melitz, and Mertens (2020) document recent concentration trends in Europe using similar administrative data to our analysis of the UK.[4] They find that concentration has risen since 2008 and that it is *positively* related to productivity (value-added per employee). This evidence supports the well-functioning competitive market ('winner takes all') hypothesis, where most efficient and innovative producers gain a higher market share (Van Reenen 2018). This is contrary to our negative relationship which supports the weakening competition hypothesis. The positive correlation in Bighelli, di Mauro, Melitz, and Mertens (2020) is at the sector level, *i.e.* sector labour productivity regressed on sector HHI. The authors suggest that the positive correlation is primarily driven by reallocation from less productive to more productive firms. Cavalleri, Eliet, McAdam, Petroulakis, Soares, and Vansteenkiste (2019) present evidence on concentration, markups, dynamism and TFP for the four largest Euro area economies (Germany, France, Italy, Spain). Consistent with our work, they find that both concentration and dynamism are flat. They find a positive relationship between TFP growth and concentration in high-tech sectors. Gutiérrez and Philippon (2017) find that in the U.S. there is a positive relationship between concentration and value-added per worker, but the relationship changes over time if TFP replaces labour productivity. Specifically, concentration and TFP are positively related over the 1990s and negatively related since the year 2000. Autor, Dorn, Katz, Patterson, and Van Reenen (2017a) find there is always a positive relationship regardless of the productivity measure (output per worker, value-added per worker, TFP, or patents per worker).

[3] Bell and Tomlinson (2018) provide evidence that increases in market concentration are larger when the 'wholesale of fuels' sectors are included.

[4] They analyse 15 countries (Belgium, Czech R., Finland, France, Germany, Italy, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Switzerland) and six broad sectors (Manufacturing, Transportation and storage, ICT, Real Estate, Professional Activities, Administrative services).

Competition & Productivity

Empirical research in industrial organization overwhelmingly finds that *firms in more competitive markets are more productive* (Backus 2020). Competition can improve productivity through within-firm improvements or between-firm reallocation and exit of low productivity firms. Modern industrial organization studies analyse clear changes in the competitive environment of a specific industry, though these well-identified studies are less scalable to a macroeconomic context. Recent industry-specific evidence by Backus (2020) finds that the within-firm effects are more important and that they occur through greater specialization and improved managerial inputs. The study is a detailed micro-analysis of the concrete ready-mix industry. It has well-defined local markets because the good is not easily transportable. Consequently, they can measure competition as the number of competitors in a geographic area. Holmes and Schmitz Jr (2010) survey the competition and productivity literature and explain some of the disadvantages of using measures such as concentration, profits, and price-cost margins to proxy competition. As Syverson (2019) notes, these latter approaches are common when working at an aggregate level, but fall under the criticized structure-conduct-performance (SCP) paradigm within industrial organization.[5] Papers by Nickell (1996), Aghion, Bloom, Blundell, Griffith, and Howitt (2005), and Griffith, Harrison, and Simpson (2010) follow the SCP paradigm but attempt to overcome endogeneity caused by omitted variables and reverse-causality. They do this by exploiting firm-level panel data with fixed effects, and, for the latter two, using instrumental variable estimation. They instrument competition, measured by profits, with product market reforms. They show that these market reforms are correlated with competition (profits), but unrelated to innovation which proxies productivity.

Competition & Productivity in the UK: Disney, Haskel, and Heden (2003) show that half of improvement in labour productivity between 1980-1992 in UK manufacturing firms arises from competition due to between-firm reallocation and market selection. Several papers focus on the relationship between competition and innovation which proxies productivity. The empirical consensus is that competition enhances innovation and therefore productivity. This result contradicts traditional theory. Blundell, Griffith, and Van Reenen (1999) show this through a linear relationship, whereas Aghion, Bloom, Blundell, Griffith, and Howitt (2005) explain there is an inverted-U relationship between competition and R&D. They use UK ARD data and measure competition by the inverse price-cost margin. This measure of the competition follows Nickell (1996). He uses various measures of competition, including number of com-

[5]The SCP approach was popularised by Bain (1951) and later criticized by Demsetz (1973). It assumes a causal link between market structure (e.g. concentration), the nature of competition and market outcomes such as prices, output and profits. Davis and Garcés (2009, Ch. 6) provide background and explain some of the pragmatic advantages of this approach.

petitors and survey answers, to show a positive relationship between TFP growth and competition for UK manufacturing firms. Griffith (2001) verifies this result across a broader range of UK industries. She uses the introduction of the EU single market to instrument competition.[6] Griffith, Harrison, and Simpson (2010) expand this technique to a larger number of EU countries and emphasize the positive effect of competition on innovation and in turn productivity growth.

UK Productivity Puzzle

The UK productivity puzzle usually refers to labour productivity, but it also appears in TFP (Goodridge, Haskel, and Wallis 2016). In 2008, UK output (measured by GDP) fell sharply whilst declines in labour inputs were mild. This caused a severe drop in labour productivity. Typically declines in output are followed by declines in labour input which cause productivity to recover.[7] From 2011 to 2016, UK employment rose and output increased slowly. This caused labour productivity to grow slowly (Riley, Rincon-Aznar, and Samek 2018). Barnett, Batten, Chiu, Franklin, and Sebastia-Barriel (2014) find that labour hoarding had a small effect. Goodridge, Haskel, and Wallis (2013) explain that skilled labour was hoarded, but switched to producing intangible output that is poorly measured. This explains both the resilience of employment and the decline in measured output. Schneider (2018) shows that the UK's weak productivity growth since the Great Recession is caused by a slowing frontier of highly productive firms. Firms with high productivity growth before the recession had much weaker productivity growth after the recession: *ailing superstars*. This differs from a popular view that the UK suffers with productivity *laggards*: too many small, unproductive firms (Haldane 2017). These two explanations focus on opposite ends of the productivity distribution. Du and Bonner (2016) study labour productivity in the UK using the same dataset as us (Business Structure Database). They show that a contributor to the slow down in aggregate productivity was the fall in within-firm productivity, particularly for single-employee firms. They also emphasize the role of entry and exit. Firms that exited were higher productivity than those that remained, whereas those that entered were low productivity. Crawford, Jin, and Simpson (2013) attribute the slow down in labour productivity to a fall in investment within firms. Riley, Rosazza-Bondibene, and Young (2015) show that between-firm reallocation of business from low productivity to high productivity firms was inhibited in the recovery from the Great Recession. The gap between projected pre-crisis productivity growth and post-crisis actual productivity growth is known as the labour productivity

[6] Griffith (2001) used establishment data from 1980-1996.

[7] This is what happened in the US where there was an initial fall in productivity but quick recovery. In the extreme case of Spain, labour input fell so severely that productivity increased despite a severe decrease in GDP.

gap. Riley, Rincon-Aznar, and Samek (2018) show that three-fifths of the gap is due to slowing productivity in three sectors: manufacturing; financial and insurance services; information and communication services. These sectors had high growth rates before the crisis which declined rapidly afterwards.

Outline

In Section 2 we discuss our data. In Section 3 we present descriptive statistics including our main plots of concentration and business dynamism. In Section 4 we analyse the relationship between labour productivity and concentration. In Section 5 we conclude.

2 Data

Our data source is the Business Structure Database (BSD). The BSD is a firm-level dataset provided by the UK Office of National Statistics (ONS) to accredited researchers. It includes basic information on the near population of UK firms (approx. 2m per year) and is annual 1997-2020. The data is collected for tax purposes. There are variables on the number of employees at a firm and its turnover, which allows us to approximate labour productivity as turnover per employee. A firm is on the BSD if it qualifies for value-added tax (turnover exceeds £85,000 in 2022) or has at least one payroll employee. Firms are recorded as enterprise units and local units. Enterprise units include a collection of local units. 97% of enterprise units have a single local unit, so for most firms the units are equivalent. We use enterprise units because it includes turnover data. The advantage of the BSD is its near universal coverage of UK firms. This makes it an ideal dataset for studying concentration and entry and exit which require data on the entire market.[8] This differs from many studies of concentration that use proprietary datasets which cover larger, limited liability, firms (e.g. Orbis, Compustat and Worldscope) but are unrepresentative of sole proprietors who make up roughly half of the UK business population. The main variables of interest for us are employment, turnover and industry. There is also information on birth year and death year but we calculate entry and exit based on activity not these variables. This is consistent with ONS calculations.

[8]Constructing reliable entry and exit figures is a valuable contribution. It is possible because we observe the population of UK firms. It is difficult to establish entry statistics in data-sets that subsample the population because firms 'enter' and 'exit' the data-set for administrative reasons.

2.1 Full Sample and Sub-sample

We present descriptive statistics for a full-sample and a sub-sample of the dataset. The sub-sample excludes subsectors that are known to be poorly measured or in which using turnover to represent output is misleading.

1. *Full-sample*: Includes all 1-digit subsectors.
2. *Sub-sample*: Excludes 9 1-digit subsectors. The following are excluded: Financial sector; Agriculture; Mining; Electricity; Water; Real Estate; Public Administration and Defense; Education; Human Health and Social Work Activities.

The sub-sample contributes half of aggregate sales and a third of employment. The financial sector accounts for the largest turnover in aggregate UK turnover in the BSD followed by the Wholesale sector. In the case of employees, Education, Public Administration, Human Health represent a significant portion of employment and accounts for the difference between the full sample and sub-sample aggregate employees. For our regression analyses and descriptive statistics at a granular industry level, we do not omit sectors because are they are controlled for either with fixed effects in regressions or because we are analysing at the industry level.

Section (SIC07 1-digit)	No. of Divisions (SIC07 2-digit)	Full sample	Sub-sample
Agriculture, Forestry and Fishing	3	✓	
Mining and Quarrying	5	✓	
Manufacturing	24	✓	✓
Electricity, Gas, Steam and A/C	1	✓	
Water Supply and Waste Management	4	✓	
Construction	3	✓	✓
Wholesale, Retail and Motor Trade	3	✓	✓
Transport and Storage	5	✓	✓
Accommodation and Catering	2	✓	✓
Information and Communication	6	✓	✓
Financial and Insurance Services	3	✓	
Property (Real Estate Activities)	1	✓	
Professional, Science and Tech.	7	✓	✓
Administrative and Support Services	6	✓	✓
Public Administration	1	✓	
Education	1	✓	
Human Health and Social Work	3	✓	
Arts, Entertainment and Recreation	4	✓	✓
Other Services	3	✓	✓
Household Production	2		
Extraterritorial Activities	1		
Total Divisions	**88**	**85**	**63**

Household Production and Extraterritorial Activities are always omitted.

Table 1: Full Sample and Sub-sample

3 Descriptive Statistics

In this section we aggregate the firm-level data and study how the broad trends compare to well-known aggregate trends.[9] Although the BSD covers the near population of firms there are jumps in coverage when a new set of firms is added. Figure 2 shows an increasing trend in the number of firms (enterprises) and there are declines during the Great Recession.[10] This suggests the effect of changes in coverage of firms is small in aggregate.

[9] The underlying data is reported in a table in the appendix.

[10] Measures of the number of firms, entry and exit do not include the year 1997.

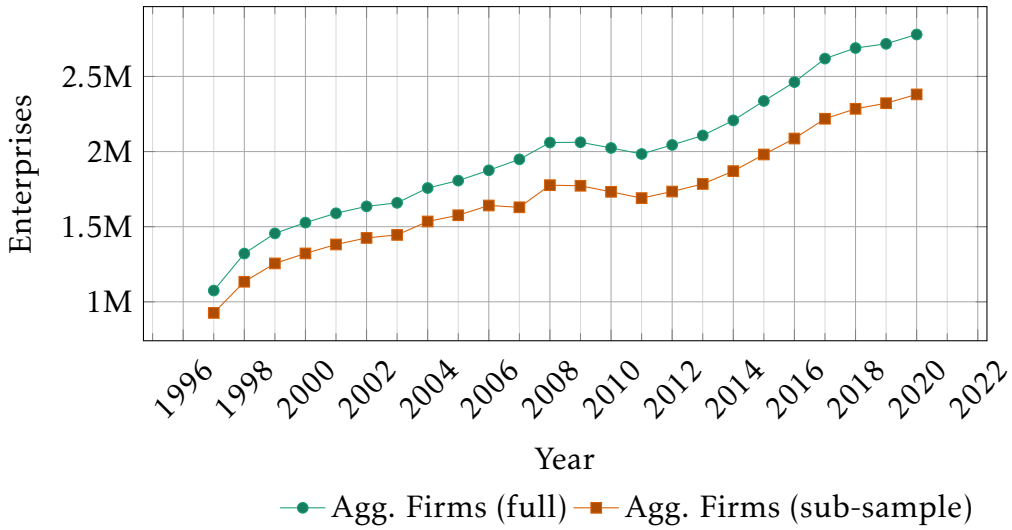

Figure 2: Aggregate Firms (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

Additional firms were added in 2008, 2012, 2014 and 2015. In 2008, the ONS added PAYE only firms. These are firms below the VAT turnover threshold, but that have a registered employee. In 2012, other firms were added due to HMRC update. In 2014 and 2015, additional firms were registered for PAYE. Annual observations in the BSD may correspond to a firm's economic activity over the previous two calendar years. This is because the snapshot is taken early in the calendar year and it summarises the most recent accounts the firm has submitted. This would explain the lagged decline in number of firms over the Great Recession.

3.1 Sales, Employees and Labour Productivity

First we show the underlying components of labour productivity which is the ratio of sales to employees, and then labour productivity itself. These three plots reassure us that the firm-level data captures the main trends in the aggregate data.

Figure 3 presents aggregate real sales (2016 prices) for the sub-sample and full sample.[11] Aggregate sales is the sum across all firms in a given year. A puzzling trend in the full sample is high and declining sales 1997-2003, which disappears in the sub-sample when financial services and other sectors are dropped. This trend causes differences between the full and sub-sample for variables based on sales such as concentration and labour productivity. Since sales is our proxy for output which is usually measured by GDP or GVA, it should broadly correspond to GDP trends.[12]

[11] Price adjustment for the real series are applied at the 2-digit level before aggregation. The price deflators for each 2-digit industry are given by the ONS.

[12] Sales are a flawed proxy for GDP because they include the value of intermediate goods. This creates double-counting that is exacerbated when there are firms with long value-chains. The BSD only includes sales data. There is no information on value-added. We provide a supplementary data appendix which covers these issues.

This seems to be the case. Both samples show an upward trend in aggregate sales over the 2000s with a dip in 2010-2011 that (given the timing considerations of the BSD) corresponds to the recession period of 2008-2009.[13]

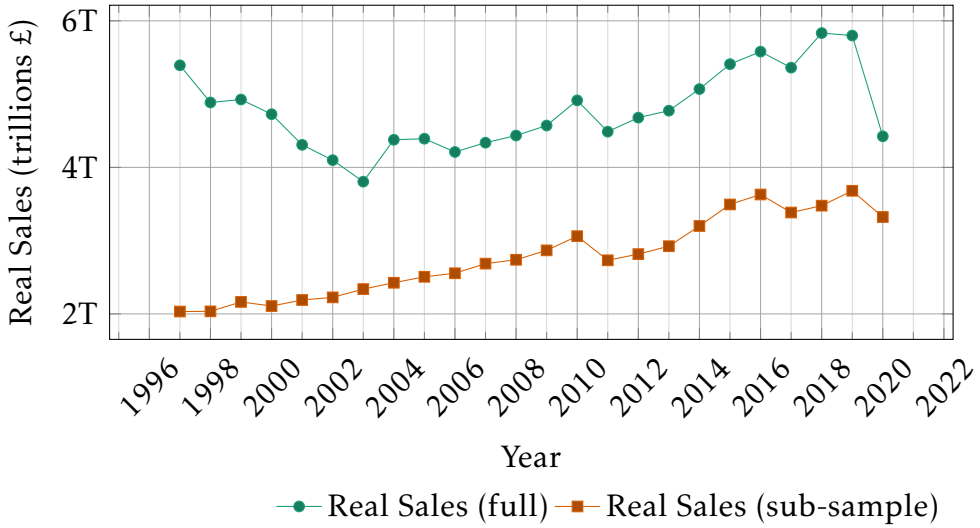

Figure 3: Aggregate Real Sales (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

Figure 4 shows aggregate employment data in the BSD. It also reflects documented aggregate trends. Comparing BSD employment data to aggregate UK employment data shows that firms in the BSD covers about 98% of total UK aggregate employment. As at the first quarter of 2018, UK employment was 32.34 million while BSD employment data captured in March 2018 was 31.64 million. The trend in BSD employment is similar to aggregate employment with a lag of one year. Before 2010, aggregate UK employment was at its peak in 2008 while aggregate BSD employment was at its peak in 2009. This shows the firms in the BSD covers a significant portion of UK business activity.

[13] Due to BSD timings, we might expect a lag of 2 years which means economic activities in 2009 goes mostly to 2011 BSD records.

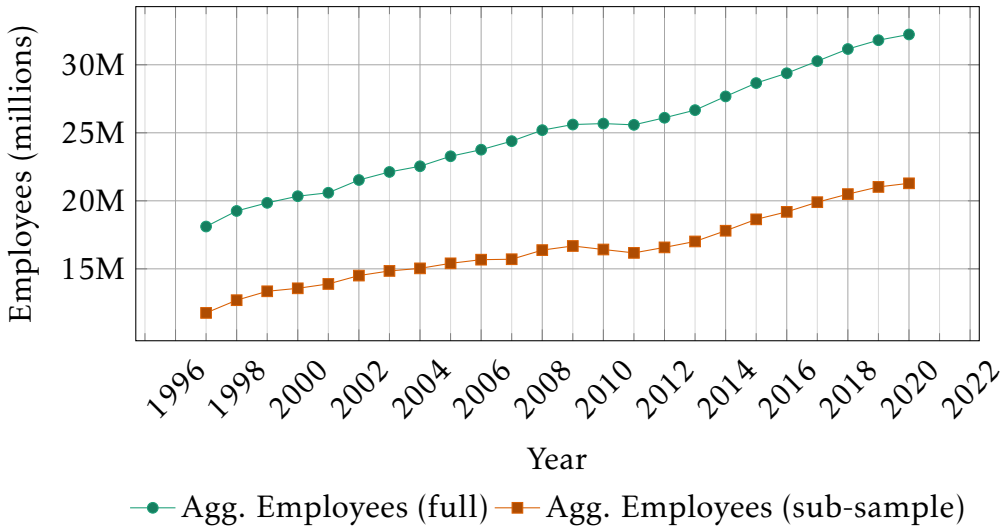

Figure 4: Aggregate Employees (BSD, 1997-2020)

Source: Authors' calculation based on BSD 1997-2020

Figure 5 plots aggregate labour productivity according to the BSD data. Labour productivity is calculated as aggregate real turnover divided by aggregate employees in a given year.[14] Both samples capture a peak in labour productivity in 2010 followed by a stark decline and subsequently low growth. The sub-sample captures the pre-crisis period better than the full sample which shows sharply declining productivity from 1997-2003.[15] In the sub-sample, there is steady growth in labour productivity over the 2000s, which declines in tandem with the Great Recession, and follows a slower growth path after 2011.[16] In both samples, the significant increase in labour productivity in 2010 is due to the increase in sales which was accompanied by a slight fall in the number of employees.

[14] In a supplementary graphs appendix we plot average labour productivity across firms. That is, we calculate firm-level productivity and then take the simple mean across all firms. The trend is similar.

[15] This early decline in labour productivity is because of the decline in aggregate sales over the same period (Figure 3), whereas employment over the same period (Figure 4) has little effect as it shows a consistent increasing trend.

[16] Remember that 2011 in the BSD is capturing economic activity for 2009 and 2010.

Figure 5: Aggregate Labour Productivity (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

3.2 Product Market Concentration

Concentration ratios (CRN) represent the sales share of the biggest N firms in a market. The market can be the whole economy or granular sectors. Figures 6 and 7 report concentration ratios for the aggregate economy, treating the whole economy as the market. For example, CR5 represents the sales share of the largest five enterprise units in the dataset. Figure 6 shows that aggregate measures of concentration are stable to decreasing in the UK over the period 1997-2020. There is an increase in concentration from 2009-2010 which typically occurs when firms exit during recession. The CR5 measure fluctuates around the 5% level from 2008 onwards. The implication is that one twentieth of all sales in the UK go through the largest five firms.[17] Figure 7 shows that in the sub-sample concentration ratios increase up to 2016 but declined rapidly afterwards. CR5 more than doubled (4% to 10%) from 1998-2016.[18] The rapid decline in 2020 suggest that the size of the top 5 firms in the economy fell more than proportionally than total market size. This suggests the COVID-19 pandemic disproportionately affected larger firms.

[17] In a supplementary graphs appendix we plot average CR5 across the main sectors. We weight each sector by its revenue share and find similar results.

[18] The spike in concentration in 1997 might be due to under-reporting of smaller firms. If the aggregate economy is missing smaller firms this reduces total sales and increases the relative size of large firms.

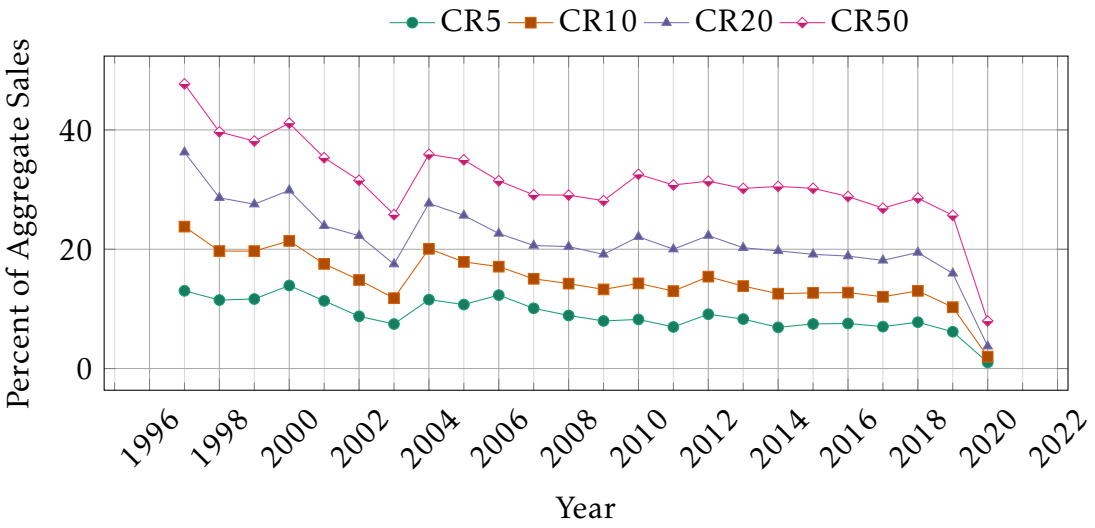

Figure 6: Concentration Ratios for Full Sample (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

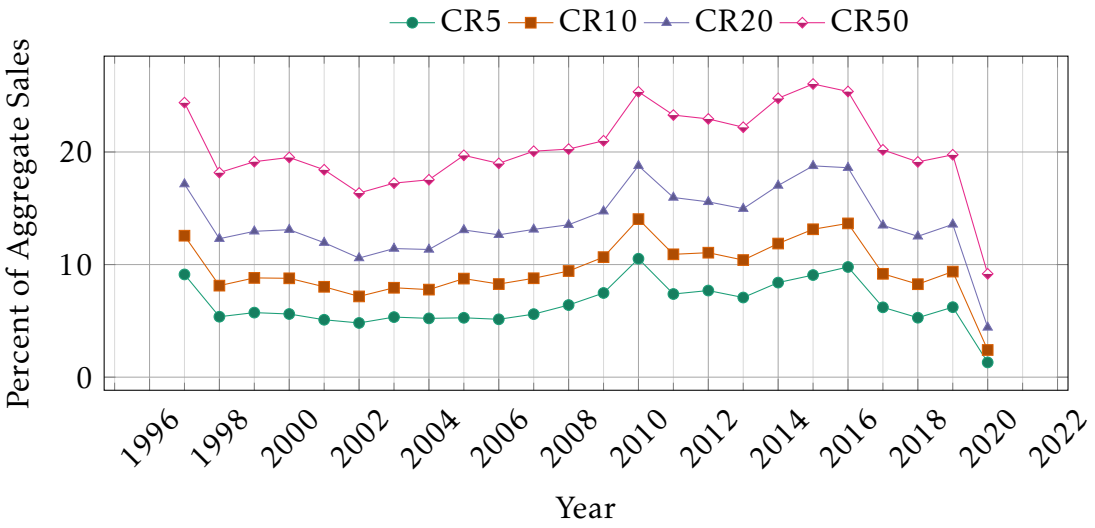

Figure 7: Concentration Ratios for Sub-sample (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

3.2.1 Concentration Aggregated from 5-digit SIC Sectors

Figure 8 plots the statistics for each measure of concentration ratio aggregated from the most granular industry definition (5-digit SIC). There are approximately 800 5-digit SIC industries each year and we present the median and mean CR*N* across these industries concentration level each year. We observe an increasing trend across all measures over the period, and this is particularly strong for the median measure. In terms of levels, the mean always exceeds the median which suggests there is a tail of high-concentration industries. For CR5, the median 5-digit industry has 15-20% market share among the top 5 firms and in the average industry the top 5 firms have 20-25% of market share. Both measures imply nearly one fifth of the market held by

a small group of firms. The remaining measures CR10, CR20 and CR50 each increase the amount of market share held as a wider number of firms is taken into consideration, and the increasing trends become starker. For CR10, the amount of market share for the median 5-digit industry increases from 20% to 25% over the period in consideration.

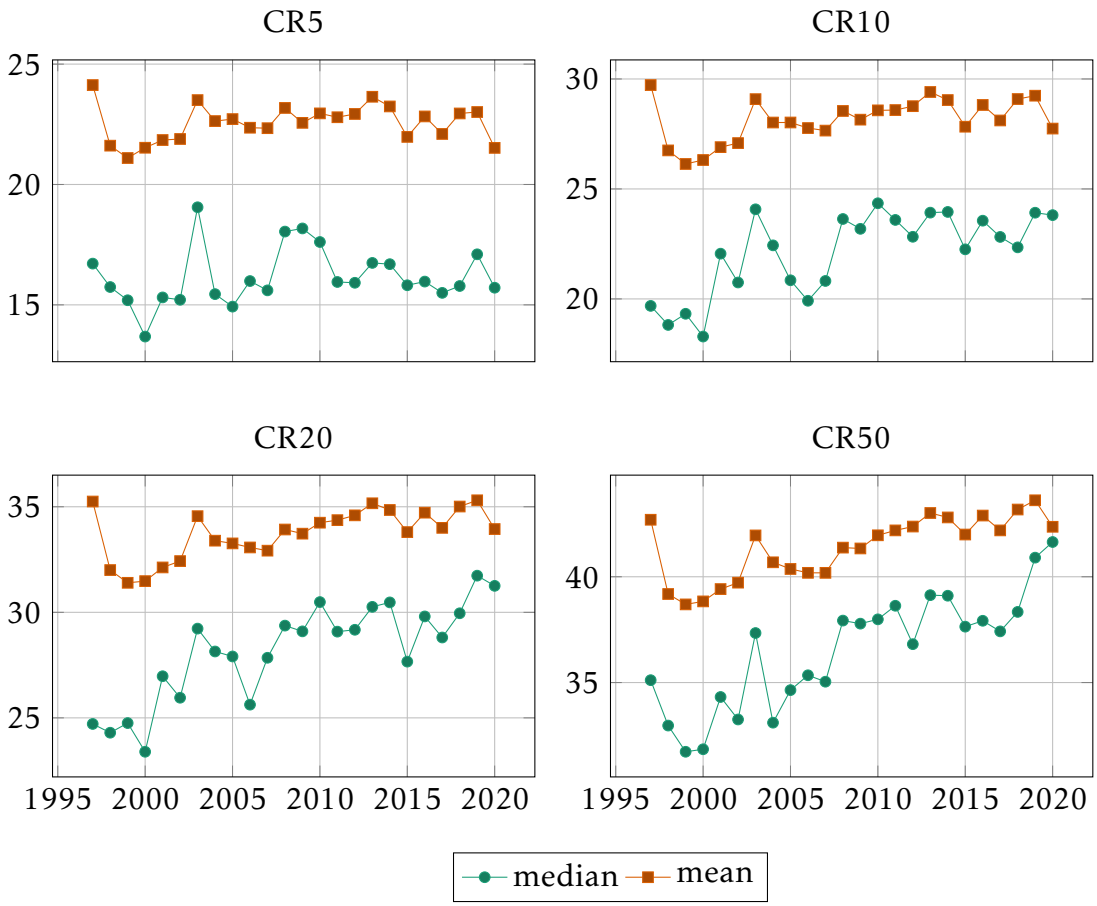

Figure 8: Aggregated Concentration Ratios for Full Sample from 5-digit SIC

Note: We calculate concentration at the the 5-digit SIC. Then, we aggregate the measure for all sectors and present the basic statistics in the plot. Each panel presents the top 5, 10, 20, or 50 firms.

Source: Authors' calculation based on BSD 1997-2020

3.2.2 Concentration Distribution across 5-digit SIC Sectors

Figure 9 shows the evolution of the distribution of CR5 at the 5-digit level. We observe the density of the distribution shifting right over time. This reflects more 5-digit industries with higher levels of concentration. This is consistent with the growth in median and mean concentration that we document in figure 8.

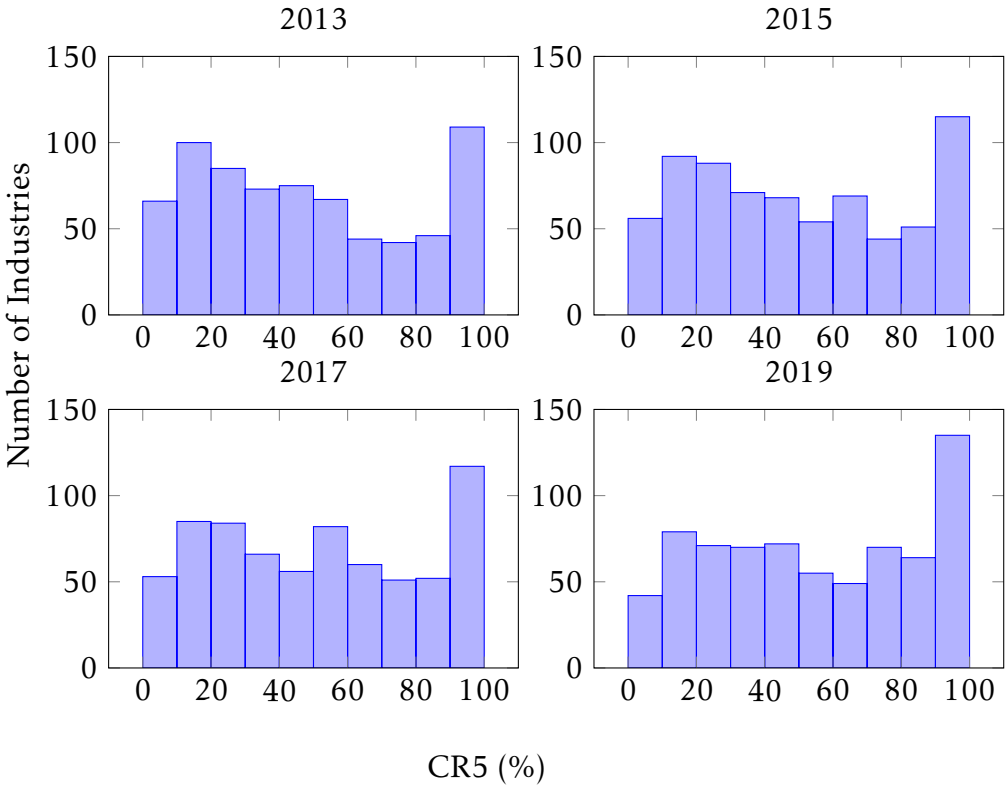

Figure 9: CR5 Distribution at 5 digit, by year

In figures 10 and 10 we classify sections of the distribution and plot their evolution over time. Figure 10 shows changes in the percentage of industries that have high and low CR5 from 1997-2020. We classify two parts of the concentration distribution CR5: 0-20% represents low concentration industries and CR5: 80-100% represents high concentration industries. Over the period, low concentration industries fall from over 20-25% of 5-digit industries to under 20% of 5-digit industries.

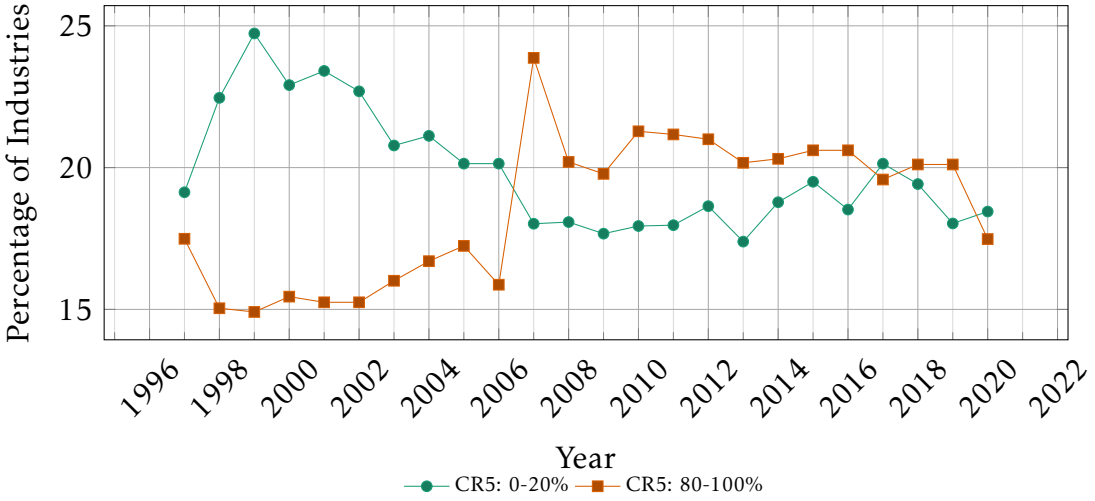

Figure 10: Percentage of high and low CR5 industries, 1997-2020, 5-digit

In antitrust cases a common classification of industries is according to Hirfindal-Hirschman Index (HHI) which is the sum of squared market shares. We plot use the following classifications HHI: HHI between 0 and 1000 are low concentration industries, HHI between 1000 and 1800 are medium concentration industries, HHI between 1800 and 10000 are high concentration industries (Whish and Bailey 2021, p.43).[19] According to this classification, figure 11 between 25-30% of industries are high concentration and this has increased over the sample period. The level of moderately concentrated industries is stable at 15%. The remaining 50-60% of industries are low concentration.

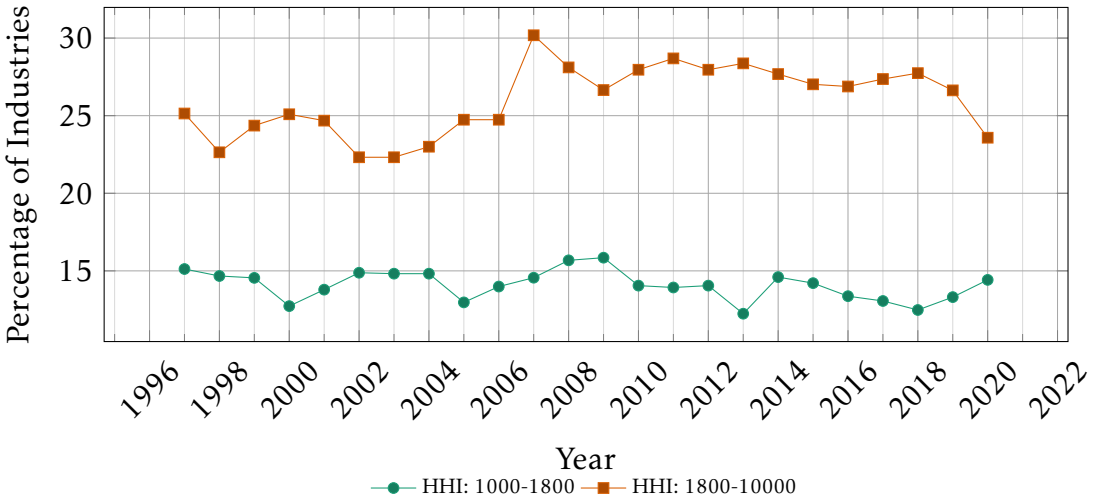

Figure 11: Percentage of high and medium HHI industries, 1997-2020, 5-digit

In the appendix we provide further analysis of concentration at the BSD sector level.

3.3 Business Dynamism: Entry, Exit and Net Entry

Entry statistics are a measure of *business dynamism*. Net entry is an alternative indicator of competition, also called *business churn*. Figures 12 and 13 show that the aggregate entry statistics have a flat trend between 1998-2020 which suggest stable business dynamism. These measures are for entry and exit in the whole macroeconomy, not averaging entry and exit statistics across different industries. The fluctuations we observe are consistent with the business cycle. In the Great Recession period net entry is negative as entry decreases and exit increases. Entry appears to be more volatile than exit, which is consistent with other work (Lee and Mukoyama 2015; Tian 2018). Unlike our other variables, we do not have data for 1997 for entry and exit. We determine entry as the first year that a firm is recorded as being active and records

[19] Paragraph 16 of the European Commission's *Guidelines on the assessment of horizontal mergers*.

employees and turnover as non-zero or not missing. Exit is the first year the firm is recorded as being inactive having been active the previous year or the first year a firm records turnover and employees as zero.

Figure 12 shows aggregate firm dynamics patterns for the full sample. Entry and exit co-move except in recessionary periods when entry declines and exit increases. Between 2008-2011, there was an fall in the number of firms entering and an increase in the number of firms exiting, so net entry became negative. Entry rates have been high since 2013. In 2020, regardless the pandemic and the two national lockdown periods in the UK, entry remained stable relative to 2019. This is because BSD data for 2020 predominantly reports on business activity up until April 2020.

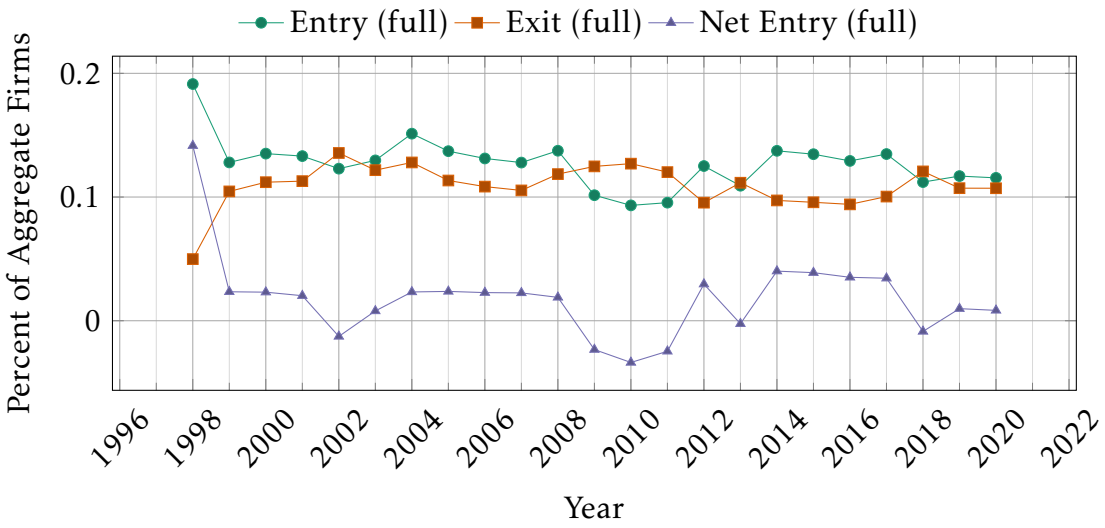

Figure 12: Aggregate Entry and Exit Rate for Full Sample (BSD, 1998-2020)
Source: Authors' calculation based on BSD 1998-2020

Figure 13 shows that the entry and exit rates for the sub-sample are similar.

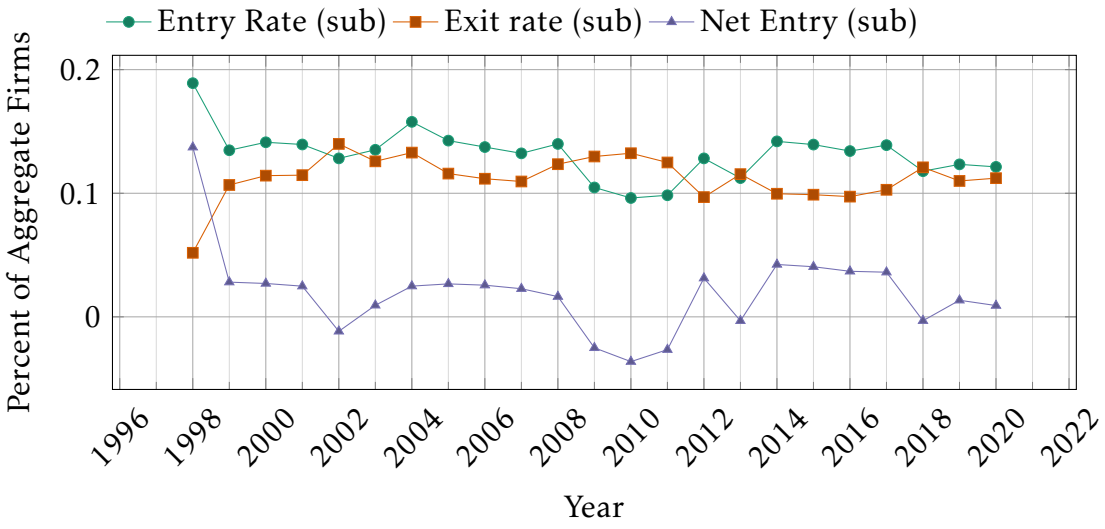

Figure 13: Aggregate Entry and Exit Rate for Sub-sample (BSD, 1998-2020)
Source: Authors' calculation based on BSD 1998-2020

In the appendix we provide further analysis of business dynamism at the BSD sector level.

4 Concentration and Productivity

We use a reduced-form regression analysis to study the relationship between concentration and productivity.

4.1 Empirical Methodology

The dependent variable is labour productivity and the main independent variable is concentration. We also include net entry as an alternative indicator of competition. Our regression specification is:

$$\begin{aligned}\text{Productivity}_{\imath\jmath t} = \alpha_\jmath + \alpha_t + \beta_1 \text{Concentration}_{\jmath t-1} + \beta_2 \text{Net Entry}_{\jmath t-1} \\ + \beta_3(\text{Concentration}_{\jmath t-1} \times \text{Net Entry}_{\jmath t-1}) + \gamma^\intercal \mathbf{x}_{\imath\jmath t} + \varepsilon_{\imath\jmath t} \qquad (1)\end{aligned}$$

The subscript $\jmath$ indicates a sector and $\imath$ indicates a firm. We consider 2-digit SIC sectors. There are 85 2-digit sectors. Concentration and net entry are sector-level variables, whereas $\mathbf{x}$ is a vector of firm-level control variables to account for other factors that may influence productivity. The firm-level controls are market share, firm size and firm age. The dependent variable, productivity, is also at the firm level. We use industry ($\alpha_\jmath$) and year (α_t) fixed effects.

Table 2 reports the measure that we use for each variable in equation (1). Our main measure of concentration is CR5. We use CR5, rather than CR10, CR20, CR50 or HHI, because a lower number of firms better captures weak competition. That is, it is easier to sustain anti-competitive practice with high market share among fewer firms.[20]

[20] In the appendix, we perform a sensitivity analysis of our results to alternative measures of concentration.

Variable	Measure	Unit
Productivity	$\log\left(\frac{\text{Real Sales}_{\iota jt}}{\text{Employees}_{\iota jt}}\right)$	Log
Concentration	$\text{CR5}_{jt-1} = \frac{\sum_{\iota=1}^{5} \text{Real Sales}_{\iota jt-1}}{\text{Real Sales}_{jt-1}} \times 100$	% of market
Net Entry	$\frac{\text{Births}_{jt-1} - \text{Deaths}_{jt-1}}{\text{Firms}_{jt-1}} \times 100$	% of active firms
Market Share	$\frac{\text{Real Sales}_{\iota jt}}{\text{Real Sales}_{jt}} \times 100$	% of market
Age	$\text{Birth Date}_{\iota j} - \text{Death Date}_{\iota j}$	Years
Size	$\log\left(\text{Employees}_{\iota jt}\right)$	Log

Table 2: Variables and Corresponding Measure in the Data

Estimation Strategy

We use first-difference estimation to estimate regression (1).[21] First-difference estimation accounts for unobservable firm-specific effects. We use first-differences instead of fixed effects due to computational restrictions in the secure lab. We account for within-cluster error correlation by clustering standard errors at the sector level. A disadvantage of using both first-difference estimation and lagged independent variables is that we lose at least two observations per firm in the regression analysis. This accounts for the difference in observations recorded in the summary statistics table and regression tables.

Regression specification (1) suffers from reverse causality. Increased concentration *causes* productivity to decrease if it causes anti-competitive behaviour. However, increased productivity *causes* increased concentration if productive firms increase their market share. The former relationship implies a negative causal relationship from increased concentration to decreased productivity, whereas the latter relationship implies a positive causal relationship from increased productivity to increased market power. To mitigate the effect of this form of endogeneity we use a lagged measure of concentration.

We include 'Net Entry' as an alternative indicator of competition in an industry. Net entry should keep incumbent firms operating efficiently. Therefore we would expect it to have a positive coefficient. Similarly to concentration, net entry also suffers from the reverse-causality problem. That is, net entry might increase productivity because it keeps incumbent firms operating efficiently. However, high-productivity industries may encourage more entry.[22] Both directions of causality imply a positive

[21] In the appendix we provide pooled OLS estimates.

[22] This could be because of a new technology. If technological innovations are industry-specific, this is controlled for in by the fixed effects. The problem would be more prominent with an aggregate

relationship. Similarly to concentration, we mitigate the reverse-causality between labour productivity and net entry by using lagged measures of net entry.

We include a 'Concentration × Net Entry' interaction term. We expect that when net entry is high then an industry does not face weak competition. Therefore the effect of concentration on productivity will be less negative when net entry is high and could be positive if the presence of concentration occurs when there is high net entry as concentration is increasing due to high-productivity firms out-competing entrants. Conversely, if net entry is low this implies little competition so the effect of concentration should be more negative.[23] In other words, we use net entry as an indicator of whether concentration is taking place for 'good' (productive frontier) or 'bad' (anti-competitive behaviour) reasons.

Regression Variable Summary Statistics

Variables	**Obs.**	**Mean**	**Median**
Productivity	40,610,710	75,360	77,650
CR5 (%)	41,313,405	16.95	14.05
Net Entry (%)	41,313,405	1.78	1.14
Market Share (%)	41,313,405	0.00	0.00
Firm Age	41,313,405	10.39	7
Employees	41,313,405	12.72	2

Table 3: Summary Statistics

Table 3 presents summary statistics of variables used in the regression. CR5, net entry and market share are percent of 2-digit industry. Productivity, age and employees are firm level. The average labour productivity is £75,000, which implies a worker generates £75,000 sales for a firm in a year. This figure appears high and might be inflated because the dataset excludes firms that do not pay VAT (revenue below £85,000 in 2018) and have no employees.[24] For context, average real income over the period 2000-2018 is roughly £28,000 (2020 prices). This implies a 37% share of wages in sales. CR5 shows average concentration ratios across two-digit industries. On average, the top 5 firms account for 17% of turnover. Average net entry at a two-digit industry is 1.8% of total firms in the industry, which implies a net increase in firms

industry-wide technology improvement.

[23]This interpretation focuses on the effect of concentration, given net entry behaviour. However, there are two interpretations of an interaction term: the relationship between productivity and net entry depends on concentration or the relationship between productivity and concentration depends on net entry. The alternative interpretation is that the effect of net entry will vary depending on the level of concentration. When concentration is high, net entry should have a stronger positive effect on productivity.

[24]Firms with sales below the VAT threshold are included if they have a PAYE employee.

each year. Market share shows that on average firms are very small. An average firm accounts for 0.004% of sales in its two-digit industry. Median firm age is 7 years while the median number of employees (firm size) is 2. The difference between mean and median for firm size implies there is a large number of small firms (positive skew).

4.2 Regression Results

The results for our regression are in Table 4[25].

Table 4: The Effect of CR5 on Log Labour Productivity

	All Firms 1	**All Firms** 2	**All Firms** 3	**Services** 4	**Production** 5
Δ CR5$_{t-1}$	-0.0677**	-0.0688**	-0.0671**	-0.0729*	0.00464
	(0.0269)	(0.0276)	(0.0268)	(0.0374)	(0.0345)
Δ Net Entry$_{t-1}$	0.0530	0.0331	0.0418	0.0915	-0.0792
	(0.0579)	(0.0732)	(0.0677)	(0.0866)	(0.0707)
Δ(CR5$_{t-1}$ $\times$ Net Entry$_{t-1}$)		0.128	0.0972	0.0243	0.0286
		(0.204)	(0.182)	(0.249)	(0.158)
Δ Market Share$_t$			0.192***	0.298***	0.110***
			(0.0323)	(0.0438)	(0.0279)
Δ Firm Age$_t$			0.00653**	-0.000647	0.00524
			(0.00298)	(0.00384)	(0.00340)
Δ Firm Age$_t^2$			-0.000178**	-0.0000108	-0.000116
			(0.0000779)	(0.000111)	(0.0000739)
Δ Firm Size$_t$			-0.564***	-0.510***	-0.621***
			(0.0375)	(0.0224)	(0.0555)
Δ Firm Size$_t^2$			-0.000214	-0.00529	0.00853
			(0.00538)	(0.00777)	(0.00992)
Industry FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
N	31,914,138	31,9148,138	31,9148,138	16,190,002	3,392,781
R^2	0.003	0.003	0.106	0.084	0.146
Clusters	85	85	85	39	37

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Regressions are in first difference.

Dependent variable is log labour productivity.
CR5, net entry and market share are measured at 2-digit SIC industry level.
Coefficients and SE for CR5 and Net Entry are multiplied by 100 (*i.e.* variable unit is divided by 100.)
Standard errors are clustered at 2-digit industry level. Sales are constant 2016 values.
All variables are in levels, except firm size which is in logs.
Industry FE are at the 2-digit sector level.

The results in Table 4 show a statistically significant negative relationship between

[25]In the appendix we provide results for pooled OLS regressions. These do not control for firm FE. The results have a similar economic significance but are less statistically significant. The interpretation of the pooled-OLS and FD regressions are the same.

concentration and labour productivity in columns 1 to 3. Higher concentration levels are associated with lower labour productivity levels in an industry. The results in column 3 have the following economic interpretations: A 1 percentage point increase in CR5 decreases productivity by 0.067%. A 1 percentage point increase in net entry increases productivity by 0.042%. A 1 percentage point increase in market share increases productivity by 19.2%. A 1 year increase in firm age increases productivity by 0.0065%, but at a decreasing rate. A 1% increase in firm size (employees) decreases productivity by 0.564%.

In terms of economic significance, our relationship suggests a 5 percentage point increase in CR5 corresponds to a 0.34% fall in productivity levels. Since average labour productivity is approximately £80,000 sales per worker per year, then a five percentage point increase in CR5 corresponds to a £280 decrease in sales per worker per year.

Specific Sector Regressions: Services & Production

Columns 4 and 5 of Table 4 report the relationship between concentration and productivity by sector. We analyse the two largest BSD sectors *Production* and *Services*.[26] The results show opposite effects of concentration on labour productivity across the two sectors. In Services there is a negative and significant effect of concentration on productivity, whereas there is a positive but not significant effect in the production sector.

Concentration may be positively related to productivity in the production sector due economies of scale. If production requires a large overhead cost, then distribution of economic activity across small firms will under-utilise the overhead and damage productivity. Hence greater concentration, increases utilisation, which increases productivity. In the production sector, net entry has a negative relationship with productivity. This also supports a theory that entry leads to replication of fixed overhead costs that are under-utilized and weaken productivity. In the production sector the interaction term indicates a negative relationship between concentration and productivity that is worse when net entry is high. Hence greater concentration increases the negative effect of entry.

[26]These are ONS-specific aggregations of 2-digit sectors called 'BSD sectors'. They are used in the BSD and other business datasets because they correspond to sampling frames used in business surveys. *Services* is called 'Other Services' by the ONS definition, see Appendix. These two sectors are the sectors comprising most 2-digit industries. In addition, they are the largest sectors, both in aggregate turnover and employment terms. Services accounts for 50% of total turnover and Production 15%.

5 Conclusion

We document product market concentration and entry dynamics in the UK using an administrative data set of all firms from 1997-2020. We show that the market share of the largest firms in the economy has not increased over the period: market concentration appears flat. However, the largest firms' market share increases for most of the period when finance is excluded. We show that trends in entry and exit, which represent *business dynamism*, are also flat over the period. Using measures of market concentration at the two-digit industry level, we find evidence that product market concentration and labour productivity are negatively related. The economic significance is modest, but not negligible. A large increase in concentration of 10 percentage points relates to a 0.4% decrease in labour productivity (revenue per worker).

Future work should investigate more sophisticated measures of market power and productivity.[27] However, it is a useful measurement exercise to document concentration trends in the UK given the current prevalence of concentration measures in policy, the media, and current interest in concentration trends elsewhere in the world.

[27] Hwang and Savagar (2020) investigate the relationship between markups and TFP in the UK.

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A Descriptive Statistics

A.1 Aggregate Time Series Statistics

Table 5 summarises the aggregate annual data. It also provides the share of the services and production sectors in total real sales. These are the largest two 1-digit sectors in aggregate real sales.

Year	Enterprises	Entry	Exit	Employees	Real Sales (£m)	Services (%)	Production (%)
1997	1,075,090			18,110,502	5,393,074	67.98	14.00
1998	1,321,225	252,814	65,833	19,255,092	4,885,578	62.50	15.01
1999	1,455,407	186,261	152,167	19,851,018	4,925,996	60.58	15.45
2000	1,527,201	206,318	171,039	20,339,884	4,725,748	61.76	15.04
2001	1,589,395	211,538	179,358	20,593,166	4,307,477	56.56	18.05
2002	1,635,202	201,040	221,751	21,530,486	4,098,721	53.53	18.65
2003	1,658,749	215,015	201,896	22,122,568	3,804,810	49.03	18.99
2004	1,757,446	265,778	224,877	22,541,196	4,376,894	55.41	16.24
2005	1,806,696	247,662	204,808	23,275,768	4,391,159	53.91	16.32
2006	1,875,485	246,033	203,362	23,758,580	4,209,926	51.77	16.80
2007	1,948,286	249,099	205,239	24,387,332	4,336,612	50.00	17.78
2008	2,060,091	283,115	244,176	25,195,884	4,434,510	51.10	15.51
2009	2,061,921	209,237	257,277	25,607,450	4,571,046	49.35	16.55
2010	2,023,946	188,748	257,003	25,677,764	4,914,382	49.31	16.26
2011	1,983,789	189,355	238,329	25,584,662	4,487,267	51.14	16.21
2012	2,044,154	255,651	195,104	26,105,020	4,678,756	52.03	16.05
2013	2,107,104	229,967	235,073	26,667,278	4,773,772	51.57	16.70
2014	2,207,507	303,228	214,686	27,674,956	5,068,780	49.89	16.64
2015	2,336,886	314,610	223,760	28,656,576	5,408,977	48.31	17.67
2016	2,462,327	318,115	231,648	29,378,782	5,579,351	48.90	16.71
2017	2,618,596	352,843	262,859	30,270,348	5,360,783	52.35	15.39
2018	2,689,104	301,419	324,638	31,158,416	5,832,771	55.98	13.52
2019	2,717,045	317,733	291,165	31,808,436	5,798,924	52.49	14.59
2020	2,779,397	321,026	297,694	32,229,096	4,423,769	45.16	16.89

Table 5: Annual Aggregate BSD Data

A.2 Distributional Statistics for 2015

We present distributional statistics to show how sales and employment are distributed across firms in the BSD. The distributions are for the year 2015 which is representative of other years. We choose 2015 because it is recent but unlikely to be revised.

Table 6 shows distribution of firms across employees in 2015. The distribution is

similar for other years. Single employee firms account for 45% of the total BSD firms. Over 99% of firms have under 100 employees.

Employees	Firms	Percent	Cum.	Real Sales (£m)
1	1,060,525	45.43	45.43	153,786
2	406,316	17.41	62.84	109,225
3	187,666	8.04	70.88	67,827
4	124,764	5.34	76.22	72,063
5	87,978	3.77	79.99	53,954
6 to 10	215,051	9.21	89.2	229,694
11 to 20	128,081	5.49	94.69	248,639
21 to 30	41,996	1.8	96.49	122,748
31 to 40	21,425	0.92	97.41	108,212
41 to 50	12,710	0.54	97.95	128,132
51 to 100	24,674	1.06	99.01	277,719
101+	23,134	0.99	100	3,501,423
Total	2,334,320	100		

Table 6: Distribution of Firm Size in Terms of Employees (2015)

Table 7 shows distribution of firms across sales in 2015. The distribution is similar for other years. Over 90% of firms in the BSD have sales under £1,000,000 in a year.

Sales (£)	Firms	Percent	Cum.	Real Sales (£m)	Employees
0-5,000	37,969	1.62	1.62	94	77,855
5,000-10,000	25,513	1.09	2.70	213	42,755
10,001- 20,000	45,527	1.94	4.64	728	75,843
20,001- 50,000	228,764	9.74	14.38	8,752	327,214
50,001-100,000	591,252	25.17	39.56	46,257	998,451
100,001-200,000	580,682	24.72	64.28	84,006	1,400,068
200,001-500,000	439,756	18.72	83.00	141,726	2,086,626
500,001-1,000,000	176,710	7.52	90.53	127,279	1,735,846
1,000,001-2,000,000	100,718	4.29	94.82	143,580	1,735,349
2,000,001-5,000,000	68,069	2.9	97.72	213,849	2,274,852
5,000,001-10,000,000	25,441	1.08	98.80	180,066	1,834,762
10,000,001-100,000,000	24,420	1.04	99.84	665,594	6,009,688
100,000,001 and above	3,801	0.16	100	3,507,418	10,455,858
Total	2,348,622	100			

Table 7: Distribution of Firm Size in Terms of Sales (2015)

B BSD Relative to ONS Aggregates

To examine if BSD data reflects aggregate UK trends as reported by the ONS, we compared UK entry and exit rates in the BSD with ONS data. Table 8 shows ONS and BSD entry and exit rates in percentages. In most cases, ONS and BSD rates are approximately the same and, in some cases, there is a difference of 1-2%. According to ONS business demography, entry and exit rates are based on the Inter-Departmental Business Register (IDBR). Birth rate is calculated as the number of new registrations (VAT and PAYE) as a proportion of the active businesses. Active businesses are businesses that had either turnover or employment at any time during the reference period. Death rate is calculated using the number of deaths (de-registration of VAT and Pay As You Earn (PAYE)) as a proportion of the active businesses.

Year	ONS entry rate	BSD entry rate	ONS exit rate	BSD exit rate
2010	10	9.323	10.6	12.663
2011	11.2	9.539	9.8	11.977
2012	11.4	12.511	10.6	9.512
2013	14.1	10.915	9.7	11.114
2014	13.7	13.749	9.7	9.683
2015	14.3	13.4804	9.4	9.527

Table 8: Entry and Exit rate (percentages) in ONS and BSD data

C Regression Sensitivity Analysis

The additional regression results are for the time period 1997-2018.

C.1 OLS Regression

Table 9 shows the results from OLS regressions of four specifications, not first-differenced. There are more observations than our main regression table as the regression is not first differenced. The first row shows that the lagged concentration ratio is negative, consistent with our main results, but not significant at the 90% level. Net entry has no effect on productivity except in column 4 where sector and year fixed effects are absent. The interaction term between concentration and net entry is also insignificant. Market share has strongly significant positive effect. Age increases productivity, but at a decreasing rate, and firm size (employment) decreases productivity at an increasing rate.

Table 9: The effect of CR5 on Log Labour Productivity; OLS

	1	2	3	4	5
$CR5_{t-1}$	-0.060	-0.0597	-0.0468	0.399	-0.0384
	(0.090)	(0.095)	(0.103)	(0.268)	(0.103)
Net $Entry_{t-1}$		-0.195	-0.179	0.186**	-0.197
		(0.207)	(0.209)	(0.080)	(0.207)
$CR5_{t-1} \times$ Net $Entry_{t-1}$			-0.0994	-0.408	-0.0858
			(0.160)	(0.294)	(0.164)
Market $Share_t$				0.216***	0.203***
				(0.0435)	(0.0403)
Firm Age_t				0.0156***	0.0096***
				(0.0048)	(0.0028)
Firm Age_t^2				-0.0003**	-0.0002***
				(0.0001)	(0.00006)
Firm $Size_t$				-0.137**	-0.147***
				(0.0625)	(0.0503)
Firm $Size_t^2$				0.0108	0.0169*
				(0.0106)	(0.0090)
Industry FE	✓	✓	✓		✓
Year FE	✓	✓	✓		✓
N	35,041,501	35,041,501	35,041,501	35,041,501	35,041,501
R^2	0.096	0.096	0.097	0.014	0.106
Clusters	85	85	85	85	85

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Note: Standard errors are clustered at industry level. Sales are constant 2016 values.
CR5, net entry and market share are measured at 2-digit SIC industry level.
Coefficients and SE for CR5 are multiplied by 100 (*i.e.* the variable unit is divided by 100.)
Dependent variable: log labour productivity

C.2 Other Concentration Measures

Table 10 shows the effect of concentration on productivity using other measures of concentration. The concentration ratio (CRN measures) capture market share of the N top firms with the highest market shares while the HHI index represents concentration from all firms in the sector. The results show other measures of concentration have weak negative effects on productivity, usually greater than 1 standard deviation from zero, but not significant at the 90% level. In all specifications, we find that net entry and market share increase productivity, while firm size reduces productivity. This means smaller firms are more productive than larger firms.

Table 10: The Effect of Different Measures of Concentration on Log Labor Productivity

	1	**2**	**3**	**4**
$\Delta CR10_{t-1}$	-0.0334			
	(0.0210)			
$\Delta(CR10_{t-1} \times \text{Net Entry}_{t-1})$	0.0051			
	(0.0376)			
$\Delta CR20_{t-1}$		-0.0321		
		(0.0216)		
$\Delta(CR20_{t-1} \times \text{Net Entry}_{t-1})$		0.0038		
		(0.0363)		
$\Delta CR50_{t-1}$			-0.0291	
			(0.0222)	
$\Delta(CR50_{t-1} \times \text{Net Entry}_{t-1})$			-0.0017	
			(0.0361)	
ΔHHI_{t-1}				-0.0073
				(0.0053)
$\Delta(HHI_{t-1} \times \text{Net Entry}_{t-1})$				-0.0037
				(0.00593)
Δ Net Entry$_{t-1}$	0.107**	0.107**	0.109**	0.112**
	(0.0494)	(0.0492)	(0.0492)	(0.0508)
Δ Market Share$_t$	0.188***	0.188***	0.188***	0.188***
	(0.0329)	(0.0329)	(0.0329)	(0.0329)
Δ Firm Age$_t$	0.00274	0.00275	0.00276	0.00274
	(0.00296)	(0.00296)	(0.00296)	(0.00296)
Δ Firm Age$_t^2$	-0.0001	-0.0001	-0.0001	-0.0001
	(0.00008)	(0.00008)	(0.00008)	(0.00008)
Δ Firm Size$_t$	-0.569***	-0.569***	-0.569***	-0.569***
	(0.0371)	(0.0371)	(0.0371)	(0.0371)
Δ Firm Size$_t^2$	-0.0007	-0.0007	-0.0007	-0.0007
	(0.0053)	(0.0053)	(0.0053)	(0.0053)
Industry FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
N	28,845,009	28,845,009	28,845,009	28,845,009
R^2	0.11	0.11	0.11	0.11
Clusters	85	85	85	85

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Regressions are in first difference.

Note: Standard errors are clustered at industry level. Sales are constant 2016 values. Concentration, net entry and market share are measured at 2-digit SIC industry level. Coefficients and SE for CR are multiplied by 100 and HHI by 1000.
Dependent variable is log labour productivity.

D Aggregate Plots

D.1 Average Labour Productivity

Figure 14 shows that average labour productivity has a decreasing trend.[28] Average labour productivity takes the average of labour productivity at the firm-level across all firms. That is, $\frac{\frac{y_1}{l_1}+\frac{y_2}{l_2}+...+\frac{y_N}{l_N}}{N}$ where N is number of firms and y_i for $i \in 1,...,N$ is revenue of a firm and l_i is employees at a firm. The fall in average labour productivity in 2011 is consistent with the post financial crisis productivity puzzle.

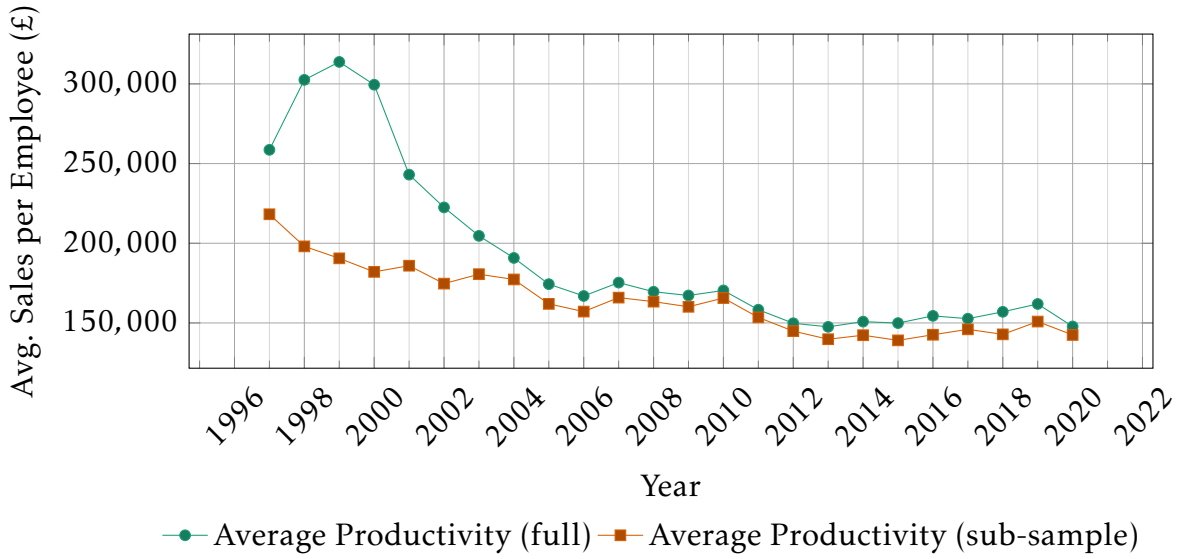

Figure 14: Average Firm Labour Productivity (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

D.2 Aggregate Nominal and Real Sales

Figure 15 shows aggregate nominal and real sales. This shows the effect of deflating nominal sales with the ONS 2016 deflator. Both nominal and real sales show an upward trend in aggregate sales over the 2000s with a dip in 2010-2011 which corresponds to the recession period of 2008-2009 given the timing considerations of the BSD. We use real sales throughout our analysis.

[28] Du and Bonner (2016) suggest that the decreasing trend in average labour productivity is due to an increase in single-employee firms.

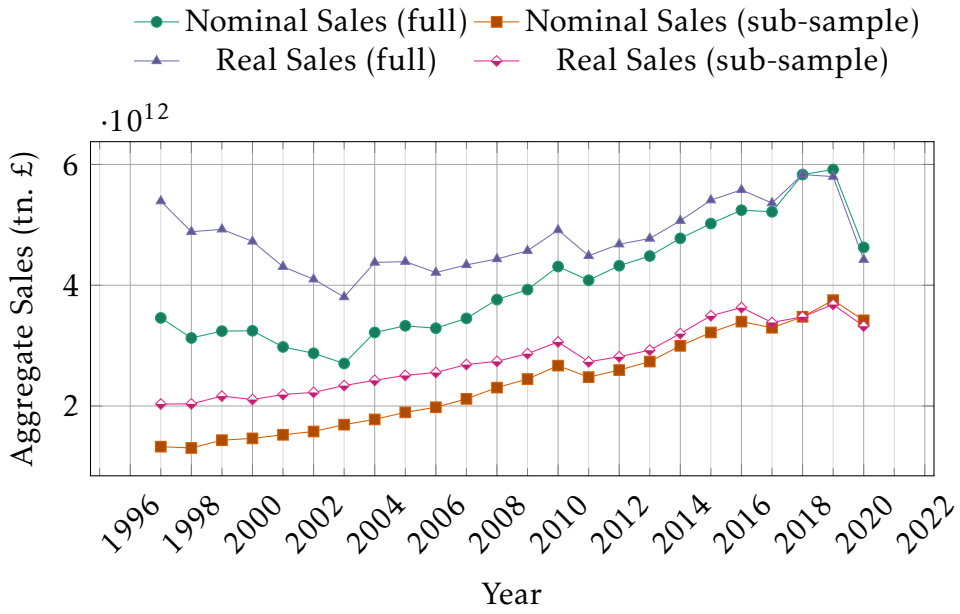

Figure 15: Aggregate Sales Real Vs Nominal (BSD, 1997-2020)
Source: Authors' calculation based on BSD 1997-2020

D.3 Aggregate Concentration Excluding Finance

Figure 16 shows an alternative, less restricted, sub-sample. It only excludes financial services from the full sample. The resulting figure shows a similar pattern to the sub-sample. Therefore the flat trend in Figure 6 is driven by the financial services sector. This emphasizes that the largest firms in the dataset are financial services firms. Therefore, we could re-interpret the trend in Figure 6 as a flat trend in the sales share of financial services firms in total sales.

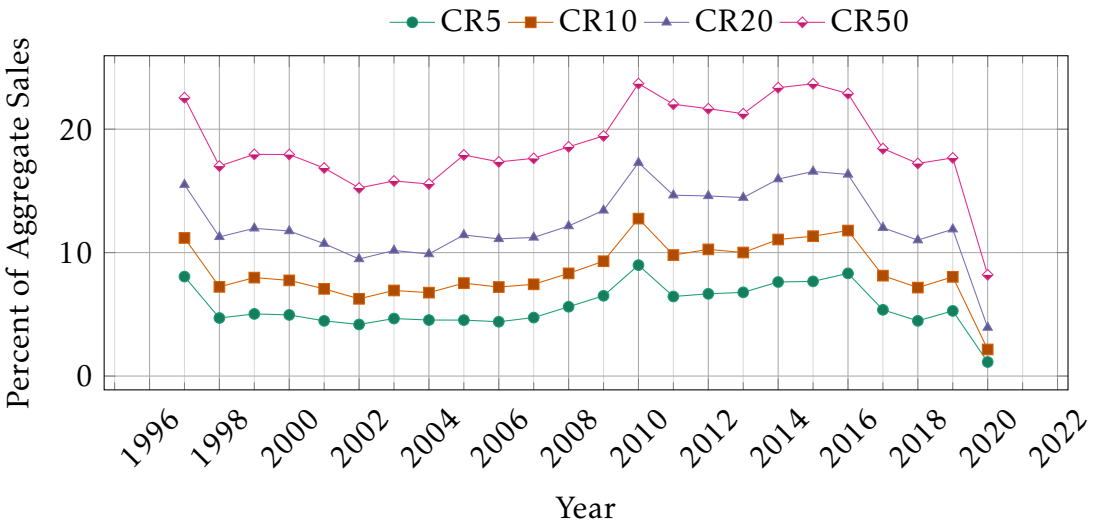

Figure 16: Aggregate CR5, CR10, CR20 and CR50, *excluding financial services*
Source: Authors' calculation based on BSD 1997-2020

E 'BSD Sector' Plots

'BSD Sectors' are an ONS-specific aggregation of 2-digit SIC industries. The BSD sector is used as a sampling frame for ONS surveys such as the Annual Business Survey (ABS). They do not correspond to SIC 1-digit sectors. We provide further details in the data appendix.

E.1 Concentration BSD Sector Level

Figure 17 plots concentration ratios at the BSD sector level.

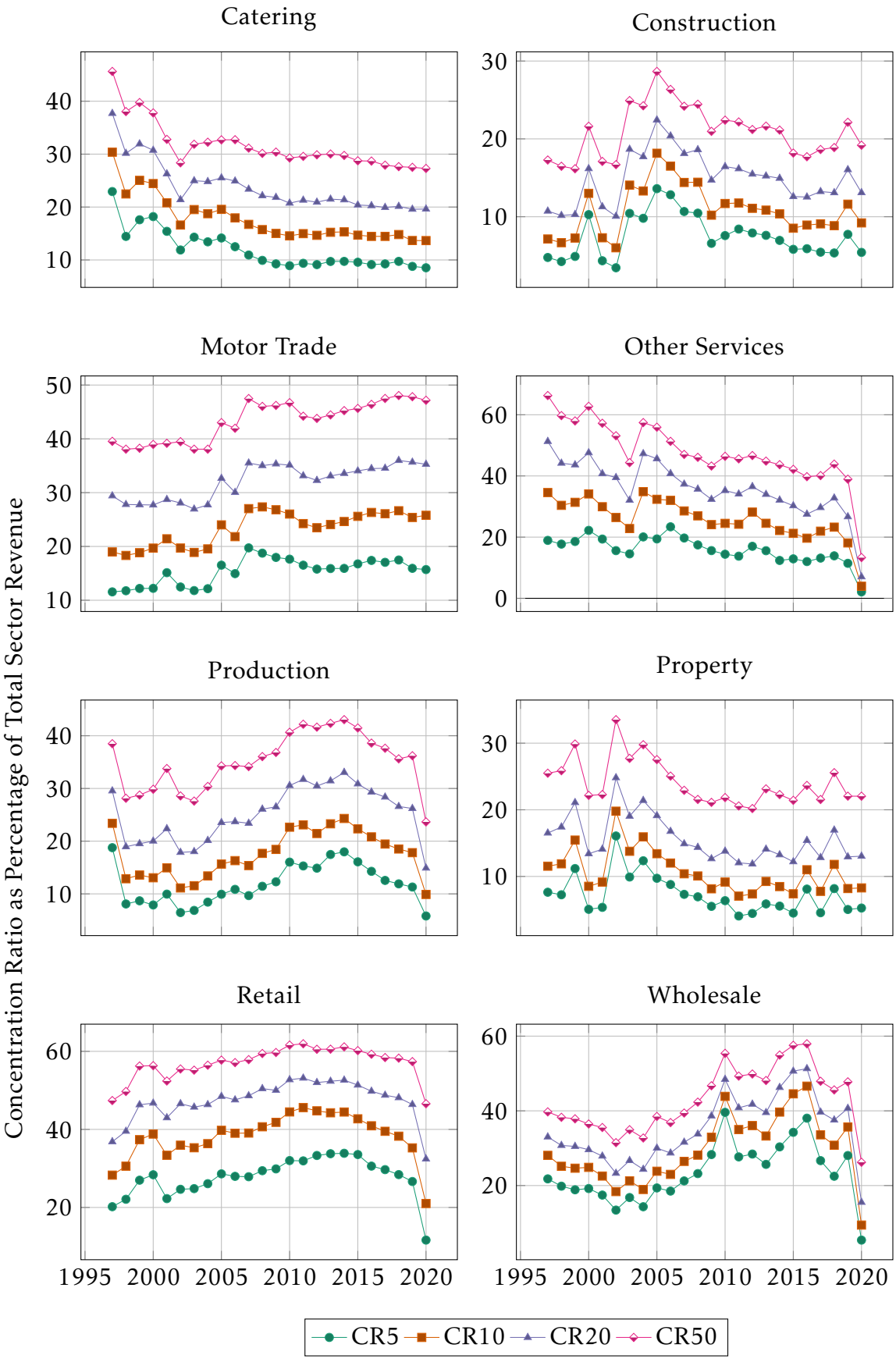

Figure 17: Concentration Ratios at BSD Sector Level
Source: Authors' calculation based on BSD 1997-2020

Figure 18 plots Hirfindahl-Hirschman Indices at the BSD sector level.

Figure 18: Herfindahl-Hirschman Indices at BSD Sector Level
Source: Authors' calculation based on BSD 1997-2020

E.2 Firm Entry & Exit BSD Sector level

Figure 19 plots entry and exit rates at the BSD sector level.[29] The plots are consistent with our aggregate observations. There are no clear long-run trends in entry and exit and the measures are responsive to the business cycle. Entry fluctuates more than exit. There is consistently high net-entry in services and low or negative net entry in production. All sectors observe more exit than entry during the Great Recession and high net entry throughout the 2010s.

[29] The 'BSD sector level' refers to an ONS-specific aggregation of 2-digit industries.

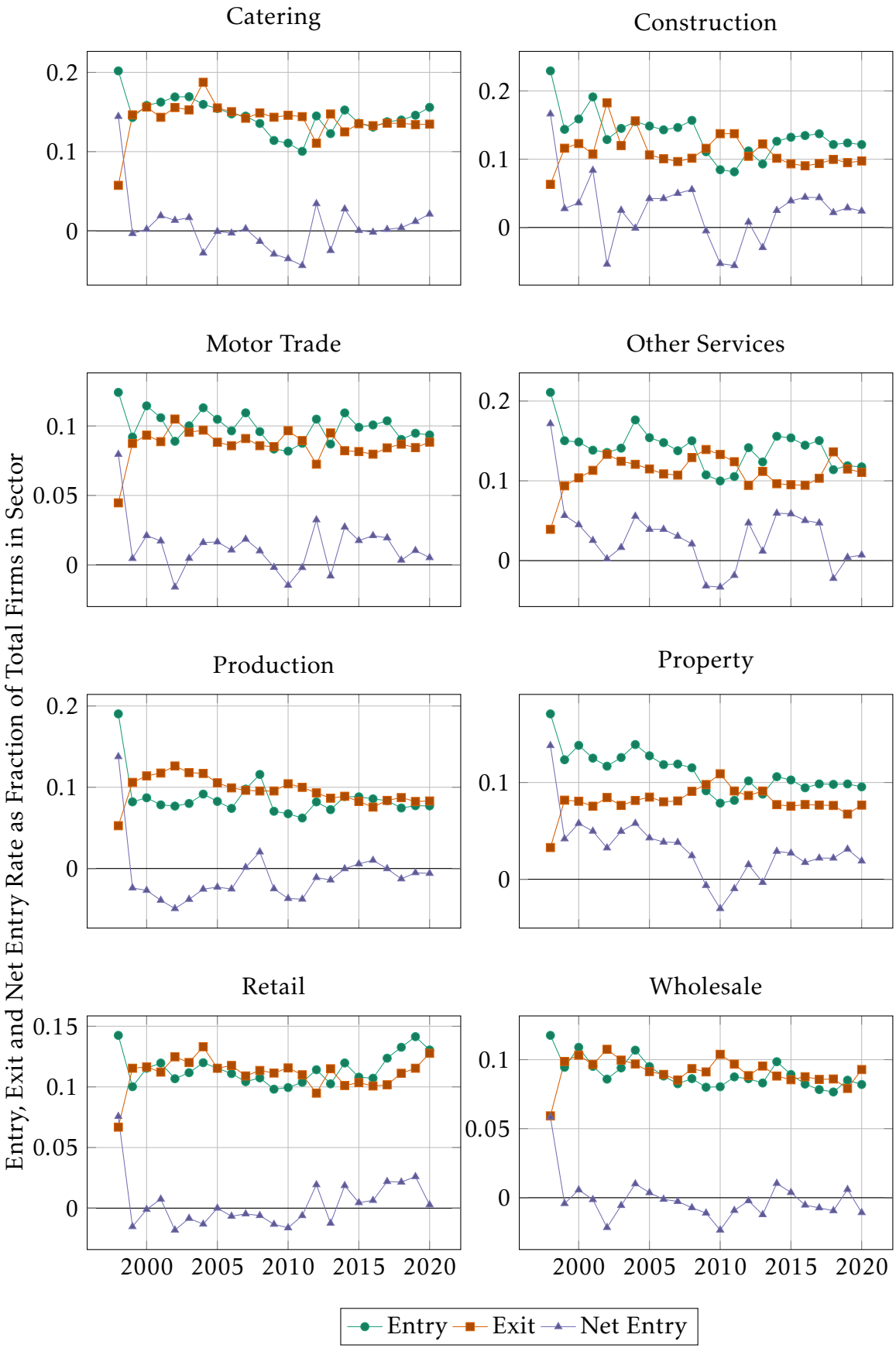

Figure 19: Entry, Exit and Net Entry Rates at BSD Sector Level
Source: Authors' calculation based on BSD 1997-2020