

No.55
February 2021

Prices and inflation in the UK - A new dataset

Richard Davies

Abstract

This paper presents a new dataset of 41 million UK consumer prices, providing facts on the frequency, size and timing of price changes between 1988 and 2020. The micro data are the ‘price quotes’ of individual consumer products that make up the official Consumer Prices Index (CPI) for the UK. Prices are recorded between January 1988 and December 2020 and cover a wide-ranging selection of items including food and drink, homewares, furniture and appliances, motoring supplies and fuels as well as a range of services. The extended time coverage allows a comparison of historic shocks, including the ERM crisis, 2008 financial crash and 2016 EU referendum, with the Coronavirus pandemic. The long-run facts fit closely with the pattern of nominal rigidities seen in other countries. Overall, state-dependent rather than time-dependent pricing models are consistent with UK firm behaviour, and the data show strong support for the notion that prices are ‘volatile while anchored’ as in the more recent menu cost models. The facts show the extraordinary experience of 2020, which was the most volatile year, in terms of pricing, since at least 1991.

Keywords: EU referendum, covid-19, consumer prices, inflation

JEL: E12; E31; E32; E51; E52; E58

I am grateful to Rowan Kelsoe and Rhiannon Sage at the Office for National Statistics for their advice on data access, and the cleaning and assumptions I have used to create the panel data set used in this paper. Henry Overman, Steve Machin, Nikhil Datta and Josh de Lyon provided helpful comments. Pete Klenow, Virgiliu Midrigan and Diego Perez gave helpful steers on an earlier incarnation of this work. The data have been compiled as part of ongoing research and are available via my web site. Files and code for charts and tables can be found at www.richarddavies.io/prices and <https://github.com/RDeconomist/prices>.

Richard Davies, Bristol University and Centre for Economic Performance London School of Economics.

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior permission in writing of the publisher nor be issued to the public or circulated in any form other than that in which it is published.

Requests for permission to reproduce any article or part of the Occasional Paper should be sent to the editor at the above address.

SUMMARY

This paper presents a new dataset of 41 million prices, recorded in the UK between January 1988 and December 2020. The data cover consumer items including food and drink, homewares, furniture and appliances, motoring supplies and fuels as well as a range of services. The paper makes four contributions.

- First, it describes a new publicly available database of consumer prices. The files are cleaned and corrected versions of raw historical records. The data improve the official CPI micro data for research and long-term price comparison purposes. A data annex sets out in detail the shortcomings and recording errors in the raw data and how they were corrected. The data is openly available and has many potential applications both to researchers and teachers. To access the data and notes on using it, visit my [website](#) or [GitHub](#) page.¹
- Second, it provides a set of stylised facts on price rigidity, using the January 2020 update of the long-run price quotes database. The database sheds new light on when and by how much firms change their prices. These descriptive statistics are compared to similar findings for the US and EU countries and contribute to the literature on price dynamics, the cost of inflation, and business cycles. (Klenow and Malin, 2010; Nakamura and Steinsson, 2018).
- Third, a perspective on the emerging impact of Covid-19 on prices and inflation. At present this is unclear: some real-time micro data pricing studies have pointed to hidden inflation; the official CPI inflation measure has been falling. The CPI data show a large increase in price changes—both cuts and rises—with a contemporaneous increase in the net balance of cuts. This simple measure is a strong predictor of inflation. This links to other work on the short-term price effects of Covid-19 tracked in real time. (Jaravel and O’Connell, 2020; Cabral and Xu, 2020).
- Fourth, price and inflation heterogeneity in the UK. I show how headline measures of inflation mask differential experience in terms of price rigidity, volatility and price distribution by item, region and firm. This links to the literature on ‘price morphology’ (Kaplan and Menzio, 2016). The emerging regional differences, while mild at present, may be important for the calculation of regional real wages. (Costa and Machin, 2019).

¹ I am grateful to Rowan Kelsoe and Rhiannon Sage at the Office for National Statistics for their advice on the data, and for considering and commenting on the corrections I have imposed on the official data – any mistakes in this process are mine alone.

I. INTRODUCTION

The technical language of macroeconomics can often seem divorced from the real-world questions people face. One exception to this stands out: prices. The public are engaged with prices—of consumer goods, the exchange rate, nominal wages—in a way that is not true for any other types of economic measure. Prices are fascinating for academic economists too.

The reason is that seemingly simple questions—for example, when, why and by how much firms change their prices—have huge implications. Price rigidities determine how monetary policy operates and how macroeconomic models work. Sticky prices help us understand of exchange-rate pass through, and the development of real wages.

Pricing studies have come to the fore internationally over the past 15 years because of the availability of new ‘micro’ data. This data tracks prices charged at an individual firm level. This paper sets out and summarises a new micro data on UK consumer prices, showing that the UK’s experience—in terms of the way price rigidities operates—is very close to the US and other advanced economies. Pricing trends, in other words, may be common.

As pricing micro data becomes more readily available, it has the potential to help answer several live questions in economics. These include:

- **Real-time analysis.** Studies that aim to help policymakers track the price implication of shocks in (close to) real time. (e.g. Jaravel and O’Connell, 2020)
- **Pricing puzzles.** In particular, the “missing” (i.e. the absence of expected, and model predicted) inflations and deflations of 2009 and 2012-14 respectively. (e.g. Ball and Mazumder, 2011; Hall 2011 and Heise et al 2020).
- **Price morphology.** The distribution of prices for individual goods and how they vary over time. (Kaplan and Menzio, 2015).
- **Business cycles – regional perspectives.** The development of inflation, real wages and business cycles (e.g. Golosov and Lucas, 2007) more recently analysed at a sub-national level. (Hazell et al 2020).
- **Measurement questions.** The emergence of free goods, and the implication of this for the measurement of prices, inflation, and GDP. (Brynjolfsson, 2019).
- **Central Bank policy levers.** The potential for new targets for central banks, including price level targets. (Bodenstein et al, 2019).

These are international puzzles, many of which have an interesting UK variant. Pre-Covid Britain had shifted to a low-inflation, low-pay growth and low-unemployment, pattern of growth. Our economy has reacted in puzzling ways—no net trade reaction to two large depreciations, for example. There are live questions about the micro-data studies of firms, including mark-ups, competition, and business demographics. On top of this, new measures and models may be needed as we recover from Covid-19, the biggest economic shock in living memory.

II. THE LITERATURE

The timing and size of price changes are a foundational question in macroeconomics. Sticky prices or ‘nominal rigidities’ are at the heart of explanations of why monetary policy has an impact on the real economy (i.e. the degree of monetary ‘non-neutrality’) with implications for the trade-offs between output and inflation, and the behaviour of business cycles. This means estimates and models of price rigidity are key elements in models used for policy analysis (Taylor, 2016).

Given the importance of this question, there is a long history of papers that investigate why and when firms adjust their prices. Theoretical models have empirical predictions which can be tested against newly available micro data. Key models, with their main idea and broad predictions are set out below (Table 1).

Table 1 Price rigidity: models and predictions	
<i>Models</i>	<i>Ideas and predictions</i>
Time dependent Calvo (1979)	<u>Idea</u> : Firms can only change prices in certain periods. <u>Prediction</u> : Staggered price setting. Large price changes when changes do occur. ‘Time dependent’ price changes.
Menu costs, traditional Sheshinski and Weiss (1977)	<u>Idea</u> : Firms face a cost when changing prices; this can be interpreted as the cost and effort of reprinting and issuing menus. <u>Prediction</u> : Irregular price changes, large ‘state dependent’ price changes as firms’ prices ‘catch-up’ with changes in the economy.
Menu costs, new Midrigan (2011), Kehoe and Midrigan (2015)	<u>Ideas</u> . There are economies of scale in changing prices, there are different costs when changing a price temporarily or permanently. <u>Prediction</u> : Price changes common but prices quickly return to a reference level, changes to a new reference level are less common.
Rational inattention Mackowiak and Wiederholt (2009).	<u>Idea</u> . Firms face information processing constraints—they are limited in the attention that they can devote to setting prices. <u>Prediction</u> . Prices change in response to idiosyncratic conditions, reacting faster and more quickly to them than aggregate shocks.
Sticky information Mankiw and Reis (2001).	<u>Idea</u> . No cost of adjusting prices, but costs of accessing and processing information about the economy, which diffuses slowly. <u>Prediction</u> . Price changes common, but not always in line with the most up-to-date information about the economy
Kinked demand Dupraz (2017)	<u>Idea</u> : Firms hold prices constant for competitive reasons, fearing loss of customers. <u>Prediction</u> : Prices more likely to change if they have recently changed, more flexible in markets where consumers can easily compare prices.
Price points. Knoetck (2010).	<u>Idea</u> . Firms aim to have prices at certain reference prices. <u>Prediction</u> . Prices will gravitate to reference points (such as £9.99) and be stickier when at reference points.

Empirical work on pricing also has a rich tradition. The first study on the frequency of prices changes was undertaken 90 years ago, in an examination of US wholesale price data (Mills,

NBER 1927; Wolman, 2007). Since data on consumer prices was difficult and costly to collect early studies focused on wholesale prices, or consumer prices relating to single products or from one type of firm. In the 1980s, for example, it was popular to look at the prices of newspapers and magazines. See Cecchetti (1985, 1986), Fisher and Konieczny (2006), Mussa (1981), and Weiss (1993).

Over the past twenty years, the use of large scale ‘micro’ datasets to study prices has become more common. This research has shed new light on longstanding questions, finding errors in official statistics or providing (close to) ‘real time’ analysis of the impact of policy or exogenous shocks. Researchers typically use one of four sources:

- Official CPI data. Using the underlying micro data collected by government agencies. This approach is the topic of this paper and discussed in detail below.
- Proprietary scanner data. For example, Weinstein et al (2013) uses a huge proprietary data set collected by Nikkei—5 billion observations—examine Japan’s inflation (finding significant differences between actual inflation and the published CPI). More recently, scanner data analysed by Jaravel and O’Connell (2020) showed a sharp reduction in sales (i.e. fewer price reductions) which contributed to a spike in inflation following the initial Covid-19 lockdown.² Their early analysis was that stagflation—i.e. rising prices coupled with falling output—was a potential risk. Since stagflation is such a difficult phenomenon for macroeconomic policymakers to offset, this shows the importance of using rapidly approaches to understanding price dynamics.
- Self-collected data. This approach involved prices ‘scraped’ from internet sites. For example, the Billion Prices Project founded in 2008 collects such data from retailers across the world daily. The micro data has led to many findings, including correcting inflation rates for Argentina. See www.thebillionpricesproject.com and Cavallo and Rigobon (2016).
- Large-scale surveys. Questionnaires that ask firms how and why they change their prices. Surveys of this kind are often organised by central banks, Fabiani et al (2005).

Papers using CPI micro data

The widespread use of official CPI data began around 15 years ago. Several country studies were undertaken by ECB-funded researchers as part of the “Inflation Persistence Network”

² Using 13.4m transaction observations they find that Covid-19 is broadly inflationary, with a reduction in the number of products whose prices were falling. The scanner data, from the Kantar FMCG Purchase Panel, has the benefit of including quantities as well as prices, and goes back as far as 2013. By comparison the CPI data has fewer products in total, a broader coverage of product types, and a longer run perspective allowing historical comparisons.

and reviewed by Dhyne et al. (2006).³ A similar vintage study for the US is Nakamura and Steinsson (2006).

The countries studied in the mid-2000s produced a set of useful benchmarks (Klenow and Malin, 2010). Ten stylised facts (below, the ‘KM’ facts) based on discussion of the US and the Euro Area are that⁴:

- KM1. Prices change at least once a year.
- KM2. Sales and product turnover are often important for micro price flexibility.
- KM3. Reference prices are stickier and more persistent than regular prices.
- KM4. Substantial heterogeneity in the frequency of price change across goods.
- KM5. More cyclical goods change prices more frequently.
- KM6. Price changes are big on average, but many small changes occur.
- KM7. Relative price changes are transitory.
- KM8. Price changes are typically not synchronized over the business cycle.
- KM9. Neither frequency nor size is increasing in the age of a price.
- KM10. Price changes are linked to wage changes.

In comparison with the US and euro-area, relatively little has been published covering the UK economy. Yates, Hall and Walsh (2000), report survey results from a panel of 654 UK companies interviewed in late 1995. The survey found that, for the median firm prices were *reviewed* monthly and had been *changed* twice in the year before the survey; they also observed that time of the year was more important than the state of the economy in justifying a price change. This was taken as early evidence that models of time- rather than state-dependent price adjustment were consistent with firms’ price-setting behaviour.

The first UK study to use newly available CPI data for the UK was conducted by Bank of England economists, (Bunn and Ellis, 2011). Examining 11m observations covering the period 1996 to 2006 they presented five stylised facts (below, the BE facts).

- BE1. An average of 19% of prices changed each month, falling to 15% if sales were excluded.
- BE2. The probability of price changes was not constant over time.
- BE3. The price of goods changed more frequently than the price of services.
- BE4. The distribution of price changes was wide. A significant number of changes are relatively small, and close to zero.
- BE5. Prices that change more frequently tend to do so by less.

³ Several studies were published in the mid-2000s as statistical agencies began to release the underlying price quotes used to calculate national CPIs. Examples are Alvarez and Hernando (2004) [Spanish CPI], Aucremanne and Dhyne (2004) [Belgian CPI], Baharad and Eden (2004) [Israeli CPI], Baudry et al. (2004) [French CPI], Bils and Klenow (2004) [US CPI] Dias et al. (2004) [Portuguese CPI and PPI].

⁴ For evidence on the euro area see Hobijn et al (2006).

Most recently, Kryvtsov et al (2018) presents an analysis of UK CPI data between 1996 and 2015. The key addition of their paper is discussion of the distribution of prices and its evolution over time. At the same time price changes become more dispersed around the time of the 2009 and 2011 recessions. They interpret this as suggesting that economic turmoil tends to trigger price adjustments across all firms.

This paper extends the coverage of the UK literature in three related ways. First, by taking the available window back to 1988, adding 8 years of comparable data covering an important and volatile period in UK macroeconomic history. Second, by bringing the analysis up to date, with coverage of both the Brexit (2016) and Covid-19. Third, by providing an open-source repository for the data and stylised facts, which are updated each month.

The remainder of the paper proceeds as follows. Section II explains the data. Section III provides UK results, comparing them to those for the US, and Covid-19 with previous crises. Section IV examines price heterogeneity by region and firm type. Section V concludes. The Annex discusses data construction and cleaning in detail.

III. THE DATA

The data are monthly records of prices collected by the Office for National Statistics (ONS) and known as ‘price quotes’. Each observation contains information on the item sold, its quantity or weight, its regional location, the shop and shop type (the size of the establishment) it is sold in, and whether it was offered at a sale or regular price. A typical example would be ‘APPLES – COOKING PER KG’ sold in London by a given store. The names of the shops are anonymised and an identifier allows prices to be compared, by shop, over time.

The files cover the months between February 1988 and December 2020. The earliest years have some gaps: two months (July 1998 and February 1989 have no data) and one month (April 1989) has limited observations (around 25% of the neighbouring months). After appending the monthly files, the final raw dataset has 45m price observations.

Extensive work has been undertaken to clean and correct the data. This includes standard cleaning steps (e.g. deletion of obvious errors).. I also imposed several assumptions and assertions to improve the time-series properties of the data, with the aim of making it more useful for research, policy and teaching purposes. These steps have been checked with the ONS, but any errors are mine and researchers seeking to recreate the official CPI should use the raw files. My cleaning steps, set out in detail in the Annex, include:

- **Correct prices recorded incorrectly.** A number of items feature ‘steps’ in their distribution between consecutive time periods. In many cases this is due to the incorrect recording of a size/weight change. These prices are wrong. I adjust them (changing the prices, rather than the item’s description).

- **Convert prices to offset weight and measure changes.** Several items—Apples, is one example—exist in the data under two measures (in this case lb and kg) that do not overlap. I adjust the imperial prices to align them with metric. Any prices that feature such an adjustment are excluded from the calculation on month-on-month price changes over the adjustment window.
- **‘Knit together’ price series.** Some prices with identical descriptions are recorded as separate (and therefore non-comparable) items. I check these item by item, appending price series whose distributions match. Combining records in this way reduces the number of unique items (which I argue is falsely high) and lengthens the time-series coverage of those that remain.
- **Delete observations that are recording errors.** The data feature outliers—prices that are in the tails of the distribution but are reasonable—these are dealt with using standard techniques (some calculation exclude the top and bottom 5% of prices, for example). There are also observations that are not statistical outliers but recording errors (6 eggs, being sold for over £100, for example). I drop these.

The result is a panel dataset containing 41m observations, at the item-shop-region level. That is, in the results that follow I am using prices of the form $P_{t isr}$ where $t \in [1, 395]$ denotes the month⁵, $i \in [1, 1343]$ denotes the unique item, $s \in [1, 3668]$ denotes the shop code and $r \in [1, 13]$ a geographical marker denotes the 12 ‘NUTS-1’ regions of the UK plus a supra-regional ‘catalogue collections’ region.

The consumer price basket is regularly updated to reflect spending patterns and so the list of CPI items changes over time. Over the 32-year sample many goods enter (e.g. DVDs) and many exit (e.g. local newspapers, VHS videos) so the panel is unbalanced, as is common in national CPIs. Despite this churn there are a large sample of goods and services that are present for long time spans.

To consider the richness of this data and its potential applications it is worth comparing it to the lowest level CPI classes which are often used by researchers (for example, in the inflationary impact of the EU referendum see Breinlich et al, 2017). There are 84 COICOP classes that make up the CPI, including for example “meat”. In this paper the lowest level series is the item-shop-region triplet, of which there are 140,000 meaningful series. Rather than a nation-wide CPI for ‘meat’ researchers can examine the price of a specific type of beef (rump steak), in the South West, in a particular shop.

⁵ In the years covered (1988 to 2020), there are three missing months (January 1988, August 1988 and February 1989) in the raw ONS data.

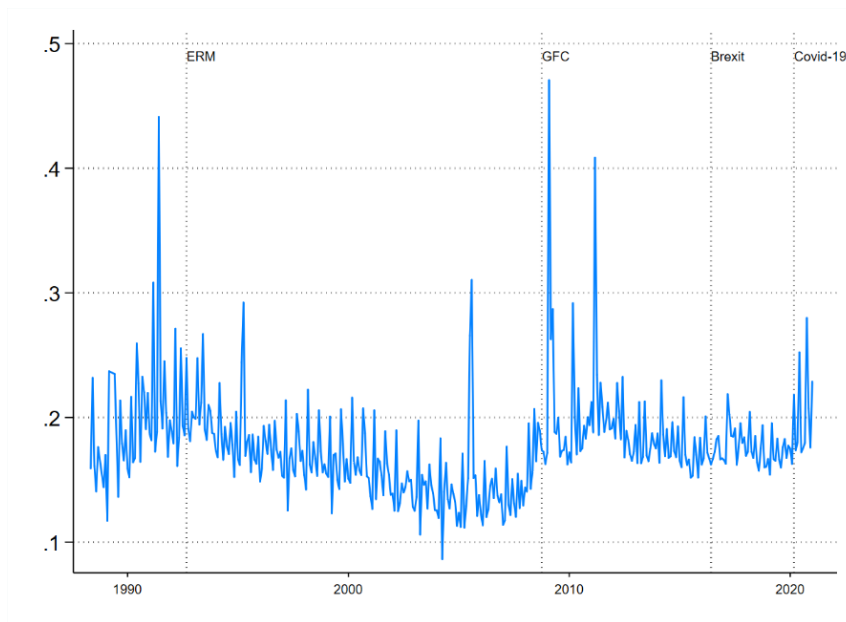
IV. NEW FACTS – THE FREQUENCY AND SIZE OF PRICE CHANGES

This section provides new long-run facts on price patterns in the UK, setting them in the international context and using previous US and UK studies as a benchmark (Klenow and Malin, 2010; Bunn and Ellis 2009). Table 2 summarises the results. The similarity in long run patterns between the UK and other countries, suggests that the UK’s readily available micro data may help gauge likely price and inflation experience in other countries.

Basic facts

The UK micro data show that price changes are common, and there is no evidence of downward price rigidity. Over the 32-year sample 81% of prices with a comparable previous monthly price were the same, with 19% having changed.⁶ Of the prices that changed, 45% were reductions and 55% were increases.

Chart 1. Proportion of monthly prices changing.



Note: The three large spikes (>40% of prices changing) are months in which VAT rates were changed i.e. there was a step function in the taxes firms faced. This is discussed further below.

Price changes are often much larger than those justified by inflation. The average annual rate of inflation over the sample is 2.7% and the month-to-month price changes are large when compared to price adjustments needed to offset this, with the median monthly rise close to

⁶ The figures in this paragraph and the table below are the long-run averages *excluding* the Covid-19 period, i.e. all data up to March 2020.

13%.⁷ At the same time there are many small price changes: over a fifth of the price changes are less than 5% of the base price.⁸

At an annual horizon, the pattern of price changes is different. A firm is *more* likely to have changed the price of an item, with 42% of prices changing over the course of a year. While month-on-month price cuts are almost as common as price rises, just 35% of year-on-year price changes are reductions. Finally, over a year the size of price changes is like to be smaller, with the median increase close to 8%.

Table 2 Comparison of stylised facts	
<i>KM-BE facts</i>	<i>UK Data</i>
KM1. Prices change at least once a year.	✓ Most prices change at least once a year. A small share (13%) of prices ‘flat line’ over a year.
BE1. An average of 19% of prices changed each month between 1996 and 2006.	✓ The average 1988-2020 is 18% of which 10% are rises and 8% are cuts.
KM2. Sales and product turnover are often important for micro price flexibility.	✓ There is significant evidence of both official sales, and de-facto sales (in the form of ‘V-shaped’ prices).
BE1. Monthly price changes falling to 15% if sales were excluded.	✓ The ratio of price changes falls to 13% if sales (and recoveries from sales) are excluded.
KM3. Reference prices are stickier and more persistent than regular prices.	✓ When an item is at a reference price (especially a ‘rounded’ price) it is less likely to change. Prices which have moved away from previous reference prices tend to gravitate back to them.
KM4. Substantial heterogeneity in the frequency of price change across goods.	✓ There are significant differences both between and within COICOP division.
BE3. The price of goods changed more frequently than the price of services.	✓ Goods and services prices differ in many ways. Goods have a wider distribution, change more frequently and change in both directions. Services prices change slowly and tend to ‘ladder’ upward, with price reductions rare.
KM5. More cyclical goods change prices more frequently.	✓ Prices frequently for goods with procyclical consumption patterns, including consumer durables (televisions, washing machines, dishwashers). But: <ul style="list-style-type: none"> • Some goods with no cyclical consumption patterns—fresh food—change very frequently. • The most flexible prices are for consumer fuels (kerosene, petrol) – these prices change almost continuously.
KM6. Price changes are big on average, but many small changes occur.	✓ Price changes are large on average. The median price change is higher than that justified by inflation.

⁷ The average annual rate of inflation given here is CPIH for 1989-2019 inclusive. Source: ONS.

⁸ 22% of recorded month-on-month price changes are within +/- 5% of the previous price.

BE. The distribution of price changes was wide. A significant number of changes are relatively small, and close to zero.	✓ Still, around 20% of price changes are below 5%.
KM7. Relative price changes are transitory.	✓ Relative price changes are transitory, large and tend to rest on short-term deviations from a set price.
KM8. Price changes are typically not synchronized over the business cycle. BE2. The probability of price changes was not constant over time.	<ul style="list-style-type: none"> ✓ There is no clear pattern linking GDP growth rates and the number of directions of price changes. ✓ The probability of price changes varies over time. It tends to increase aftershocks (economic or policy), and exchange rate depreciations. Also: <ul style="list-style-type: none"> • VAT changes cause significant jumps in the probability of price changes.
KM9. Neither frequency nor size is increasing in the age of a price. BE. Prices that change more frequently tend to do so by less.	<ul style="list-style-type: none"> ✓ Frequency and size are decreasing in the age of a price. One exception is that prices that last one year are likely to jump. Many firms impose a c5% increase every 12 months. ○ There is no clear relationship between frequency prices change and the size of change when they do.
KM10. Price changes are linked to wage changes.	<ul style="list-style-type: none"> ○ The geographic marker in the UK data allows the comparison of prices at a regional level. Price and wage <i>levels</i> are correlated. Regional heterogeneity in wage changes is larger, and not correlated with, regional price flexibility.
<u>Key:</u> ✓ Fact matches that seen in the US/EU • New fact. ○ Differs from previous finding / requires further investigation.	

Sales and references prices

As in the US studies and previous UK evidence, sales make a significant contribution to price flexibility. The ONS provides a marker to track the prevalence of sales. There are around 2.3m markers for sale, and just over 700,000 that mark the recovery from a sale. Defining ‘regular’ prices as those that are neither on sale, nor just ending a sale, the proportion of monthly price changes falls to 13.3%.

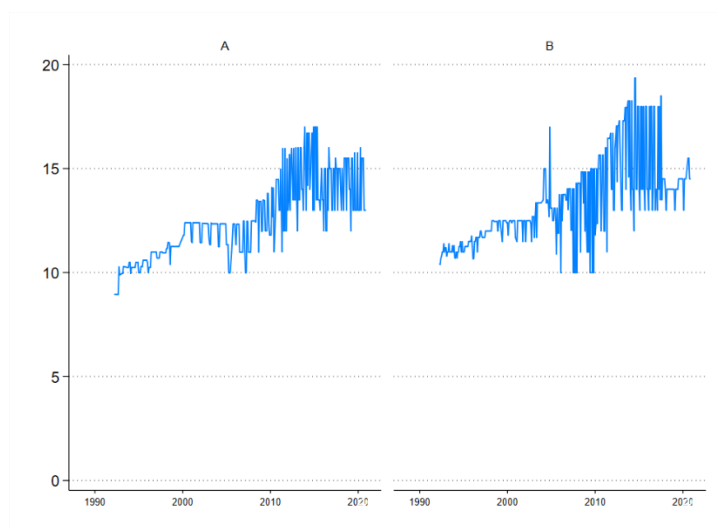
In addition to the *official* sales tag, I filter the data for *de facto* sales by identifying ‘V-shaped’ price patterns. Following Nakamura and Steinsson (2008) I define these as a price with a one month cut before returning to its previous price. There are around 425,000 of these V-shaped prices, of which the ONS’s official sales marker captures around 70%. Most official sales tend not to be ‘V-shaped’ lasting longer than a month—this is intuitive, clearance sales, for example, may last for many months.⁹

Recent studies for the US have shown that prices, while flexible, are also strongly anchored, due to the prevalence of ‘reference’ or ‘anchor’ prices that items repeatedly return to (Midrigan and Kehoe, 2015). This phenomenon—both volatile *and* anchor—can seem

⁹ Almost half of the sales prices (820,000) do not reflect a reduction on the previous month’s price, indicating an extended sale. In addition, several extended sales are only marked as sales in the first month.

puzzling and is also a strong feature of the UK data. As an example, the chart below shows the price of a bottle of Whisky sold in two shops in London between 1990 and 2020 (**Chart 2**). Flexibility is a clear feature, seen in the jagged lines as prices rise and fall. At the same time, there is a clear tendency of prices to return to certain anchor levels—£10, £12, £15 and £18—which increase slowly over time.¹⁰

Chart 2. Reference prices: Bottles of Whisky, 1992-2020



Notes: Chart shows the price for a bottle of whisky sold in two London shops.

The anchor or reference prices that are most used by firms are intuitive. The five most common prices—£1, £10, £0.99, £2 and £9.99—appear over 1.5m times and account for more than 5% of all prices in the data. By contrast, prices just over a whole pound are extremely rare.¹¹ (The prevalence of 99p prices is declining over time, perhaps because these prices are less important in on-line shopping.) When an item is priced at a 99p or whole pound price, its price is less likely to change: across the whole data set 74% of prices with a comparable previous month are unchanged. For whole pound and 99p prices 81% are unchanged, for other prices 69% are unchanged. This is consistent with the ‘price points’ theory set out in Table 1 above (Knoteck, 2010)

I examine more formally the tendency of UK prices to gravitate back to previous levels. Klenow and Malin (2010) define a “comeback” price as a price level which has been seen at least once in the past 12 months (but was *not* the previous month’s price) and a “novel” price as a level at which a good has not been sold in the past 12 months.¹² Novel prices are

¹⁰This is consistent with models such as Kehoe and Midrigan (2014) in which individual goods may be very flexible when examined at high-frequency there is, at the same time, low-frequency price stickiness. Both these results are in line with the previous CPI study for the UK (Bunn and Ellis, 2011).

¹¹ The top 944 prices account for 90% of the data. £1.01 occurs just 4,340 times (the 757th most common price).

¹² I generalise this creating a measure, “repeat”, which asks how many times a price has been seen in the past year. (So a novel price has a repeat measure of 0; a price that has been seen in each and every month has a repeat score of 12).

relatively rare in the UK data, representing just 18% of prices. By contrast fully 70% of prices are comeback prices in the UK micro data. This is consistent with models in which firms face costs of maintaining prices away from recognised reference levels.

Price changes by item type

A striking feature of the data is the heterogeneity—both short and long-term—in pricing patterns by type of item being sold. Table 3 shows price flexibility using the ‘COICOP’ classification division (United Nations, 2018).¹³ The most flexible prices are for alcohol and tobacco, of which over a quarter of prices change each month.¹⁴ The least flexible are restaurants and hotels where less than 10% of prices change between typical months.

Table 3 Price flexibility by division

<i>Division</i>	<i>Prices</i>	<i>CPI Weight</i>	<i>Changes</i>	<i>Up</i>	<i>Down</i>
Alcohol & tobacco	1,686,665	32	27.6%	17.9%	9.7%
Food & drink	8,644,429	79	23.8%	13.0%	10.8%
Household & furniture	4,153,236	51	20.8%	10.6%	10.2%
Clothing & footwear	5,467,306	50	20.3%	9.3%	10.9%
Transport	1,410,191	120	18.5%	11.2%	7.3%
Communication	103,039	17	17.7%	8.1%	9.6%
Recreation & culture	3,160,340	136	16.6%	8.1%	8.5%
Miscellaneous	2,512,890	77	14.4%	8.1%	6.3%
Utilities, fuels & housing	1,138,471	296	12.8%	7.9%	4.9%
Health	588,953	22	9.5%	6.0%	3.5%
Restaurants & Hotels	3,620,405	96	9.2%	7.4%	1.8%

Notes: These figures are for the pre-Covid period, i.e. February 1988-February 2020. CPI weights are out of 1000. The numbers presented are the February 2020 update. [ONS \(2020\)](#).

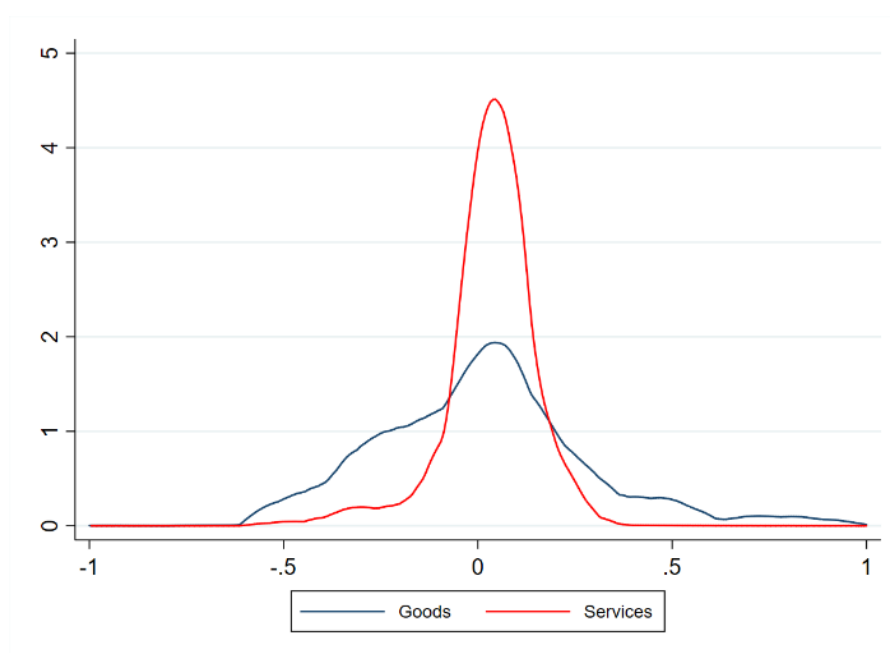
The divisions themselves contain large differences in price flexibility at an individual item level. Within food and drink, for example, the proportion of prices varies from over 50% for cauliflower, lettuce and tomatoes, to under 12% (pork piece, peanuts, dried fruit). This, perhaps, is due to the urgency to sell fresh products that will spoil if on the shelf for an extended period.

¹³ This is the Classification of Individual Consumption According to Purpose published by the UN which almost all countries’ statistical agencies follow.

¹⁴ Throughout I use shortenings of the official COICOP divisions. In this case the full division is “Alcoholic beverages, tobacco and narcotics.”

The most striking difference in price pattern is between goods and services. This cuts across the COICOP divisions. Goods prices are much more likely to change month-on-month than services, changing 20% of the time versus 8% for services. There are differences in direction: goods prices are equally likely to rise and fall (10.4% and 9.4% respectively) whereas services prices are much more likely to rise than fall (6% and 1.6% respectively). And there are differences in size: the median price rise (cut) for goods is 13% (-17%) whereas for services it is 5% (-7%). These differences are intuitive: a 20% or even 50% price cuts for goods is a familiar occurrence. For services, a typical pattern is flat line pricing with occasional 5% price rises. Chart 3 plots the distribution of price changes for goods and services.

Chart 3. Distribution of price changes by goods and services



Notes: Estimate of the distribution of the size of price changes (m-o-m), entire pre-Covid sample.

Cyclical and durability

International evidence suggests goods with more pro-cyclical consumption patterns change prices more often. In the US CPI, for example, prices changes are more common for goods the consumption of which varies positively with the economic cycle (Klenow and Malin, 2010). Examples of procyclical consumption growth in the US include transport (cars, airfares) and clothing. Durability and perishability also seem to matter. Evidence for Europe points to durable items (white goods, for example) being more flexible. In addition, fresh (fruit and vegetables) and raw (meat and fish) items are found to be more flexible than dried or preserved foods.

My new results for the UK cohere with international evidence. In particular:

- Prices frequently for goods with procyclical consumption patterns. This includes consumer durables (televisions, vacuum cleaners) and white goods (washing machines, dishwashers).
- Some goods with no cyclical consumption patterns also change very frequently. Many of these are fresh foods that perish quickly: strawberries, grapes and cucumbers being some of the fastest changing prices (all over 50%).
- The most flexible prices are for consumer fuels. For example, kerosene prices change over 90% of the time, and petrol prices over 60% of the time. These fast-moving prices have a tight distribution, suggesting they are determined by a mark-up over wholesale prices.

Relative price changes – size and duration

The data allows the examination of relative price changes. Tracking these questions is important since it helps distinguish the importance of firm-level versus economy-wide shocks. In the US, researchers have found transient relative price changes: that is, price changes that are dispersed across firms (i.e. lots of idiosyncratic changes) and are often temporary (Klenow and Kryvtsov, 2008; Kehoe and Midrigan, 2008).

One way to examine this question is how sales—both official and *de-facto*—operate (Nakamura and Steinsson, 2008). In the UK:

- Sales are short. Most official sales, i.e. those marked as a sale and captured as such in the ONS data, last one (65%) or two (20%) months. The weighted average sales duration is 1.67 months, in line with evidence for the US. In addition ‘V shaped’ prices, i.e. unofficial sales of one month in duration, are common.
- Price changes associated with sales are large. The median price change in the first month of a sale is -21%. After this, most sales involve firms holding their prices at the new sale price (the median price change is zero, and the mean close to zero).
- Prices often revert to previous levels when sales end. After sales, the largest share of prices (40%) return to exactly their pre-sale level. Around 20% remain at a price lower than the original price (but not the sale price). Intriguingly, almost 30% of prices return to a higher price once a sale is completed.

Put together this suggests transitory relative price changes are common. Firms selling the same product in the same region often vary their prices. This tends to suggest idiosyncratic shocks and motivations are important in determining prices. Firms setting prices for temporary, idiosyncratic, reasons rather than in response to macro shocks is a feature of the ‘rational inattention’ models set out in Table 1 above.

Age – hazard functions

The relationship between the ‘age’ of a price—i.e. how long a price has been held the same—and the size and frequency of price changes is an important question, since many pricing

models predict a positive relationship. The intuitive idea is that a price can be ‘stuck’—that is, not at its optimal level—due to the costs of changing prices. During this period shocks or information can accumulate. Then, when prices are free to change, either exogenously (as in Calvo, 1983) or when a firm can change prices cheaply (as in, for example, Dotsey et al. 1999) there can be a sudden ‘release’: prices are more likely to change, and to change by more.

International evidence finds only weak correlation between size and age (Klenow and Kryvtsov, 2008; Álvarez and Hernando, 2004). Hazard rates are found to be downward sloping for the first few months of a price, then flat (Nakamura and Steinsson, 2008). I calculate the age of a price and examine the association with the frequency and size of price changes. In particular:

- Frequency of price changes. In general, the frequency of price changes falls with the age of a price: price changes that are new or 1 month old are most likely to change, with the likelihood decreasing with age. There is one exception: after 11 consecutive months of being ‘held’ prices are almost twice as likely to rise than at 10 or 12 months. This is intuitive, reflecting once-yearly repricing. Price changes at a yearly horizon are smaller, with a median close to 5%. There is no pattern of price cuts at a yearly horizon. This suggesting many firms use a simple rule of thumb, raising prices by around 5%, once per year.
- Size of price rises. From age 2-24 months, there is no correlation between the age of a price and the size of price change once a price change occurs. The exception is prices that are ‘new’ (i.e. age 0 or 1) which exhibit much larger median price changes. This is consistent with sales and V shaped prices, and evidence on transitory relative pricing set out above
- Size of price cuts. For price cuts there is no relationship between the size of the reduction and the age of the price. This includes prices that are ‘new’. The is consistent with the lack of short-term price spikes (i.e. \wedge shaped prices) in the data.

These facts can help discriminate between pricing models. If pricing is time-dependent (as in a Calvo-type model) then price-length spell is exogenous. Over time, firms are hit by shocks of various kinds and their desired prices move further away from current prices. For some firms the differences between current and desired prices become large. This ‘pent up’ price pressure means we should expect larger price rises after a long spell at a set price. By contrast with state-dependent pricing firms still face costs, but the decision not to change prices is endogenous. That is, the current price may not be their unconstrained desired price, but given the cost of changing their menus, prices are always at their desired levels. In this world, as in the UK evidence, we would not see large jumps in price after long periods at a set price.

Table 4. Age, frequency and size of price changes

<i>Age</i>	<i>Prices</i>	<i>Down</i>	<i>Up</i>	<i>Level</i>	<i>Size (cuts)</i>	<i>Size (rises)</i>
0	8,353,673	15.0%	19.3%	65.7%	-14.9%	18.2%
1	4,967,689	11.4%	11.8%	76.8%	-16.7%	11.8%
2	3,490,418	8.9%	8.8%	82.3%	-16.5%	9.4%
3	2,641,739	8.0%	8.1%	84.0%	-16.0%	7.7%
4	2,047,385	6.7%	6.7%	86.6%	-16.7%	7.3%
5	1,645,678	5.5%	6.5%	88.0%	-14.7%	6.8%
6	1,358,600	4.6%	6.0%	89.4%	-14.3%	6.3%
7	1,137,892	4.5%	6.5%	89.0%	-14.3%	6.2%
8	955,167	3.8%	5.4%	90.7%	-15.0%	6.3%
9	814,294	3.7%	5.2%	91.1%	-15.0%	6.5%
10	695,556	3.7%	5.9%	90.4%	-16.7%	6.1%
11	580,075	3.4%	9.4%	87.2%	-12.5%	5.3%
12	478,550	2.7%	5.2%	92.1%	-14.3%	6.1%
13	418,638	2.7%	4.4%	92.9%	-14.3%	7.0%
14	370,721	2.5%	4.1%	93.4%	-13.3%	7.1%
15	329,177	2.5%	4.9%	92.6%	-14.5%	7.1%
16	290,113	2.4%	3.7%	93.9%	-16.4%	7.5%
17	259,668	2.3%	3.8%	93.8%	-14.0%	7.7%
18	232,236	2.1%	3.5%	94.4%	-14.3%	7.8%
19	208,467	2.3%	4.3%	93.4%	-14.4%	7.7%
20	185,590	2.1%	3.4%	94.5%	-14.3%	7.7%
21	166,399	2.0%	3.4%	94.6%	-13.8%	7.7%
22	149,045	2.1%	3.8%	94.1%	-15.8%	8.0%
23	130,038	2.3%	5.3%	92.4%	-14.3%	7.1%
24	1,342,328	1.5%	2.8%	95.7%	-13.3%	9.1%

Notes: Size refers to the median price change, given a price change in that direction.

A related question is the relationship between the frequency and size of price changes. The single study for the UK found a positive relationship: using data for 1996 to 2006 they find that the median price change rises from around 2% with prices that are 4 months old, to 4-5% for prices that are 24 months old (Bunn and Elliss, 2009). Over the period 1988-2020 I find no clear relationship between frequency and size. Correlation coefficients between the share of prices changing for a good and both the mean and median percentage absolute change in price are low. The variance of price change is higher with fast-changing goods.

In summary these new facts accord closely with previous findings for the US and Euro Area. This suggests that the UK data, which is more readily available than in other countries may be indicative of their price and inflation experience. For macro modellers, the evidence supports state-dependent over time-dependent pricing, and menu-cost models in which anchor or reference prices are important.¹⁵

¹⁵ The implication of for exchange rate pass through are important also, and an avenue for future research with this data. For evidence on the US, see Gopinath and Itskhoki (2010).

The next two sections look in detail at two related questions: the timing and size of price changes versus the economic cycle and various shocks, and the role that wages play in pricing decisions.

V. TIMING: CYCLES CRASHES AND PANDEMICS

This section examines the role of business cycles and shock in price setting. This question is important both for understanding the implications of these shocks, and to help distinguish between different models of price setting. For example, a lack of synchronization with the business cycle would tend to suggest firm-level shocks are more important and that time-dependent pricing models best describe firm behaviour. For the US evidence points to weak synchronisation over the long run (i.e. moderate business cycle movements) but a ‘surge’ in price movements with the 2008 recession (Klenow and Malin, 2010). This suggests looking at acute periods of stress may be helpful.

Two large (pre-Covid) shocks—the ERM crisis and the GFC

For the UK, pre-Covid, two stress periods provide interesting comparators. First, the Exchange Rate Mechanism (ERM) period, in which the UK adopted a fixed exchange rate later abandoning it following a large-scale currency crisis in the autumn of 1992 (Cobham, 1997). Second, the GFC. Britain was at the forefront of the global crash, with UK banks having evolved to be highly concentrated, thinly capitalised, and reliant on short-term funding (Davies et al, 2010). These two periods are compared to Covid-19 in Table 5 and summarised briefly below.

Table 5 Comparing crises, crashes and pandemics

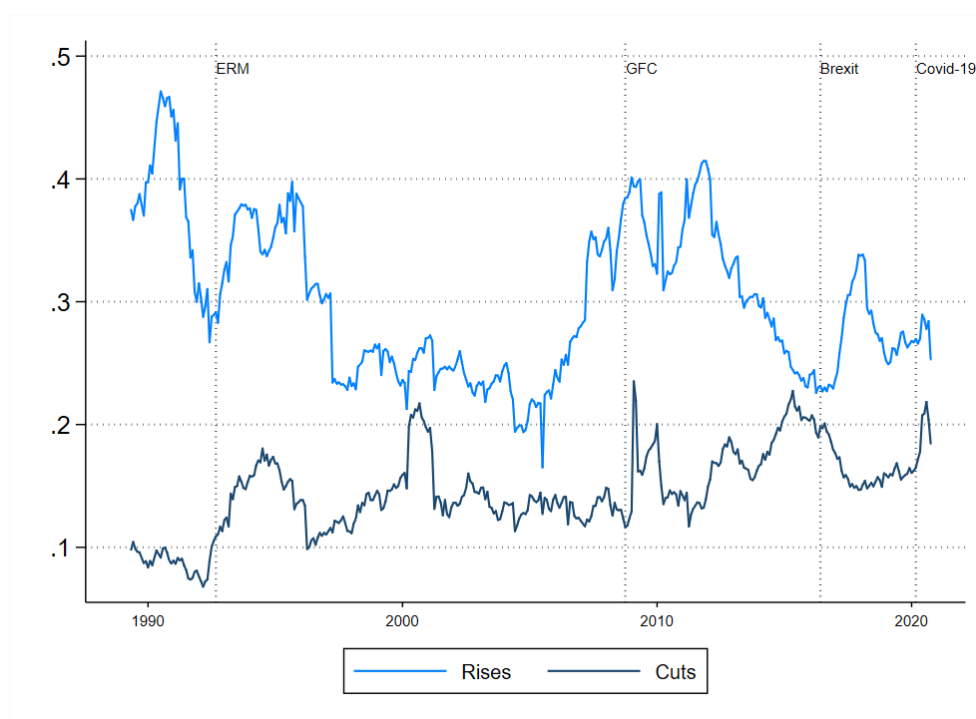
Event	<i>ERM</i> (1990-92)	<i>GFC</i> (2007-09)	<i>EU Referendum</i> (2016-2017)	<i>Covid-19</i> (2020-)
GDP	-2%	-6%	0%	-22%
Inflation	9.2%	4.8%	2.6%	0.5%
Exchange rate	-20%	-40%	-16%	-7%
Unemployment rate	10.6%	8.5%	4.7%	5%

Notes: GDP is peak to trough in quarterly volume of output (ONS: ABMI). Inflation is peak CPIH inflation (ONS: L550), and current inflation for Covid-19 period. Unemployment is peak unemployment rate for age 16 and over and latest rate for Covid (ONS: MGSX, Feb 2021 data: Sep-Nov 2020). The exchange rate tracks depreciations and is the peak to trough fall in the Sterling ERI during these periods, with not all windows the same size (BoE: XUDLBK67). The “Brexit” shock is hard to date. The numbers here refer to the year following the referendum result of June 2016 (inflation rose from close to 0 to 2.6%); the Sterling ERI fell from 87 to 73 over the course of 4 months.

- *ERM*. The period 1990-92 was a volatile one for the UK. There was a recession (1990) and a currency crisis (1992). The general level of inflation was also considerably higher in this period—averaging 6.7% annually—than in any year since. This shows up in the micro pricing data, particularly in the run up to the ERM exit. During the spring of 1992 price changes began to pick up, with a 10-percentage point increase in the number of prices rising. At the same time, there was a similar rise in the number of firms cutting prices immediately following the ERM exit. In summary, the UK experienced short-term price volatility, and a shift in relative prices.
- *GFC*. The GFC generated significant price volatility. A greater share of prices were cut in 2008 than in any other year of the pre-Covid sample. This was a strong downturn in the UK—the worst since the First World War—with firms across sectors cutting prices in response. At the same time, many firms began to raise prices. Some companies, particularly those importing inputs, will have faced higher costs as sterling depreciated. Tight corporate credit conditions in the UK, and a rise in global oil prices during this period also likely increase firms' costs. For the UK household the result was an increase in both price cuts and price hikes—the GFC thus led to a shift in relative prices, similar to that seen with the ERM crisis.
- *Brexit*. The EU referendum result of June 2016 confounded political polls. The shock result led to a revaluation of UK growth prospects (Dhingra et al, 2017). Sterling depreciated by 10% in a week, falling 20% by the end of the year.¹⁶ The price series that underlie the UK *producer* price index (PPI) show that the prices of specific types of inputs including foods, dairy and chemicals all rose in line with the depreciation of sterling. The CPI micro data showed that many firms took steps to offset this, with the frequency of year-on-year price changes stepping up: in the year running up to the vote, around 23% of the prices had risen, a year on from it 34% had; the share of annual price reductions dropped from 20% to 15%. This is in line with previous findings, Breinlich et al (2017). In short, the Brexit shock was unlike the ERM and GFC in that it was straightforwardly inflationary: more prices went up, and fewer went down.

¹⁶ The result was a shock: on the day of the vote, June 23rd, political betting sites were strongly predicting that the majority of UK voters would want to remain in the EU.

Chart 4. Year-on-year price changes, 1988-2020



Notes: The chart shows the proportion of prices with a comparator one year previously that have risen and fallen when compared on a yearly basis.

VAT shifts

The monthly price change series feature several extreme spikes. The three largest peaks, each of them months in which more than 40% of price rise, are explained by tax changes. VAT rose from 15% to 17.5% on 1st April 1991, it was cut to 15% on 1st December 2008, and increased to 20% (from 17.5%) on 4th January 2011. These months all experienced a surge in price changes.¹⁷

The VAT data show the high degree of price responsiveness to sales taxes in Britain. The way taxes are levied may play a role here: in the UK listed consumer prices include tax, while in the US taxes are added at the till. This means that from the perspective a UK business listed consumer prices are 'gross': the true return from the sale is the price *minus* the tax amount. There are implications for tax pass through: a shop that holds its price constant when VAT rises faces a loss. Several studies have looked at VAT pass through: Karadi and Reiff (2015), examine Hungarian data across 123 stores (focussing on processed foods) and find flexible but asymmetric responses to VAT changes.

In addition to price rises following a tax hike there is evidence of downward flexibility in the UK. Following the December 2008 VAT reduction almost 40% of prices were cut. This was

¹⁷ The most volatile months in terms of pricing are December 2008 (47%, of which 37% cuts), April 1991 (41%, of which 41% rises), and January 2011 (41%, of which 30% rises).

far higher than price cuts seen in other months, or in December in other years. The UK data are indicative of *immediate and symmetric* pass-through, at least initially.

The data also point to an interesting phenomenon. Shortly (3 months) after the 2008 VAT cut an unusual number of prices rose, eradicating the previous price reductions. A similar pattern has appeared with VAT cuts introduced as part of the Covid stimulus package (see accompanying brief). It is unclear what is happening here. One possibility is that some firms cut prices in response to the widespread pressure to pass on the tax break, only to raise price back to previous levels shortly afterward. This would be consistent with significant evidence of ‘anchor’ prices, discussed below.

VI. PRICES AND WAGES – REGIONS AND FIRM TYPES

There are many reasons to expect price and wage changes to be linked. Wages are an important source of firms’ costs and are adjusted relatively infrequently in most firms. This means that across firms we would expect those with higher labour costs as a proportion of overall costs to adjust their prices relatively slowly. In addition, wages represent consumers’ ability to pay, so we might expect firms based in regions where wages are growing more strongly to raise their price more frequently.

International evidence points to the importance of labour market conditions for price changes. Klenow and Malin (2010) find that firms in labour-intensive sectors adjust prices less frequently. By matching US goods to the manufacturing industries they are produced in Peneva (2009) shows that labour intensity is negatively associated with the frequency of price changes. More recently, Kaplan and Menzio (2015), study US prices distributions between 2004-2009 and show that households with fewer employed members pay lower prices and do this by visiting a larger number of stores. This would suggest that firms in low wage or low employment locations should charge lower prices.

Full answers to these questions are topics for further research. To provide some preliminary clues I use the regional and firm characteristics available in the UK data.

Regional pricing and regional wages

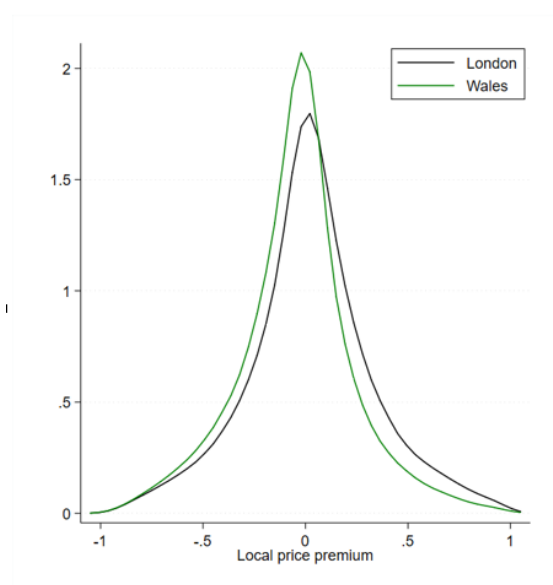
The UK data provide a ‘shop code’ identifier. Using this I calculate the national average price for all firm-item pairs on every date (that is, the mean price a firm is selling an item at across all its regions of operation). Most firms in the data (2,932 or 71%) operate in just one region. These firms are likely to be small and provide few price quotes.

By contrast a relatively small number of firms (443) are active in all 12 regions, but these firms provide over 90% of the price quotes. This means the price data allow good within-firm regional comparisons—i.e. a given price in the data is likely to have a comparator being sold by the same firm somewhere else in the UK.

Table 6 Regional activity of firms providing price quotes

<i>Regions active</i>	<i>Firms</i>	<i>Price records</i>	<i>Firms share</i>	<i>Share</i>
1	2,932	155,628	71%	0.38%
2	127	47,688	3%	0.12%
3	102	55,755	2%	0.14%
4	147	128,992	4%	0.31%
5	48	106,093	1%	0.26%
6	34	41,093	1%	0.10%
7	64	119,766	2%	0.29%
8	98	159,151	2%	0.39%
9	89	207,634	2%	0.51%
10	30	68,756	1%	0.17%
11	41	1,385,870	1%	3.38%
12	318	23,496,928	8%	57.30%
13	125	15,036,256	3%	36.67%
Total	4,155	41,009,610		

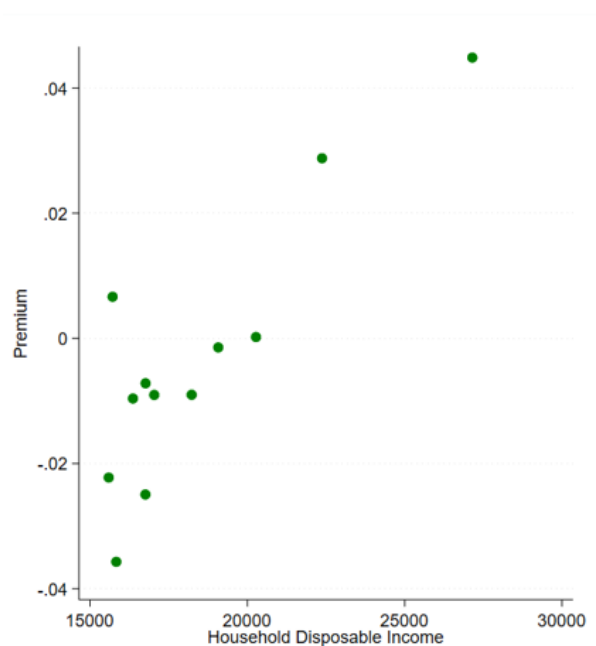
I next calculate, for each price reported by a multi-region firm, the distance of the price from the firm's relevant national average price. Multi-region firms vary their prices. Comparing prices for the same good in different locations reveals that 48% of goods are sold at nationally uniform prices, with the remainder sold at prices that vary by location. UK firms thus impose a 'price premium' in some areas, and lower prices in others. Chart 5 plots the distribution of these premia, by firm, in London and Wales. As we would expect, higher prices higher price premia) are more common in London than in Wales.

Chart 5. Price premia London and Wales

Notes: Estimate of the distribution of price premia (the % difference between a firm's regional price and its mean-UK price) for Wales and London. Prices with zero premia are excluded.

These item-level premia can be aggregated to provide a composite measure of price discrepancies at a regional level. These differences in price levels are associated with spending power. The average price premium is 4.4% in London. In Wales comparable firm-item prices are 3.9% *below* the national average. These differences are correlated with household disposable incomes (Chart 6). This measure suggests multi-region firms vary their prices systematically by region.

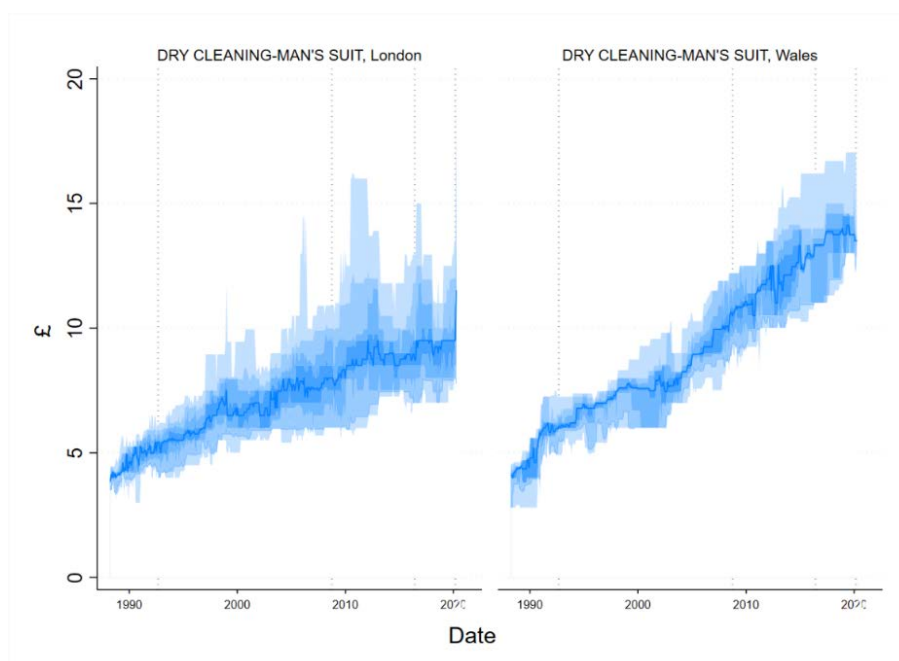
Chart 6. Average price premia and household income, UK regions



Notes: Scatter of the mean price premium for a region (entire sample) against a measure of household disposable income.
Source: ONS, Gross disposable household income (GDHI) by NUTS1 region, UK, 2016.

The data suggest factors other than wages are at play. For example, the price distributions for some goods fit poorly with the pattern described above. For example, Chart 7 plots the price distribution of a service: dry-cleaning charges. Wales has lower income levels and growth rates, but the price distribution is higher and faster growing. The sources of these discrepancies would be interesting future research.

Chart 7. Varying price level change and spread: dry cleaning in London and Wales.



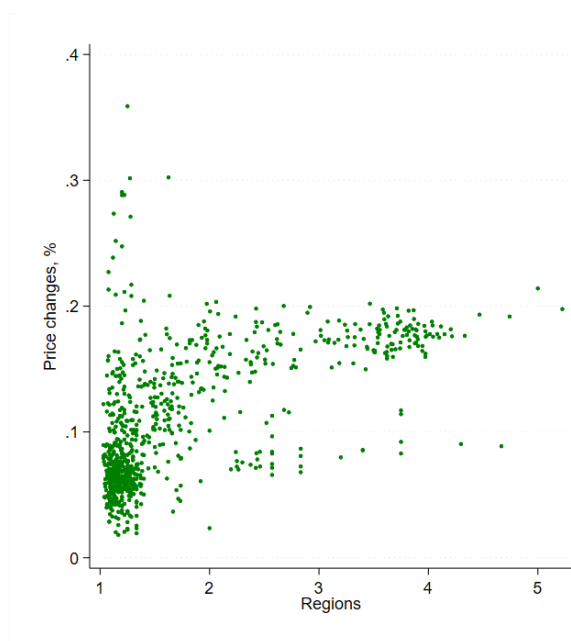
Notes: Plot of the distribution of prices. Colours refer to deciles. The coloured region is the 10th to 90th deciles. The solid blue line is the median.

Price changes and firm size

The micro data allow three indirect measures of size to be created. First, I look at the number of price observations the ONS collects from firms: this ranges from below 10 to hundreds of thousands. Second, I examine the regional span of a firm's operation: quotes from some firms represent just one region, other firms provide prices for every region of the UK—a measure of geographic scope. The third measure is the number of distinct items that prices are collected for from a particular firm—i.e. the scope of its 'menu'. This ranges from 1 to over 1000. These measures of firm size are all imperfect but offer interesting clues as to the nature of the firm providing the price quotes.

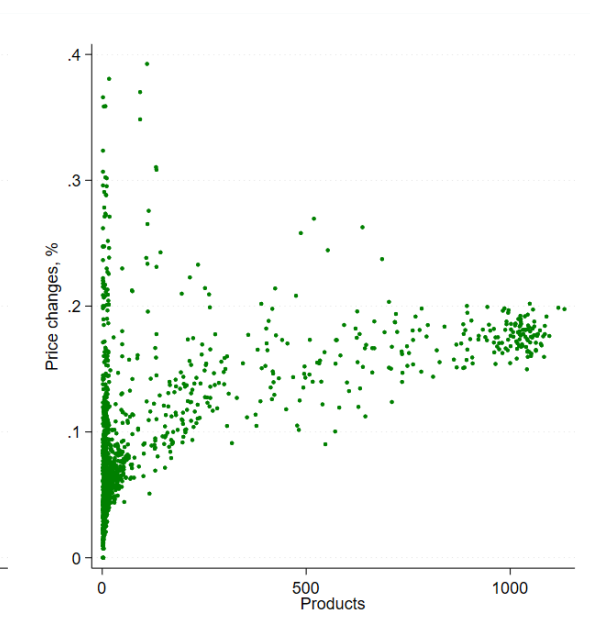
On all three measures price flexibility rises as firms get bigger (Charts 8 and 9). That is: when a firm is operating in more regions or offering more products it is more likely to change its prices. There is considerable heterogeneity among smaller firms, with some hardly changing any prices, and others being the most active in altering pricing. As firms get bigger, the distribution tightens—the regularity of price changes is much more similar among firms that are active across many regions and/or sell many products.

Chart 8 Price change by region



Notes: Each dot represents a single shop. X-axis is the mean number of regions active (entire sample); Y-axis the mean number of prices that are changes on the previous month's price for the same item.

Chart 9 Price change by product



Notes: Each dot represents a single shop. X-axis is the mean number of product lines with prices recorded, Y-axis the mean number of prices that are changes on the previous month's price for the same item.

Frequency of price changes – regional

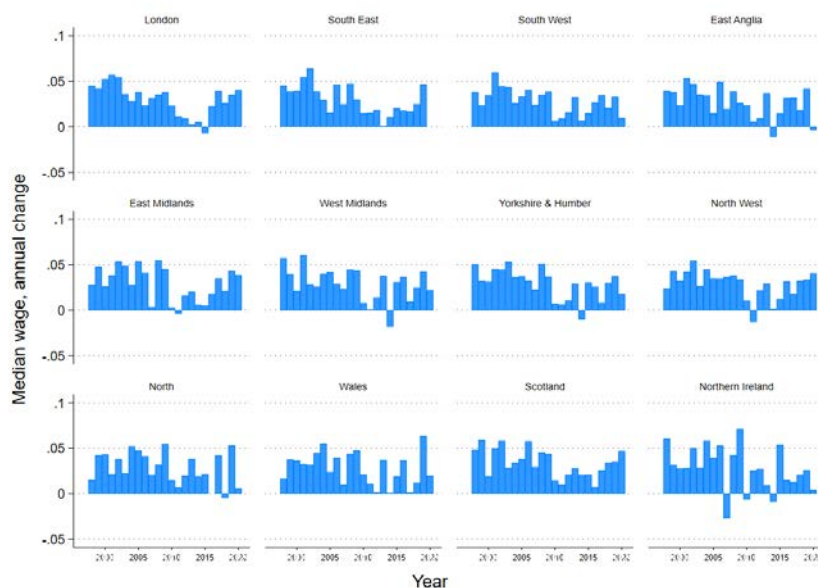
The geographic dimension of the price data allows an examination of the relationship between changes in wages and prices across the UK regions. Median wages are available from the Annual Survey of House and Earnings (ASHE) for the period 1997-2020.¹⁸ There has been considerable heterogeneity across British regions over this period (Chart 10).

Notable differences include:

- Periods of zero or negative wage growth that are not associated with 2008.
- Volatile and low wage growth in Wales and Northern Ireland.
- The strength and consistency of wage growth in Scotland.

¹⁸ Data are from *Annual Survey of Hours and Earnings time series of selected estimates*, Table 12.

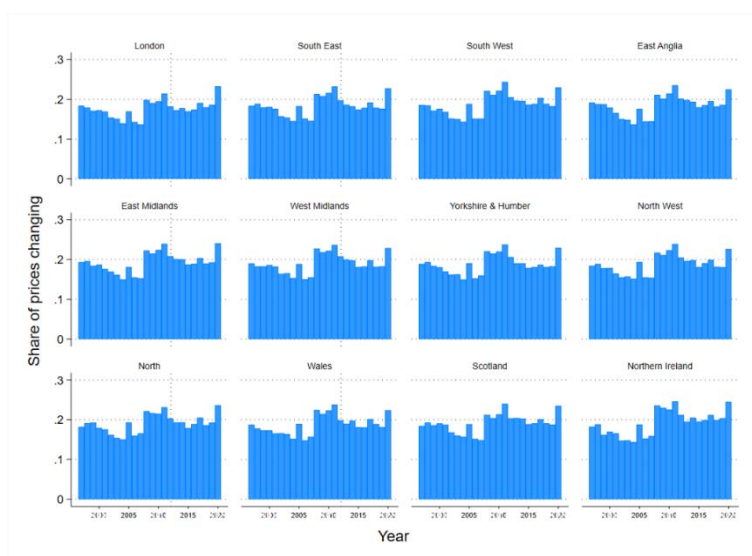
Chart 10. Wage growth, UK regions, 1997-2020.



Notes: Chart shows the annual change in median wages. Data are from ONS (ASHE, Selected estimates, November 2020, Table 12). Data series is 'Median hourly earnings excluding overtime'.

These facts, combined with the potential for wage-price channels, suggests there may be differential experience in terms of price flexibility by region. To examine this, I calculate the frequency of price changes at a regional level on an annual basis over the same window (Chart 11). The result appears to confound the notion of short-term wage-price channels. There is a striking similarity in terms of the proportion of price changes across the UK regions. Correlation coefficients between these variables (and lagged values) are low.

Chart 11. Proportion of price changes, UK regions, 1997-2020.

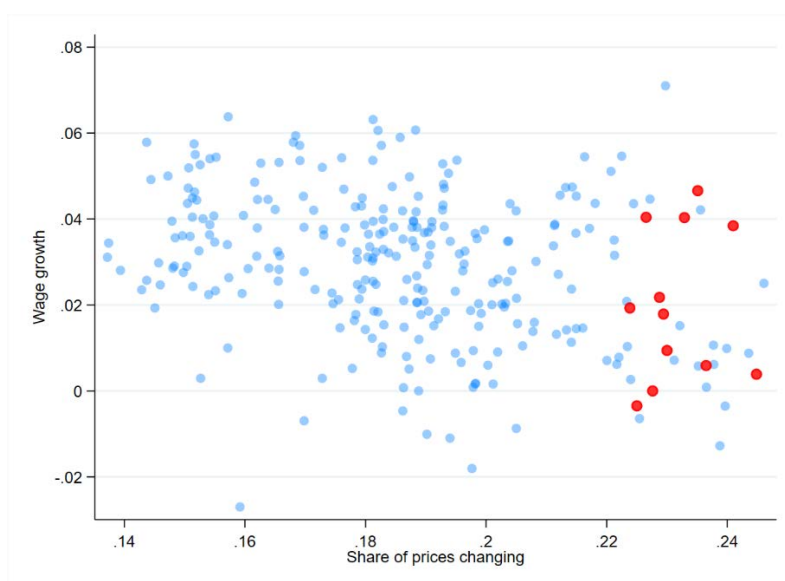


Notes: Chart plots the proportion of annual price changes, by UK region (whole year).

The ‘NUTS-1’ regions of the UK are large, and the results above may mask localised effects. This could be examined with more granular locational data. The ASHE data (on wages) allow this, but more granular locational information on prices is available only via the ONS Secure Lab. While unhelpful for those seeking real-time analysis, this is an interesting avenue for future research.

The most striking observation in the regional data is the experience in 2020. It is the first year in which more than 22% of prices changed in each of the 12 UK regions (Chart 12). This fits with the headline result set out in the accompanying Covid-19 briefing: 2020 was an extraordinarily volatile year in terms of pricing.

Chart 12. Wage growth and share of prices changing. Red dots = 2020 data.



Notes: Each dot represents a region-year. The red dots are the 12 UK NUTS regions, for 2020.

CONCLUSIONS

The discussion in this paper shows the value of micro data. High level price indices like the CPI and CPIH are examples of how headline measures needed for policy purposes mask important underlying information. Even lower-level CPI aggregates—indices for types of food, for example—are a far higher level of aggregation. As such they mix products that have different origins and inputs, sold in different regions and shop types. These indices thus mask interesting and useful price dynamics.

The new stylised facts add to the rich literature on micro-data pricing studies by describing and making public a new dataset of 41m observations for the UK. New data is available monthly and linking these to the cleaned and corrected back series means researchers now have prices covering 32 years.

In terms of the ‘fit’ with different models of price rigidity, the UK descriptive statistics match those for the US and EU closely. Price changes are frequent, and there are many small changes. There is no evidence of ‘pent up’ price pressure leading to large price changes when prices get ‘old’, as is predicted by time-dependent models. Prices tend to gravitate back to familiar levels—novel prices are rare, comeback prices common—suggesting firms may face higher costs when holding prices away from such benchmark prices.

While the data clearly favour some models over others, they also show the difficulty of fitting just one pricing model. There are many different price morphologies, both in cross section and time series. Among them, the division between goods and services is important. Goods prices change more, and in both directions, and goods have wider (and widening) distributions. Services prices tend only to rise, by moderate amounts, infrequently.

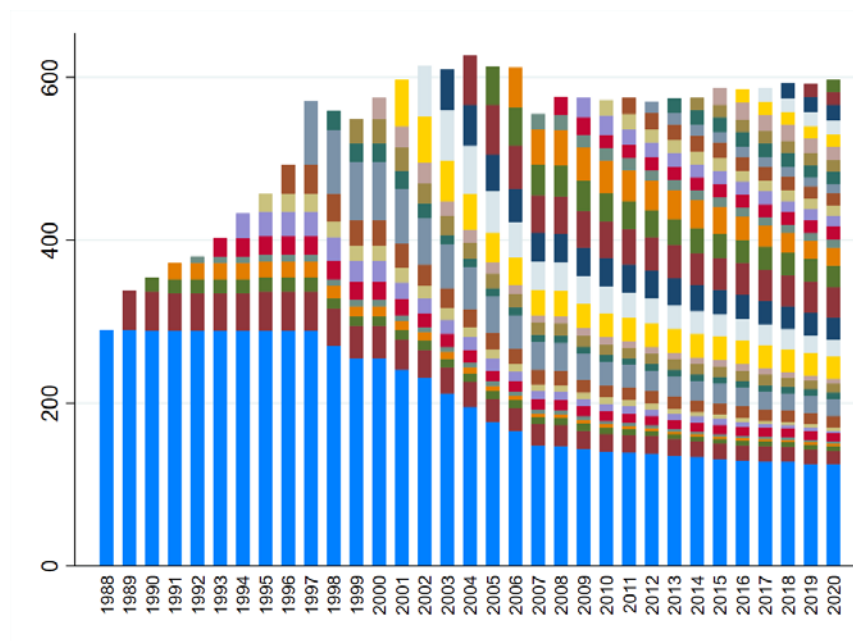
The stylised facts presented here suggest it will be interesting to examine how pricing patterns evolve in coming years. First, the division between goods and services may become important as consumption continues to shift towards services away from goods. Second, the fact that larger firms change prices more may affect the aggregate flexibility as the share of ‘superstar’ type firms rise. Third, the move to on-line shopping may reduce menu costs, leading to more flexible prices. Fourth, regional policy leaning to regional pricing as economic levels are increasingly devolved to local policymakers.

The impact of Covid-19 is discussed in the companion briefing. In short, the pandemic looks, in price terms, like a more severe version of 2008. There has been a surge in the frequency of price changes, with prices moving both up and down. This is unlike the 2016 election ‘shock’ which was more straightforwardly inflationary.

All this suggests both the official CPI data and developments with scanner data and scraped data may provide fruitful studies in coming years.

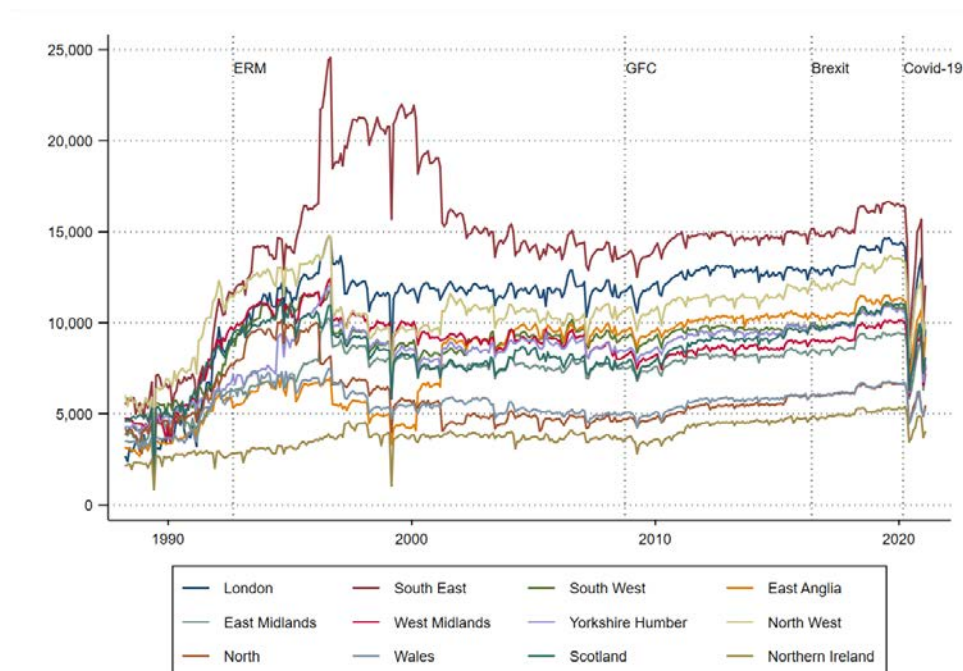
ANNEX A - TABLES AND CHARTS

Chart A1. The evolving CPI – number of products, by vintage



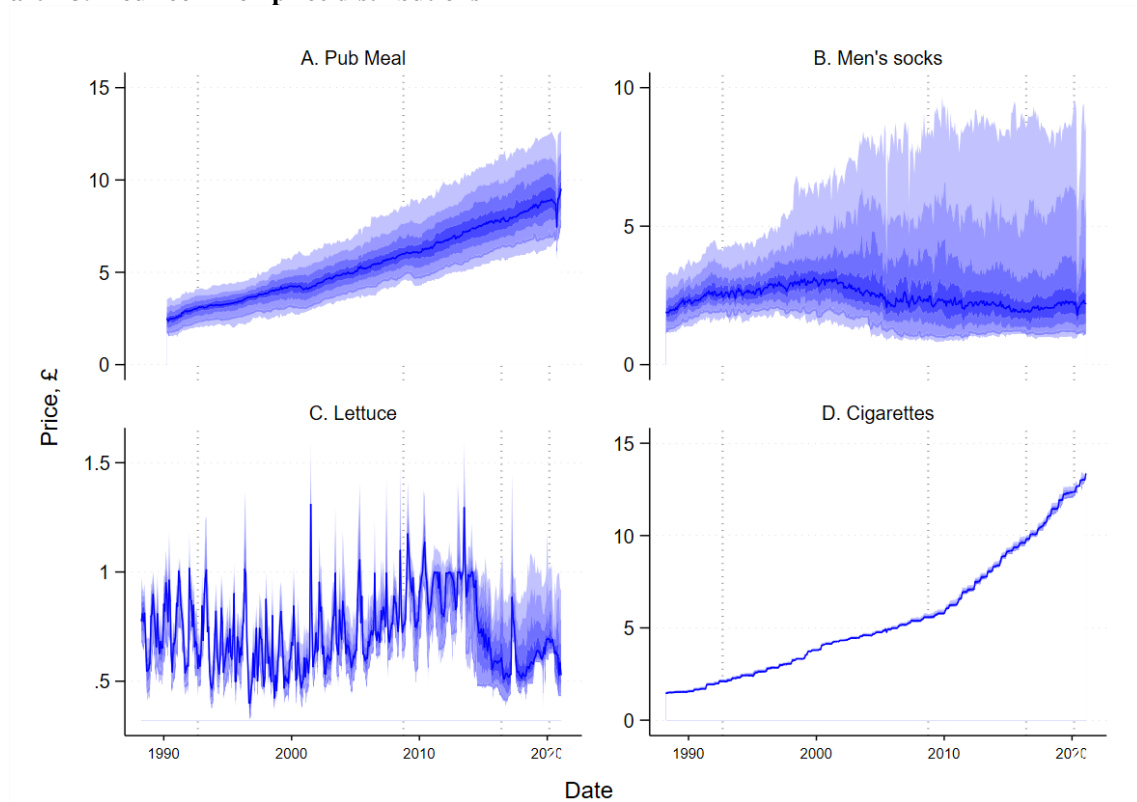
Notes: The height of each bar represents the number of products present in that year. Each new ‘vintage’ of CPI items is given a new colour to track how vintages fall out of the CPI over time.

Chart A2. Price quotes by region



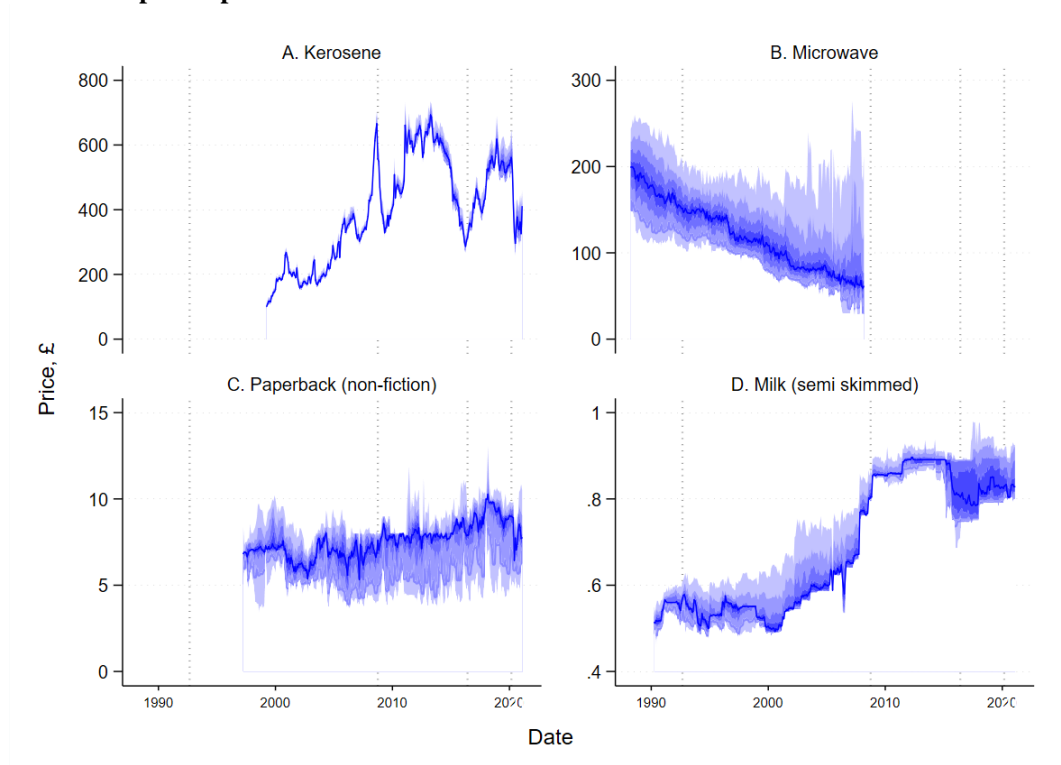
Notes: The chart shows the number of price quotes in the sample, by region. The South East (c9m people) is the UK’s most populous region, followed by London. This explains the differential sampling.

Chart A3. Four common price distributions



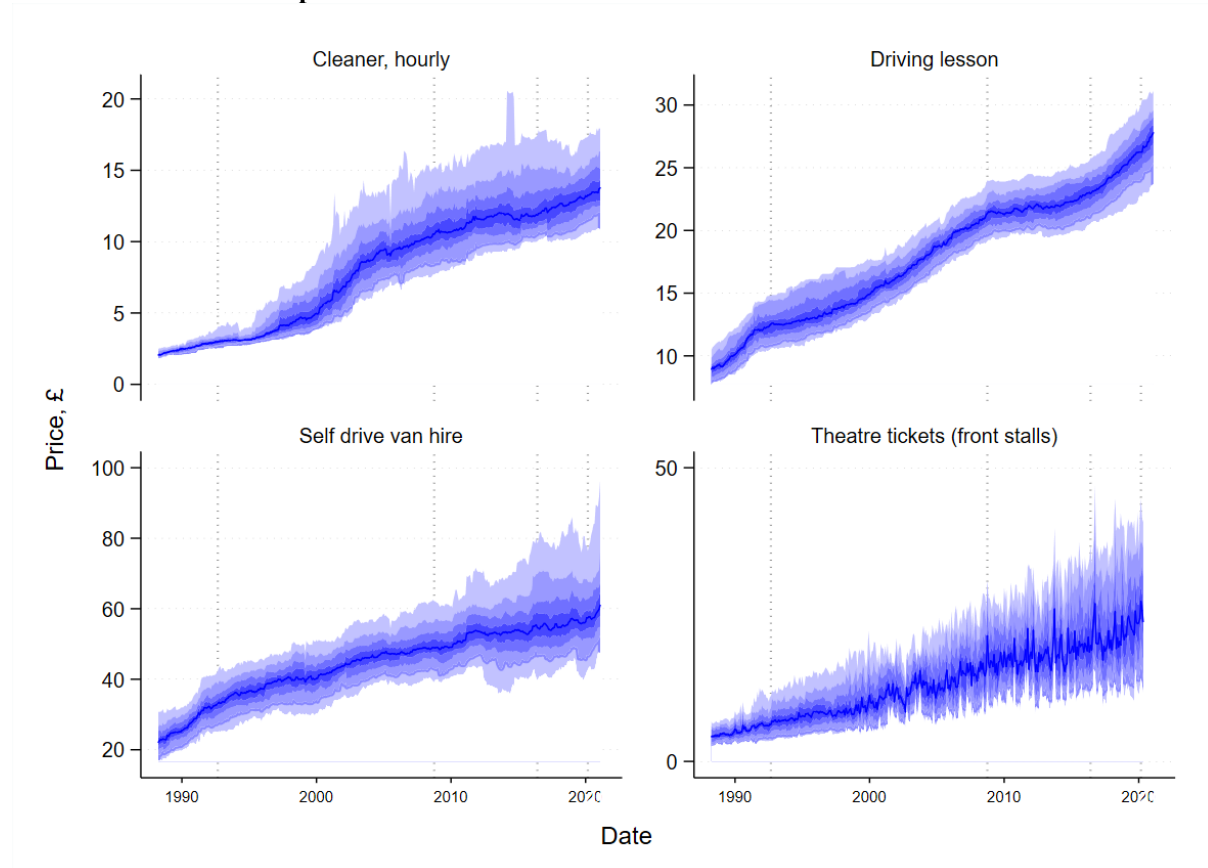
Notes: The charts plot the distributions for four items. Colours are defined based on deciles, with the coloured region representing the central 80% of prices (i.e., the 10th to 90th deciles). The median is a solid blue line. These four distributions are “typical” in that many goods have these characteristics.

Chart A4. Four specific price distributions



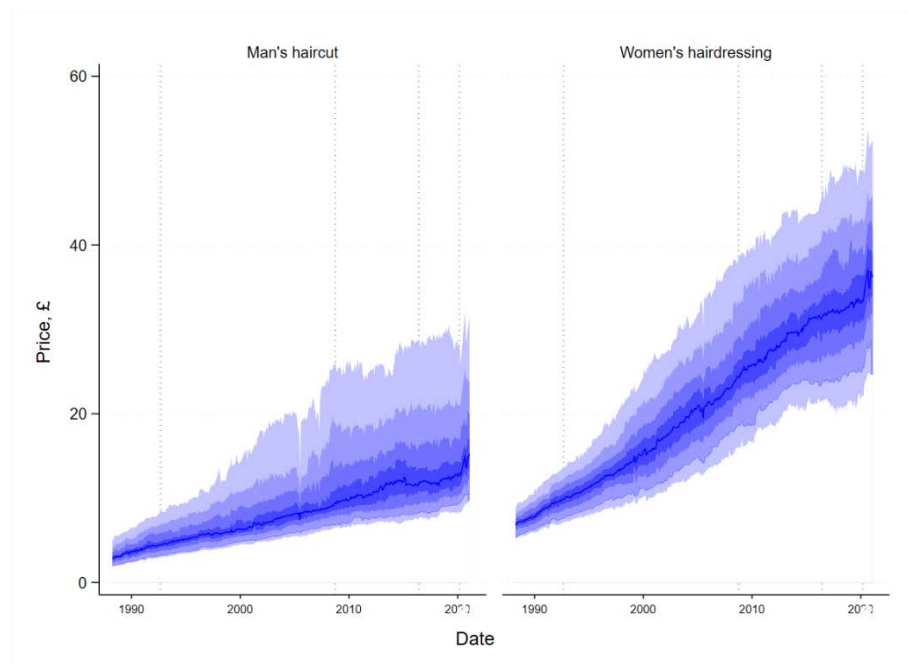
Notes: See note above. These distributions are more idiosyncratic, but a number of other goods follow these patterns. In particular note that for books, prices below the median but not above it are observed. For milk, the median price is at a price floor: few prices are below it.

Chart A5. Four services price distributions



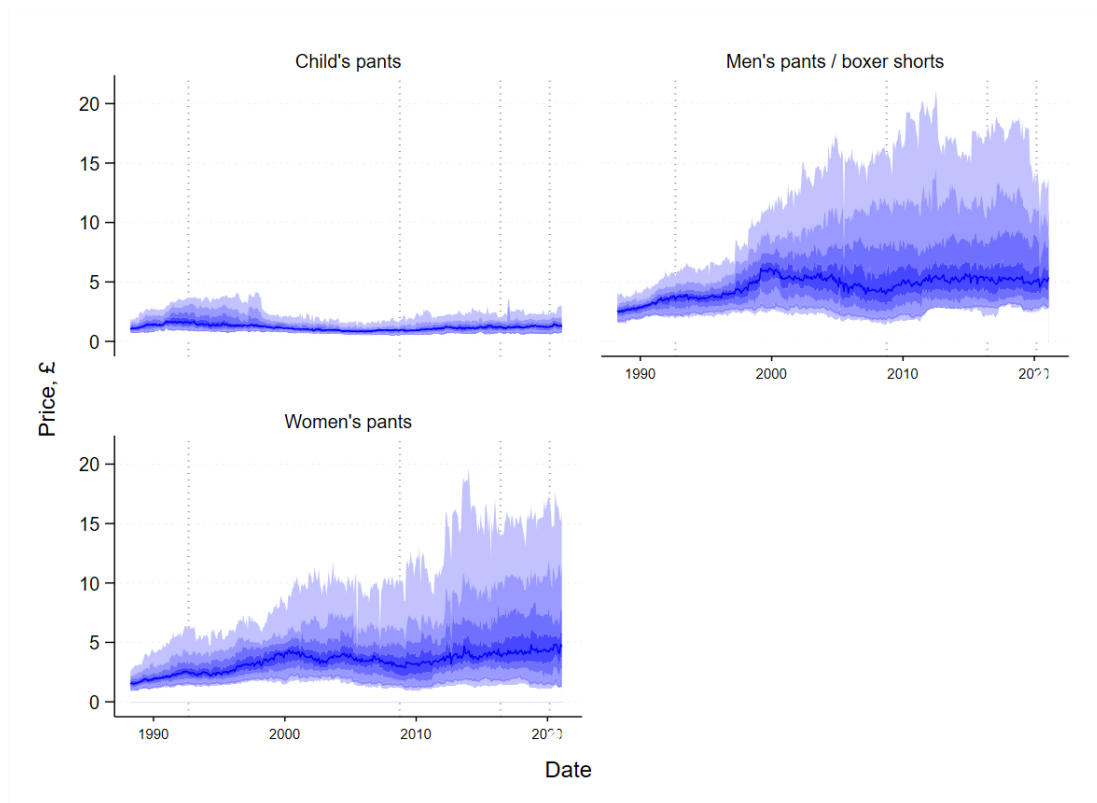
Notes: See note above. Driving lesson prices are an example of service prices that 'ladder' upwards—price cuts are very rare. By contrast the sales activity used to fill venues can be clearly seen for theatre tickets. Theatre tickets also show a strong regional component, with London prices significantly higher than elsewhere in the UK.

Chart A6. Gendered items



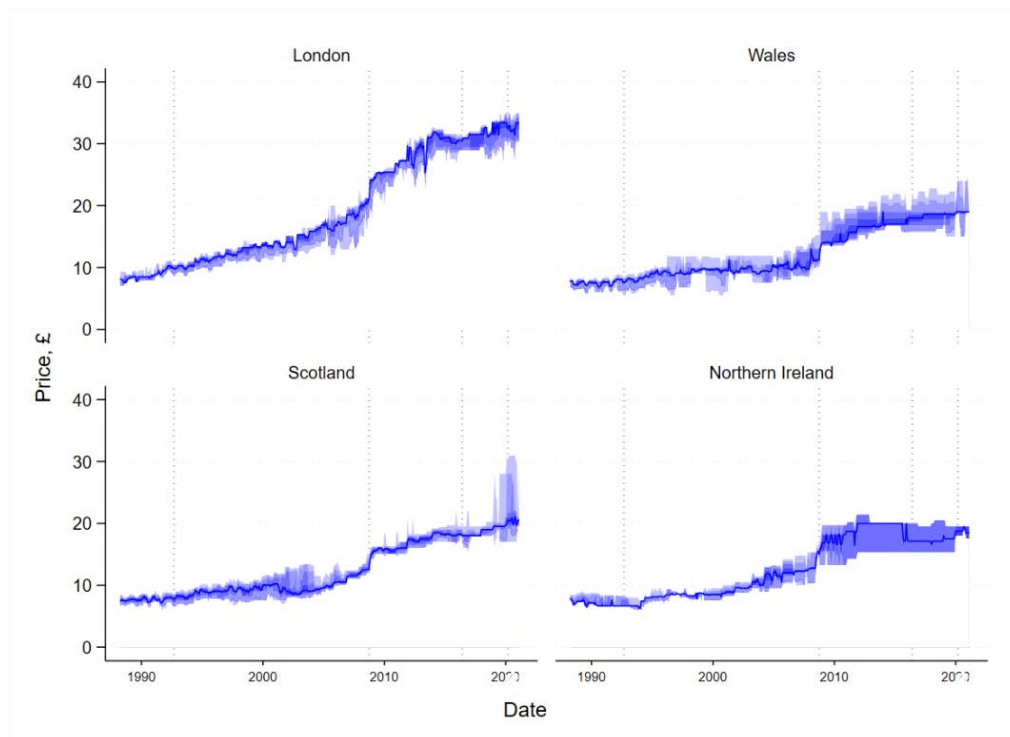
Notes: See chart A3.

Chart A7. Children's versus adult goods



Notes: See note above.

Chart A8. Regional pricing: smokeless fuel



Notes: Chart is for item "SMOKELESS FUEL 50KG". See notes above.

Table A1 – Item level price flexibility – most and least flexible

<i>Item description</i>	<i>Obs</i>	<i>Start</i>	<i>End</i>	<i>Months</i>	<i>Changes</i>	<i>Rises</i>	<i>Cuts</i>
<u>Most flexible prices</u>							
KEROSENE - 1000L DELIVERED	34,335	1999	2020	262	94.4%	50.3%	44.1%
ULTRA LOW SULPHUR PETROL 10L	112,825	1988	2006	226	65.7%	37.6%	28.1%
FRESH VEG-CAULIFLOWER-EACH	111,458	1988	2020	394	64.5%	32.3%	32.2%
STRAWBERRIES PER KG OR PUNNET	29,979	1999	2020	259	61.5%	30.9%	30.6%
GRAPES-PER KG	71,873	1999	2020	262	60.6%	31.6%	29.0%
FRESH VEG-LETTUCE-ICEBERG-EACH	115,657	1988	2020	394	60.2%	30.9%	29.3%
ULTRA-LOW SULPHUR DIESEL 10L	113,424	1988	2006	226	59.7%	34.9%	24.8%
LEAD REPLACEMENT PETROL,10 LTR	96,222	1988	2003	179	58.7%	33.5%	25.1%
FRESH VEG-CUCUMBER-WHOLE	118,509	1988	2020	394	53.2%	26.8%	26.4%
BOOK-NON-FICTION-HARD-COVER	40,539	1997	2020	286	50.9%	24.9%	26.0%
<u>Least flexible prices</u>							
DECORATOR-DAILY RATE;SPEC HRS	45,480	2001	2020	238	3.6%	2.7%	0.8%
BASIC MANICURE	30,828	2004	2020	202	3.5%	2.7%	0.8%
WASHING MACHINE REPAIR	31,797	1999	2020	262	3.4%	2.8%	0.6%
WINDOW-CLEAN 3-BED SEMI	62,246	1995	2020	310	3.4%	3.2%	0.3%
NON-NHS MEDICINE-PHYSIOTHERAPY	37,009	1998	2020	274	3.3%	3.0%	0.3%
CAR PARK CHARGES	50,796	2004	2020	202	3.3%	2.8%	0.5%
CHILD MINDER - HOURLY RATE	47,940	2001	2020	238	3.2%	2.9%	0.3%
CARPENTER HOURLY RATE	31,382	2005	2020	190	3.1%	2.1%	1.0%
CONTACT LENS-SOFT PER PAIR	31,911	1995	2013	215	2.8%	1.7%	1.1%
NON NHS CHIROPRACTOR	27,210	2005	2020	190	2.4%	2.1%	0.4%

Notes: Table shows the top and bottom 10 items ranked by the number of price changes during their time in the dataset. The table is drawn for the 500 most sampled items in the CPI.

Table A2 – Item level inflation – price changers – top and bottom 10

<i>Item description</i>	<i>Observations</i>	<i>Start</i>	<i>End</i>	<i>Months</i>	<i>Start price</i>	<i>End price</i>	<i>Price rise</i>
<u>Biggest risers</u>							
CIGARETTES 8	82,879	1988	2020	394	£1.46	£13.34	812%
9CT GOLD CHAIN 18-20"/46-51CM	94,277	1988	2020	394	£24.27	£180.00	642%
PUB: COLD FILLED ROLL/SANDWICH	122,729	1989	2013	286	£0.61	£4.18	584%
MINTS	61,144	1988	2020	394	£0.10	£0.67	573%
DOMESTIC CLEANER HOURLY RATE	70,837	1988	2020	394	£2.06	£13.77	570%
LEISURE CENTRE ANNUAL M'SHIP	13,025	1993	2003	119	£20.46	£134.61	558%
POTATO CRISPS-INDIVIDUAL PACK	196,675	1988	2020	394	£0.15	£0.99	558%
CHEDDAR-IMPORTED-PER KG	30,612	1988	2009	251	£1.42	£9.19	549%
POTATO CRISPS-25G/40G	64,706	1988	2020	394	£0.14	£0.86	516%
ADULT'S WATCH	48,150	1988	2004	191	£12.22	£74.45	509%
<u>Biggest fallers</u>							
PERSONAL CD PLAYER	16,091	1998	2006	95	£83.16	£35.19	-58%
ENCYCLOPAEDIA 99	1,075	1999	2000	11	£49.78	£20.20	-59%
CAMCORDER-8MM OR VHS-C	21,335	1994	2005	131	£599.95	£226.91	-62%
COLOUR TV-14INCH/34CM PORTABLE	49,838	1988	2006	226	£166.56	£56.24	-66%
MICROWAVE (STATE IF COMBINED)	46,225	1988	2008	239	£199.28	£61.24	-69%
BLANK VIDEO CASSETTE VHS/E180	30,713	1988	2006	226	£4.44	£0.99	-78%
DVD PLAYER - NOT PORTABLE	27,009	2002	2014	143	£177.98	£34.42	-81%
VHS VIDEO RECORDER	48,412	1988	2007	228	£331.15	£61.23	-82%
CONTACT LENS-SOFT PER PAIR	31,911	1995	2013	215	£80.16	£13.56	-83%
DECODER FOR DIGITAL TV	3,268	1999	2001	23	£199.99	£0.01	-100%

Table A3. Item level price spread. Diverging and tightening price distributions

Description	Obs	Start (1988)			End (2020)			Change			Change
		10 th	50 th	90 th	10 th	50 th	90 th	10 th	50 th	90 th	90 th /10 th ratio, change
<u>Diverging prices</u>											
PUSHCHAIR/STROLLER	67,609	£26.95	£50.82	£66.63	£25.91	£184.87	£827.17	-3.9%	263.8%	1141.4%	29.5
WOMEN'S PANTS	113,983	£0.90	£1.53	£2.72	£1.26	£4.66	£15.95	40.4%	204.5%	486.0%	9.6
SLEEPING BAG	52,010	£12.86	£17.54	£24.18	£11.75	£29.20	£134.33	-8.7%	66.5%	455.5%	9.6
SMALL SAUCEPAN,MILK	68,726	£3.63	£6.43	£10.36	£2.64	£8.66	£31.64	-27.1%	34.6%	205.5%	9.1
WOMEN'S TIGHTS	108,945	£0.60	£0.97	£1.33	£1.04	£3.37	£11.69	73.6%	246.4%	780.1%	9.0
MENS JACKET/COAT	104,194	£21.07	£32.64	£47.62	£20.45	£41.05	£217.38	-3.0%	25.8%	356.5%	8.4
MOISTURISER FACIAL 50-150ML	65,721	£0.83	£1.32	£2.02	£2.22	£4.30	£23.84	168.2%	225.2%	1082.2%	8.3
DUVET-DOUBLE TOG 10-13.5	100,075	£18.44	£27.04	£39.73	£11.49	£22.66	£112.46	-37.7%	-16.2%	183.1%	7.6
MEN'S TIE	113,253	£2.31	£3.34	£5.59	£3.69	£9.87	£36.38	59.8%	195.8%	550.5%	7.4
DOUBLE WARDROBE	104,020	£70.07	£150.64	£323.82	£104.17	£413.95	£1,199.50	48.7%	174.8%	270.4%	6.9
<u>Tightening prices</u>											
CIGARETTES 8	82,879	£1.40	£1.46	£1.55	£13.09	£13.34	£13.50	838.1%	812.3%	771.6%	-0.1
PAINT BRUSH-2INCH/5CM WIDTH	71,280	£1.01	£1.74	£2.65	£2.58	£3.80	£6.48	155.0%	118.7%	144.5%	-0.1
TYRES-TUBELESS RADIAL	81,621	£17.67	£24.46	£42.07	£46.50	£66.53	£103.91	163.2%	172.0%	147.0%	-0.1
EGGS-LARGE-PER DOZ OR 2 X 6	57,203	£0.83	£1.17	£1.26	£2.52	£3.00	£3.35	203.1%	155.6%	165.8%	-0.2
FORTIFIED WINE (70-75CL)	82,962	£2.08	£3.58	£4.53	£6.93	£9.00	£11.82	232.8%	151.6%	160.9%	-0.5
SOFA BED	82,236	£222.99	£610.97	£1,230.93	£300.65	£577.54	£1,370.81	34.8%	-5.5%	11.4%	-1.0
DOOR HANDLE-PACK FOR ONE DOOR	63,502	£1.72	£4.25	£7.02	£8.30	£12.54	£22.80	381.6%	194.7%	224.9%	-1.3
CONSTRUCTION TOY: SPEC KIT NO	51,473	£3.52	£8.28	£17.50	£8.53	£15.95	£27.54	142.1%	92.5%	57.4%	-1.7
STAFF RESTAURANT MAIN COURSE	87,310	£1.19	£1.86	£4.30	£3.83	£3.89	£4.38	221.5%	109.3%	1.9%	-2.5
CHILD'S PLASTIC DOLL	55,441	£3.20	£9.69	£17.03	£7.28	£11.50	£19.33	127.7%	18.7%	13.5%	-2.7

Table A4. Frequency of price changes, pre-pandemic (2017-2019) and Covid-19 period (April 2020-)

Division	Price changes		Rises		Cuts	
	2017-2019	2020*	2017-2019	2020*	2017-2019	2020*
Alcoholic beverages, tobacco and narcotics	27.9%	30.1%	15.9%	16.6%	12.0%	13.5%
Clothing and footwear	21.7%	27.7%	10.5%	13.9%	11.2%	13.8%
Communication	18.4%	22.9%	9.2%	9.2%	9.1%	13.6%
Food and non-alcoholic beverages	20.1%	24.6%	11.0%	11.9%	9.1%	12.7%
Furnishings, household equipment and maintenance	21.4%	25.4%	11.0%	12.8%	10.4%	12.6%
Health	9.8%	13.1%	5.8%	6.4%	4.0%	6.7%
Housing, Water, Electricity, Gas and other fuels	14.8%	14.2%	8.9%	7.5%	5.9%	6.7%
Miscellaneous goods and services	17.0%	26.6%	9.0%	13.0%	8.1%	13.6%
Recreation and culture	18.9%	26.6%	9.4%	12.6%	9.5%	14.0%
Restaurants and Hotels	8.0%	33.0%	6.4%	9.5%	1.6%	23.5%
Transport	8.6%	7.6%	5.4%	4.7%	3.2%	2.9%

Notes: Data are the average month on month price changes, price rises and cuts. The dates are 2017-2019, and for 2020, dates since April 2020 reflecting the Covid-19 period.

REFERENCES

Ball, L. M. and Mazumder, S. (2011). “Inflation Dynamics and the Great Recession,” NBER Working Paper No. 17044.

Brynjolfsson, Erik, Avinash Collis, W. Erwin Diewert, Felix Eggers & Kevin J. Fox (2019) “GDP-B: Accounting for the Value of New and Free Goods in the Digital Economy”, NBER WORKING PAPER 25695.

Breinlich, H, Leromain, E., Novy, D. and Sampson, T. (2017), “The consequences of the Brexit vote for UK inflation: First evidence”, VoxEU.org, 20 November.

Bodenstein, M, Hebden, J. and Winkler, F. (2019), “Learning and Misperception: Implications for Price-Level Targeting”, Finance and Economics Discussion Series (FEDS), November 2019.

Bunn, P. and Ellis, C. (2009), “Price-Setting Behaviour in the United Kingdom: A Microdata Approach,” *Bank of England Quarterly Bulletin*, 2009 Q1.

Burstein, A. (2006), “Inflation and Output Dynamics with State Dependent Pricing Decisions,” *Journal of Monetary Economics* 53 (7/October): 1235-1257.

Cavallo, A. and Rigobon, R. (2016).The Billion Prices Project: Using Online Prices for Measurement and Research, *Journal of Economic Perspectives*, 30 (2): 151-78.

Cecchetti, Stephen (1986), “The frequency of price adjustment: A study of the newsstand prices of magazines”, *Journal of Econometrics*, Volume 31, Issue 3, April 1986, Pages 255-274.

Cabral, L and L Xu (2020), “Seller Reputation and Price Gouging: Evidence from the COVID-19 Pandemic”, NYU and Bank of Canada.

Costa, Rui and Stephen Machin (2017), “Real Wages and Living Standards in the UK”, CEP Paper EA036, June 2017.

Cobham, David, (1997), “The Post-Erm Framework for Monetary Policy in the United Kingdom: Bounded Credibility”, *The Economic Journal*, Vol. 107, No. 443 (Jul., 1997), pp. 1128-1141.

Davies, Richard, Peter Richardson, Vaiva Katinaite and Mark Manning (2010), “Evolution of the UK Banking System”, *Bank of England Quarterly Bulletin*, vol. 50(4), pp 321-332.

Dhyne, E., Alvarez, L.J., Bhan, H.L., Veronese, G., Dias, D., Hoffmann, J., Jonker, N., Lunnemann, P., Rumler, F. and J. Vilmunen (2006). “Price Setting in the Euro Area and the United States: Some Facts From Individual Consumer Price Data,” *Journal of Economic Perspectives*, 20(2), 171–192.

Fabiani, S., Druant, M., Hernando, I., Kwapil, C., Landau, B., Loupias, C., Martins, F., Mathä, T.Y., Sabbatini, R., Stahl H. and Stokman, A.C.J. (2005), “The Pricing Behavior of Firms in the Euro Area: New Survey Evidence,” ECB Working Paper 535.

- Fabiani, S., Gattulli, A. and Sabbatini, R. (2007), "The Pricing Behavior of Italian Firms. New Survey Evidence on Price Stickiness," in *Pricing Decisions in the Euro Area: How Firms Set Prices and Why*, OUP, S. Fabiani, C. Loupias, F. Martins, and R. Sabbatini, eds.
- Fisher, Timothy (2006) and Jerzy Konieczny, "Inflation and Costly Price Adjustment: A Study of Canadian Newspaper Prices", *Journal of Money Credit and Banking* 38(3):615-633.
- Gagnon, E. (2009), "Price Setting during Low and High Inflation: Evidence from Mexico," *Quarterly Journal of Economics* 124 (August): 1221 – 1263.
- Golosov, M. and Lucas, Jr., R.E. (2007), "Menu Costs and Phillips Curves," *Journal of Political Economy* 115 (April): 171–199.
- Gopinath, G. and Itskhoki, O. (2010): "Frequency of Price Adjustment and Pass Through," *The Quarterly Journal of Economics*, 125, 675–727.
- Hall, R.E. (2011). "The Long Slump." *American Economic Review*, 101: 431-469.
- Hall, S., Walsh, M. and Yates, A. (2000), "Are UK Companies' Prices Sticky?" *Oxford Economic Papers* 52 (3): 425-446.
- Hazell, Jonathon, Juan Herreño, Emi Nakamura & Jón Steinsson, "The Slope of the Phillips Curve: Evidence from U.S. States", NBER WORKING PAPER 28005.
- Heise, Sebastian, Fatih Karahan & Ayşegül Şahin, "The Missing Inflation Puzzle: The Role of the Wage-Price Pass-Through", NBER WORKING PAPER 27663.
- Hobijn, B., Ravenna, F. and Tambalotti, A. (2006), "Menu Costs at Work: Restaurant Prices and the Introduction of the Euro," *Quarterly Journal of Economics* 121 (August): 1103 – 1131.
- Jaravel, X. and O'Connell, M. (2020a), 'Real-time price indices: inflation spike and falling product variety during the Great Lockdown', *Journal of Public Economics*, 191, 104270.
- Klenow P. and Malin, B. (2010), "Microeconomic Evidence on Price Setting", *Handbook of Monetary Economics*.
- Kryvtsov, O. and Midrigan, V. (2009), "Inventories, Markups, and Real Rigidities in Menu Cost Models," unpublished paper, Bank of Canada.
- Kryvtsov, O. and Vincent, N. (2015), "On the Importance of Sales for Aggregate Price Flexibility," 2015 Meeting Papers 46, Society for Economic Dynamics.
- Kryvtsov, O (2017), "On the Evolution of the United Kingdom Price Distributions", working paper with Ba M. Chu, Kim P. Huynh, David T. Jacho-Chavez.
- Knotek, Edward (2011), "The Roles of Price Points and Menu Costs in Price Rigidity", Federal Reserve Bank of Cleveland, December 1, 2010.

- Lünnemann, P. and Mathä, T.Y. (2005), “Consumer Price Behaviour in Luxembourg: Evidence from Micro CPI Data,” ECB Working Paper 541.
- Kehoe, P. and Midrigan, V. (2014) “Prices are Sticky After All,” *Journal of Monetary Economics*, Volume 75, October 2015, Pages 35-53.
- Kaplan, G. and Menzio, G. (2015), “The Morphology of Price Dispersion”, *International Economic Review*, Volume 56, Issue 4.
- Mackowiak, B. and Smets, F. (2008), “Implications of Micro Price Data for Macroeconomic Models,” CEPR Discussion Paper 6961.
- Midrigan, V. (2011), “Menu Costs, Multiproduct Firms, and Aggregate Fluctuations,” *Econometrica*, Vol. 79, pp. 1139-1180.
- Mills F.C. (1927). “The Behavior of Prices”. NBER: New York.
- Mussa, (1981), “Sticky Prices and Disequilibrium Adjustment in a Rational Model of the Inflationary Process”, *American Economic Review*, 71 (1981), pp. 1020-1027.
- Nakamura, E. and Steinsson, J. (2008), “Five Facts About Prices: A Reevaluation of Menu Cost Models,” *Quarterly Journal of Economics* 123 (November): 1415-1464.
- Nakamura, E. and Steinsson, J. (2013), “Lost in Transit: Product Replacement Bias and Pricing to Market”, *American Economic Review* 2012, 102(7): 3277–3316.
- Sheshinski, E. and Weiss, Y. (1977). “Inflation and Costs of Price Adjustment”. *The Review of Economic Studies*, 44(2), 287-303.
- Taylor, J.B. (2016): “The staying power of staggered wage and price setting models in macroeconomics,” NBER Working Paper, #22356, pp2009–2042.
- United Nations (2018), “Classification of Individual Consumption According to Purpose”, ST/ESA/STAT/SER.M/99.
- Weinsten D., Hanbury, J. and Watanabe T. (2013), “How Much do Official Price Indexes Tell us about Inflation?”, NBER Working Paper #19504, October.
- Wolman, A. (2007), “The Frequency and Costs of Individual Price Adjustment,” *Managerial and Decision Economics* 28 (6): 531-552.

CENTRE FOR ECONOMIC PERFORMANCE
Occasional Papers

- | | | |
|----|--|---|
| 54 | Christian Krekel
Sarah Swanke
Jan-Emmanuel De Neve
Daisy Fancourt | Are happier people more compliant? Global evidence from three large-scale surveys during Covid-19 lockdowns |
| 53 | Nicolas González-Pampillón
Henry.G. Overman | Regional differences in UK transport BCRs: An empirical assessment |
| 52 | Jonathan Wadsworth | Labour markets in the time of Coronavirus: measuring excess |
| 51 | Morten Bennedsen
Berthe Larsen
Ian Schmutte
Daniela Scur | Preserving job matches during the Covid-19 pandemic: firm-level evidence on the role of government aid |
| 50 | Lindsay E. Relihan Marvin
M. Ward Jr. Chris W.
Wheat
Diana Farrell | The early impact of COVID-19 on local commerce: Changes in spend across neighborhoods and online |
| 49 | Richard Layard
Andrew Clark
Jan-Emmanuel De Neve
Christian Krekel
Daisy Fancourt
Nancy Hey
Gus O'Donnell | When to release the lockdown? A wellbeing framework for analysing costs and benefits |
| 48 | Jack Blundell | Clusters in UK Self-Employment |
| 47 | Jonathan Wadsworth | Immigration |
| 46 | Nicholas Bloom Renata
Lemos Raffaella Sadun
Daniela Scur
John Van Reenen | International Data on Measuring Management Practices |

45	Alex Bryson John Forth	The UK's Productivity Puzzle
44	Max Nathan Anna Rosso	Mapping Information Economy Businesses with Big Data: Findings for the UK
43	Luis Garicano Esteban Rossi-Hansberg	Knowledge-based Hierarchies: Using Organizations to Understand the Economy
42	Chiara Criscuolo Peter N. Gal Carlo Menon	Dynemp: A Stata® Routine for Distributed Micro-data Analysis of Business Dynamics
41	Nicholas Bloom Renata Lemos Raffaella Sadun Daniela Scur John Van Reenen	The New Empirical Economics of Management
40	Ghazala Azmat Barbara Petrongolo	Gender and the Labor Market: What Have We Learned from Field and Lab Experiments?
39	Christopher J. Boyce Alex M. Wood James Banks Andrew E. Clark Gordon D.A. Brown	Money, Well-Being, and Loss Aversion: Does an Income Loss Have a Greater Effect on Well-Being than an Equivalent Income Gain?
38	Nicholas Bloom	Fluctuations in Uncertainty
37	Nicholas Oulton	Medium and Long Run Prospects for UK Growth in the Aftermath of the Financial Crisis
36	Phillipe Aghion Nicholas Bloom John Van Reenen	Incomplete Contracts and the Internal Organisation of Firms

For more information please contact the Publications Unit
Tel: +44 (0)20 7955 7673; Email: cep.info@lse.ac.uk
Website <http://cep.lse.ac.uk>