Measuring the Volume of Services Industries Output and Productivity: An Audit of Services Producer Price Indices in OECD Countries

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Abstract

This article discusses measurement of Services Producer Price Indices, which are important in estimating the volume of the output of services sectors. Price indices for 31 individual services activities were downloaded from the websites of National Statistical Offices for 16 OECD countries and compared to those for the UK. The results show that UK services prices tend on average to have either lower or equal price growth than in other countries, suggesting that an underestimate of services output growth is not likely to be a greater problem in the UK than in other comparable countries. Nevertheless, there may be common biases across countries due to inadequate adjustments for quality. Further analysis of measurement methods suggests a small but significant positive bias in price inflation for one commonly employed method based on time spent on the provision of services. This means that the growth in the volume of services activity may be understated in general in the group of countries considered in this article.

Introduction

In many countries aggregate productivity growth has increasingly been dependent on trends in services sectors, both due to declines in the share of manufacturing over time and in the concentration of many in-

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novations related to information technology, and more recently, digital technology, in services. For example, Timmer et al. (2010) present evidence for the importance of services sectors as drivers of productivity benefits from the use of information technology. Likewise, Lehrer et al. (2018) discuss how digital technologies, in particular big data analytics, provide a key organizational resource for services innovations. Measuring the productivity of service industries requires accurate measures of real output. For many privately provided service industries, surveys and censuses contain the necessary information on nominal output. The main measurement issue is the need to have reliable measures of prices to construct volume measures, which are comprehensive in their coverage and capture any quality changes in the provision of these services. Improvements to the Services Producer Price Indices (SPPIs), which feed into deflators of domestic output of service industries is a priority area for the Office for National Statistics (ONS) and is recognised as an important channel for statistical improvement internationally.

Several national and international initiatives have aided both our understanding of measurement methods and provided better estimates of SPPIs. ONS carried out a quality review of SPPIs, summarised in Thomas (2016). This recommended improvements in the quality and coverage of existing SPPIs, including "the introduction of rotational sampling in the SPPI survey to establish the SPPIs on a sustainable, methodologically-robust foundation," as well as the development of new SPPIs. The updated guide for developing statistics on SPPIs is based on Eurostat (2013), and more specifically on OECD/Eurostat (2014) which provides a detailed methodological guide on mechanisms that service industry providers use to price their outputs, possible data sources and a review of practice for a number of countries. The Voorburg Group reports contain more details of the discussions among National Statistical Offices (NSO) on ways to measure prices of service industry activities.[2]

Since there is considerable effort currently devoted by OECD, Eurostat and the Voorburg group to reviewing and improving methodologies and data sources, we do not attempt to duplicate this discussion here but instead undertake a systematic attempt to compare the resulting Business to Business SPPIs. We concentrate on international comparisons of producer prices for service industry activities using data that is in the public domain via downloads from NSO websites. We use price growth, relative to aggregate price movements, as our unit of analysis. This reflects the fact that, in contrast to traded goods, there are fewer market mechanisms that would lead to common price levels across countries for the same service. At the same time, we should not expect very large deviations in relative price growth, and any such deviations might indicate measurement issues

2 The Voorburg Group on Services Statistics was established in 1986 in response to a request from the United Nations Statistical Office to help in the development and production of services statistics. Its objective is the design of an internationally comparable methodology for measuring the constant dollar outputs of the service industries. Available at: http://voorburggroup.org/.

that need addressing. It might have been useful also to examine relative price levels using purchasing power parity prices (PPPs) but this was considered beyond the scope of this article which is concerned primarily with volume measures across time.

The article starts with the SPPIs produced by ONS and reviews them against similar metrics in other countries. This takes the form of normalising annual average price changes, relative to measures of country specific inflation, for specific services and describing these across a number of dimensions, such as country, time and measurement method. The aim is to understand the extent to which the UK prices deviate from the average across countries. The analysis is based on data for 16 countries and 31 separate SPPIs. The choice of SPPIs was driven by those available for the UK and the choice of countries was dictated by the availability of readily downloadable SPPI series. The time series extend from the early 2000s to 2017 but the coverage varies by country and type of service.

We then extend this analysis to include other factors that impact on relative prices. We take account of market structure, which might impact on mark-ups charged, and we also attempted to allow for differences in regulation of markets. Other influences on relative prices such as preferences/tastes are captured by the country dummy variables, as these are likely to be time invariant. Here we focus more on those business services where measurement is most affected by the use of methods that do not allow for productivity improvements as explained below. This concentrates on differences in prices when time based (TB) methods are used relative to model pricing (MP), which is a method that attempts to price a standardised service and so can capture productivity change. We then provide some general descriptive analysis, based on panel regressions, and controlling for market structure and regulation. In this more complete analysis, we find that the average difference in these two methods lead to about 0.3 to 0.4 percentage points per annum lower prices using MP. This might affect output growth in volume terms and productivity in industries that intensively use the former, such as Professional Services. The impact on aggregate productivity growth, however, is likely to be relatively small, given the size of these industries. The article then investigates a possible alternative method that employs opportunity costs to measure price change for professional services, where opportunity costs are estimated based on the provision of these services internally in firms. We do this for a small number of services where TB methods are currently used. The results are consistent with the findings from the regression analysis, indicating that prices may be overstated using TB methods, but we also note some shortcomings of such an approach.

Context

Early on Griliches (1992) pointed to the mismeasurement of output and prices in the service sector as a possible explanation for the productivity slowdown in the US in the 1950s-1980s. In fact, it is widely believed that the measurement of output and prices in services is non-trivial and tends to be more challenging than in commodities or goods. Griliches (1994) argued that, with services gaining more importance and ac-

counting for more output over time, there is a risk that the quality of the national income statistics could fall.

OECD/Eurostat (2014) classify the mechanisms that service industry providers use to price their outputs into three broad groups: explicit output charged mechanisms where a fee/price is charged for a service based on the output provided; time-spent mechanisms, often named 'time-based' (TB), where an explicit fee/price for the service is charged and payable as a function of time spent delivering the services; and margin-pricing where no explicit fee is identifiable but instead is bundled within the price of another good or service. This review concentrates on the first two mechanisms. Therefore, we excluded wholesale and retail trade and financial services from the analysis as these service industries predominantly employ margin-pricing. These SPPIs refer to Business to Business transactions and do not include services sectors that mainly transact with consumers and government such as personal services, education or health. The services industries included in this article combined account for about 60 per cent of total services value added in the UK.

Although much methodological and practical progress has been made in measuring SPPIs in recent years, significantly increasing the availability of SPPIs across countries, measuring price changes in services remains challenging because of the way in which businesses supply and charge for services and the difficulty of identifying quality changes or separate price indices per end-user (OECD, 2018). It is difficult to track prices for repeated service transactions and approaches designed for repeated product transactions are generally less applicable. Services are often provided together with other services or with goods, requiring either these bundles to be broken down and priced individually or priced together. Either way, non-monetary benefits of the bundle will need to be taken into account in the price index and the components of the bundle will need to remain the same over time, either through incorporating quality adjustments or by updating the bundle's components.

Although the same quality adjustments for goods can also be applied to services, the implementation is more challenging as the service provision, delivery or structure may change over time (Loranger, 2012). Very often, the service is unique in nature which requires convention-based assumptions that seldom reflect real quality changes. Finally, due to data limitations, published SPPIs only refer to business to business and not business to consumers or exports. Although distinguishing between those users is a crucial requirement for national accounts when price discrimination is evident, it is a non-trivial task.

This article is based on ESCoE reports, O'Mahony and Samek (2018, 2021), that investigated if there is evidence that the UK measurement methods in producing SPPIs are systematically out of line with international best practice. These reports also investigated empirically the dependence of measurement of SPPIs on the methods employed more generally. The results presented below indicate that UK services price growth was, on average, lower than in most other countries, suggesting little evidence of a particular UK measurement problem. Given the UKs increasing

Table 1: Coverage of Services Producer Price Indices by Country

Country	No. of SPPIs	Country	No. of SPPIs
Australia	25	Italy	12
Austria	16	Netherlands	18
Belgium	8	New Zealand	8
Canada	11	Norway	17
Denmark	8	Spain	12
Finland	22	Sweden	23
France	28	United Kingdom	31
Germany	19	United States	26
		Total	**284**

Notes: Authors' compilation based on *number of individual SPPIs available to download in 2018.

reliance on service sectors, this in turn suggests that an underestimate of services real output growth is not likely to be an explanation of why productivity growth in the UK continues to lag that in other countries in recent years. However, this does not preclude common problems shared by all countries. If no NSO adjusts adequately for quality, for example, by using hedonics, then all suffer from a measurement issue.

Given that countries commonly use similar methodologies, we delve deeper into where bias might arise due to lack of quality adjustments. Based on both regression analysis and examination of alternative methods, we find a small but significant upward bias in price inflation using TB methods. This means that the growth in the volume of services activity may be understated in general in the group of countries considered in this article.

Data and Method

The starting point for the choice of price series is the UK services producer price indices produced by ONS. We then checked availability of equivalent series for other countries and extracted data from 2001 to 2017 for 284 separate SPPI series, although for many countries/services the series starts much later than 2001. We extracted data mostly by industry but sometimes by product to fill gaps.

Table 1 lists the countries included in this study and shows the number of price series available for each. By design the UK has the highest number of SPPIs – these cover industries that represent about 36 per cent of aggregate Gross Domestic Product (GDP). This is closely followed by France, the United States and Australia. A significant number of SPPIs on the UK list were also available for Finland and Sweden and more than half were available for Austria, Germany, the Netherlands and Norway. Fewer were available for other countries.[3]

Table 2 shows the list of SPPIs compared and the number of countries for which these

3 Readers may be surprised by the small number of SPPIs covered, given the size of the service industries in each of these economies and the heterogeneity of service products. This is especially true relative to other industries, e.g. manufacturing in the UK represents around 10 per cent of the UK economy yet it has over 950 PPIs. Some countries, such as the US, do have additional price indices which are not easily comparable with those in the UK. However, in general there is a clear need for more coverage of services activities and more granular measures within industries, in many of the countries considered in this article.

Table 2: Coverage of Services Producer Price Indices by Type of Service

	Industry	No. of SPPIs		Industry	No. of SPPIs
4921:	Commercial Rail Freight	5	6820:	Property Rentals	8
4939:	Bus and Coach Hire	3	6830:	Real Estate Agency	8
4941:	Freight Transport by Road	15	6910:	Legal Services	10
5011:	Vehicle Ferries - Commercial Traffic	3	6920:	Accountancy	11
			7022:	Business and Management Consultancy	12
5020:	Sea & Coastal Water Freight Transportation Services	12	7111:	Architectural Services	10
5210:	Storage and Warehousing	14	7112:	Engineering Services & Related Services	10
5224:	Cargo Handling	11			
5229:	Freight Forwarding.	5	7120:	Technical Testing and Analysis	9
5310:	National Post/Parcelforce	8			
5320:	Courier Services	15	7312:	Advertising Services	10
5510:	Licensed Hotels and Motels with Restaurants. Business Customer	7	7320:	Market Research	8
			7732:	Renting Services of Civil Engineering Machines and Equipment	8
5620:	Canteens and Catering	5			
5810:	Book Publishing Services	5	7800:	Recruitment and Personnel Services	13
5920:	Sound Recording and Music Publishing Services	2			
			8011:	Security Services	13
6110:	Business Telecoms	11	8122:	Industrial Cleaning	14
6200:	Computer Services	15	8210:	Secretarial Activities	4
				TOTAL	**284**

Notes: Authors' compilation based on number of individual SPPIs available to download in 2018.

data were available. Some services had almost complete coverage, including freight transport by road, courier services, computer services and industrial cleaning services. Others have very few entries, for example bus and coach hire, sound recording and secretarial services. Nevertheless, the sample represents a reasonable cross-section by type of service and is not overly concentrated in any one industry. In total we have data on 3,383 observations on annual price changes in the dataset.

OECD/Eurostat (2014) lists various sources of data that can be used in constructing SPPIs. These include: actual transaction price (the price of a service actually paid in the market, inclusive of any discounts, surcharges or rebates); list prices; unit values calculated as the ratio of revenues to amounts sold; percentage fees; expert estimate; and input data. Given these sources OECD/Eurostat (2014) distinguish pricing methods used by national statistical offices. We attempted to classify SPPIs by type of measurement method, using information from national sources, as well as OECD/Eurostat (2014) and reports by the Voorburg Group (Exhibit 1). In many cases SPPIs were based on aggregates compiled from two or more measurement methods. We classified some of these mixed methods into groups, as noted below, and allocated prices to a method if more than 75 per cent of the prices used one method. If there were multiple methods where none were dominant, we classified the prices as a mixed method (MX). Finally, if there was no information forthcoming we classified as unknown (UN). In this way all prices were classified to one category.

The first row of Table 3 shows the coverage of price changes by measurement method, for all countries included in this article. The highest concentration is in RP and the lowest in PF. RP and CP are most heavily employed in transport services whereas MP and TB are most used in professional services. Again, there are ex-

Exhibit 1: Typology of Measurement Methods

RP	**Direct use of prices of repeated services**	This uses either real transaction prices, or sometimes list prices, of the same service product in successive survey periods.
CP	**Contract pricing**	Prices in long term contracts for the repeated delivery of similar services.
RPCP	**Direct use of prices of repeated services and contract prices**	This category refers to cases where SPPIs were calculated using a mix of RP or CP methods at the detailed price level.
PF	**Percentage fee**	This method calculates the price of the service as the product of the percentage fee and value of the product to which the fee relates.
UV	**Unit value**	This constructs prices as the ratio of revenue to quantities.
MP	**Model pricing**	This is based on the hypothetical price of a (representative) standardised service.
TB	**Time based**	This is where the price of a service is specified in terms of the time spent in its provision.
MX	**Mixed methods**	Where the method was identifiable but involved a mix of the above methods and there was no clear reason to allocate to one of these.
UN	**Unknown**	Where there was little or no information on the method used.

Source: Authors' computation

Table 3: Services Producer Price Indice Growth Rates Relative to General Inflation: Summary Statistics by Measurement Method (Average Annual Rate of Change)

	RP	**CP**	**RPCP**	**PF**	**UV**	**TB**	**MP**	**MX**	**UN**	**Total**
Share of methods (%)	25.6	7.2	9.4	3.3	4.9	13.8	8.3	15.9	11.6	100
Mean price growth										
Raw data										
Mean growth (% p.a.)	1.75	1.82	1.78	2.27	-1.83	1.88	1.15	1.42	1.30	1.46
St. dev.	2.98	5.19	3.00	3.94	7.10	2.18	2.87	3.20	2.52	3.51
Relative to GDP Deflator										
Mean growth (% p.a.)	-0.21	0.04	-0.28	0.37	-3.20	0.08	-0.26	-0.13	-0.27	-0.29
St. dev.	3.18	5.40	3.12	3.97	6.99	2.55	2.72	3.25	2.63	3.59
Relative to CPI										
Mean growth (% p.a.)	-0.13	0.12	-0.23	0.36	-3.46	0.15	-0.39	-0.21	-0.28	-0.28
St. dev.	2.92	5.20	2.75	4.10	7.06	2.16	2.72	3.12	2.59	3.45

Note: See Exhibit 1 for definitions of variables
Source: Authors' compilations

ceptions so that the measurement method does not map entirely into service activities. PF on its own was a relatively rare occurrence but featured more frequently as one of the methods in the MX group. About 12 per cent of the price changes were categorised to the UN group.

Table 3 also shows mean growth in SPPIs in the raw data. The SPPIs in our sample grew on average by 1.46 per cent per year, with prices for a number of methods showing lower growth, notably UV and MP. To aid interpretation, we also show the growth relative to measures of price inflation to abstract from country specific macroeconomic factors that might affect prices. Table 3 presents the results of using two alternative measures of general price changes, the GDP deflator and the consumer price index (CPI). These relative growth rates

are mostly negative, suggesting lower price growth in service industries than in other industries of the economy. The exceptions are CP, PF and TB, which showed positive growth in relative prices, using either the GDP deflator or CPI to normalise. The UV mean relative price growth is a clear outlier, driven mostly by price falls in the telecommunications industry. These numbers are in percent per annum, so the averages are quite small. The difference between TB and MP suggests about a 0.35 percentage point lower price growth for the latter, when normalized by the GDP deflator and a larger difference when using the CPI.

In what follows we present results using the GDP deflator but note any differences when using the CPI or no normalization. Note that when both time and country fixed effects are included, as is the case in the later regressions, the results are invariant to the normalization used. Finally, in Table 3 the standard deviations are large relative to the mean, suggesting noticeable variability in the data depending on year, country or sector.

UK SPPIs in Comparative Perspective

Table 4 shows the number of observations by country. This largely reflects the availability of SPPIs in Table 1, but the countries where only a few SPPIs were available also reported these for shorter periods of time. The negative mean value overall says that service industry prices on average grew by 0.29 percentage points annum less than prices in general measured by the GDP deflators.

The reasons for this are likely to be complex, but might be linked to the SPPIs referring only to business to business, with different margins for business to consumer, as well as the usual explanations for variations in price changes such as the degree of competition and regulation. Here we are normalizing by the growth in general prices to abstract from inflation. For most countries the mean is negative, the main exceptions being Canada, Finland and Sweden with the United States showing no change on average. The average relative price declines were greater than the UK only in Italy, but there were only small numbers of observations for that country and this is dominated by abnormally large declines for telecommunications services.[4] If the CPI is instead used to normalize, or no normalisation is used, the UK continues to show price growth lower than for most other countries. These averages hide very large year-on-year variation for some services, as shown by the fact that the standard deviations reported in Table 4 are multiple times the mean, as previously noted when discussing Table 3.

A similar picture emerges if we restrict attention to the period from 2006, which is the starting year for a greater number of countries. If we restrict further to 2010 onwards, then on average prices decline marginally in the United States and the difference between the UK and France and the Netherlands is much smaller. Nevertheless,

4 In fact, the UK is currently revising its telecommunications prices to better account for quality change – see Abdirahman *et al.* (2020) for details.

Table 4: SPPI Growth Rates Relative to GDP Deflator: Summary Statistics by Country (Average Annual Rate of Change)

	No. obs.	Mean (% p.a.)	St. dev.
Total all countries	**3383**	**-0.29**	**3.59**
Australia	401	-0.37	3.31
Austria	176	-0.24	2.97
Belgium	97	-0.15	7.05
Canada	97	0.29	3.18
Denmark	87	-0.14	1.7
Finland	304	0.25	3.54
France	270	-0.41	2.3
Germany	215	-0.3	5.6
Italy	96	-1.79	3.93
Netherlands	201	-0.39	2.48
New Zealand	127	-0.2	2.94
Norway	186	-0.38	5.18
Spain	365	-0.02	3.17
Sweden	258	0.3	2.81
UK	412	-0.74	3.16
US	350	0.03	3.08

Source: Authors' compilations

average relative price decline by more in the UK than in most other countries.

Given the very large standard deviations relative to the mean in Table 4 it is worth looking at the results from panel regressions to obtain an idea of the significance of these differences across countries (Table 5). In this analysis we first removed a very small number of outliers, 12 in total, where price change was more than 20 per cent per annum in absolute values, reducing the sample to 3,371 observations. First, we regressed the growth in relative prices on the UK dummy in addition to year dummy variables to abstract from period specific effects, and dummy variables for the 31 SPPI codes. The regressions were carried out both for the entire time period and restricting to the 2006 and after period.

In the first two columns of Table 5 the coefficient on the UK dummy is negative and significant. This is even more so if the CPI is used as a measure of general price increases, with coefficients of -0.66 and -0.89 for the periods 2001-2017 and 2006-2017, respectively. The coefficients for the UK dummy remain negative and significant even if we do not normalize for general price movements. We then ran the same regressions but with the UK as the excluded country. The coefficients in the third and fourth columns are all positive, with the exception of Italy, with sizeable coefficients for the US, Canada, Finland, New Zealand and Sweden. These results are similar in the two periods. The availability of price indices before 2006 are confined to a few countries and mostly restricted to the transport industries. Overall, these results are consistent with equal or lower price changes in the UK, on average, than other countries.

Measurement issues still arise even if the UK broadly follows best practice, as there are many services where prices are measured poorly everywhere. The remainder of this article examines more closely these measurement issues.

Table 5: Regressions Results by Country: Dependent Variable is Growth in Relative Services Producer Price Indices

	2001-2016 (1)	2006-2017 (2)	2001-2016 (3)	2006-2017 (4)
UK	-0.50*** (0.16)	-0.53*** (0.17)	-	-
US	-	-	0.66*** (0.21)	0.66*** (0.23)
Australia	-	-	0.08 (0.20)	0.32 (0.23)
Austria	-	-	0.48* (0.27)	0.53* (0.28)
Belgium	-	-	0.34 (0.34)	0.34 (0.34)
Canada	-	-	1.05*** (0.33)	1.15*** (0.35)
Denmark	-	-	0.34 (0.35)	0.35 (0.35)
Finland	-	-	1.13*** (0.22)	0.94*** (0.24)
France	-	-	0.31 (0.23)	0.31 (0.24)
Germany	-	-	0.43 (0.25)	0.47* (0.26)
Italy	-	-	-0.61* (0.34)	-0.62* (0.34)
Netherlands	-	-	0.07 (0.26)	0.15 (0.26)
New Zealand	-	-	0.93*** (0.30)	0.82** (0.34)
Norway	-	-	(0.39) (0.26)	0.58** (0.27)
Spain	-	-	0.36 (0.33)	0.36 (0.34)
Sweden	-	-	0.94*** (0.23)	0.89*** (0.25)
Adjusted R2	0.13	0.13	0.14	0.15
No. of observations	3371	3018	3371	3018

Notes: Time and SPPI code dummies included in all regressions; Standard errors in parentheses; * , ** , *** significant at 0.1%, 0.05% and 0.01%, respectively.

SPPIs: The Impact of Measurement Methods

Results from Panel Regressions

It is well known that of the methods outlined above, those using TB methods do not allow for any productivity improvements in providing the services. In many professional services, the ONS and many other NSOs use TB methods. Therefore, it is useful to examine the change in prices in this method relative to others, especially MP which is commonly used for professional services.

Table 6 shows panel regressions when we include TB and MP, with all other methods of measurement as the excluded cate-

Table 6: Regressions Results by Measurement Method: Dependent Variable is Growth in Relative Services Producer Price Indices

	(1)	(2)	(3)	(4)	(5)	(6)
TB	0.43***	0.44***	0.37**	0.13	0.38**	0.14
	(0.14)	(0.14)	(0.15)	(0.17)	(0.19)	(0.21)
MP	0.10	0.11	-0.10	-0.16	-0.10	-0.16
	(0.18)	(0.18)	(0.19)	(0.21)	(0.24)	(0.25)
Year Dummies	NO	YES	YES	YES	YES	YES
Country Dummies	NO	NO	YES	YES	YES	YES
Service type Dummies	NO	NO	NO	YES	NO	YES
Adjusted R2	0.002	0.02	0.035	0.16	0.025	0.09
No. Observations	3371	3371	3371	3371	3371	3371
F-value for test TB = MP	2.92*	2.65*	4.86**	1.41	3.07*	1.06
Rho					0.25	0.2

Notes: Robust standard errors in parentheses. * , ** , *** significant at 0.1%, 0.05% and 0.01%, respectively.

gories.[5] This allows us to clearly see the difference in magnitude of the coefficients and to test for differences across the two. In general, the coefficient on TB is positive and significant, but that on MP varies more. Without any controls for time, country and year, the regressions imply a 0.34 percentage point per annum difference between price changes in TB relative to MP. This differential is unchanged when time dummies are included but becomes a little larger (0.44) when we include country dummies and a little smaller (0.28) when we include year, country and type of SPPI dummies. However, both TB and MP are concentrated in a few services types, so adding these dummies may be over controlling, as suggested by the insignificance of TB and MP in column (4).

The final two columns in Table 6 report the results if we correct for first order autocorrelation, but this has little impact in this sample. The difference between TB and MP is not precisely determined, due to the high standard errors noted earlier. Testing for the significance of these differences suggests that only in column (3) is the difference significant at the 5 per cent level but it is significant at the 10 per cent level in columns (1), (2) and (5). In turn this lends itself to a cautious interpretation that is merely suggestive of a difference in relative price growth using the two methods. Note the results are robust to using the CPI to control for general price movements in columns (1) and (2) and are of course the same when year and country dummies are included in columns (3) and (4).

We experimented with examining the sensitivity of the estimates to using different time periods, e.g. restricting the sam-

5 The relative coefficients on TB and MP do not depend on how many measurement categories we include, since the measurement method is a set of mutually exclusive dummy variables. However, the significance of the coefficients varies according to the excluded category.

Table 7: Regressions Results Including Additional Controls: Dependent Variable is Growth in Relative Services Producer Price Indices

	(1) Market Structure	(2) Regulation	(3) Industries MN
TB	0.14	-0.38	-0.15
	(0.18)	(0.32)	(0.14)
MP	-0.17	-1.51**	-0.51***
	(0.30)	(0.44)	(0.12)
Lfirmsize	-0.90***	-	-
	(0.15)		
Churn	-0.09	-	-
	(0.34)		
Small	-7.28***	-	-
	(1.18)		
PMR	-	0.03	-
		(0.17)	
Year Dummies	YES	YES	YES
Country Dummies	YES	YES	YES
R2	0.06	0.15	0.08
No. Observations	1643	321	780
F-value for test TB=MP	0.89	4.82**	4.37**

Notes: Robust Standard errors in parentheses. * , ** , *** significant at 0.1%, 0.05% and 0.01%, respectively.

ple to years from 2006, when most countries have some observations, or after the financial crisis. The relative coefficients on TB minus MP remain at about 0.30-0.40 in these regressions.

We next attempted to include other control variables to try to capture elements of market structure and regulation. It turned out to be quite difficult to find measures at the level of service detail covered by the SPPIs so we had to use measures aggregated to broad industry level. We included three measures from the Eurostat Structural Indicators database. The first is the log of the ratio of value added to number of enterprises, a measure of the average size of firms (lfirmsize). To this we added a measure of 'churn' within each industry, (births of firms minus deaths of firms /births of firms) and the share of enterprises with fewer than 10 employees (small). In terms of regulation there were fewer data available so we decided to use the OECD indicator for product market regulation in the services industries (PMR). Both the market structure and product market regulation indicators are available for shorter time periods and fewer countries than observations in our main database.

Table 7 presents the results. In the first column we include the three market structure indicators. Looking at column (1) we see that the difference between TB and MP is similar to previous estimates, 0.31, when all three market structure variables are included. However, the sample size is much reduced, to a little over half the size in the main database. The results on the differ-

ence between TB and MP are not overly sensitive to including these three variables one by one. Therefore, controlling for market structure appears to have little impact on the relative difference between TB and MP. The market structure variables themselves are all negative, with lfirmsize and small both highly significant. Both the churn and small variable can be seen as measures of greater competition so we would expect their coefficients to be negative. It is unclear a priori what impact lfirmsize would have on price growth.

The second column of Table 7 shows the results if we include the PMR indicators. These regulation indicators are available for only four professional services – accounting, legal, architectural and engineering services and so the sample size is reduced to a very small number. In this case, the difference between TB and MP is much larger, greater than 1 percentage point per annum, and is significant at the 5 per cent level. The small sample size does not allow any robust conclusions, but the results suggest that these services are worthy of more scrutiny. Finally, column (3) shows the basic results when we restrict the sample to just include components of industries MN, 'professional, scientific, technical, administration and support service activities', where time based or model based price measurement is common.[6] The results suggest again a similar magnitude to previous results, 0.34 percentage point difference between TB and MP. This result is not very different if market structure variables are included, but these variables are especially aggregated for this industry and are insignificant in the regressions.

SPPIs for Professional Services: The Use of Opportunity Cost Measures

A suggestion arising from discussions with ONS officials is to use a shadow price based on opportunity costs, rather than attempting to directly measure prices based on time rates. This is based on the idea that professional services purchased from the business services industries (MN) are frequently produced in-house by firms. Therefore, the opportunity cost is the amount these firms pay internally for these services. Our search of the relevant literature did not throw up any instances of this idea being used in price measurement. However, it seems an interesting avenue to explore so we investigated the growth in opportunity costs compared to prices for a small number of professional services. We based opportunity cost on the gross hourly wages paid to similar occupations to those covered by the relevant SPPI. We could only find information to match four of the SPPIs listed in Table 2: legal services (91); accountancy services (692); business and management consultancy (7022) and advertising services (7312). For each of these broad groups we compared the average annual growth in the UK SPPI with an index of hourly earnings using data from the Annual Survey of Hours and Earnings (ASHE), as labour costs are the largest input to these services. Changes to the standard classification of occupations meant that we could only start

6 Industry classification 691-732 and 78-821 in Table 2.

Table 8: Relative Services Producer Price Indices and Wages in Professional Services, UK, 2012-2017 (Average Annual Rate of Change)

	SPPI	Wages	Wages minus SPPI
Legal Services (691)			
Legal Professionals	2.75	3.76	1.02
All Legal occupations (1)	2.75	1.94	-0.81
Accounting Services (692)			
Chartered and certified accountants	2.89	1.37	-1.52
All accountants (2)	2.89	0.77	-2.12
Management Consultancy (7022)	0.31	1.09	0.78
Architectural Services (7111)	1.69	1.75	0.06
Advertising Services (7312)	1.58	1.07	-0.51

Notes: 1. Including legal professionals and legal associate professionals; 2. Including financial accounts managers, and financial and accounting technicians.
Source: Authors' compilations

the analysis in 2012 and our SPPIs are only available to 2017, so we are comparing over a relatively short period of time.

In Table 8 we show the difference between the annual average growth over the period 2012 to 2017 for the SPPI relative to its comparator. To measure in-house services that abstract from services sold on the market, we use the gross hourly wage rates in all sectors of the UK economy excluding the specific industry covered by the SPPI. For example, wages of advertising managers are for all industries other than advertising services (7312). Also, for two of the services we include both a narrow and broad occupation definition, using weights from ASHE to aggregate across occupations.

For all legal services, accounting (both narrow and broad definition) and advertising services the growth in hourly wages is lower compared to the current SPPI, and for architectural services there is little difference. The exceptions are management consultancy and legal professionals, where wages rise significantly more than the SPPI. The short time period prohibits any precise conclusions from this exercise, but it does appear broadly consistent with the earlier results that there may be an upward bias in price growth in services that use time-based methods for constructing the SPPIs.

There are a large number of caveats in using this opportunity cost approach as an alternative to the current method. First we are only using labour costs so there should be adjustments for costs of intermediate inputs and capital. Second the estimates in Table 8 are based on very small samples of data on hourly wages. We investigated using the Labour Force Survey as an alternative to ASHE but the number of observations was even lower and the hourly wages were consequently very volatile. Of greater importance is that the services produced in-house by staff classified to these occupations may be very different to that produced outside the firms. Firms may employ persons with legal training or accountancy training, but it is doubtful if their qualifications and tasks undertaken are equivalent to those for barristers, solicitors and chartered accountants working in independent firms. The fact that legal professionals, which are mostly barristers and solicitors, show much higher wage growth than for the aggregate across all legal occupations, lends weight to this concern and suggests the match is not as strong as we would

wish. Firms outside the legal services industry rarely exclusively employ their own barristers. Therefore, even if better data were available, it would still be necessary to ensure we were comparing like-for-like.

Conclusion

The analysis in Section 2 of this article suggests that measurement of SPPIs in the UK are in line with standard practice elsewhere. Section 4 provides some evidence in favour of the argument that there is an upward bias in measures of SPPIs using TB methods. In the period under consideration, total factor productivity (TFP) growth in industries MN in the UK was about 1.8 per cent per annum over the period 2005 to 2015, using recent estimates from EU KLEMS. In these industries 8 of the 13 SPPIs are either wholly based on TB methods or have a significant share of prices using this method. Multiplying our result (approximately 0.35 percentage point bias in annual price growth in TB) by 8/13 yields an estimate of 0.22 percentage points as the 'missing productivity' from using TB based methods. Correcting this bias would raise productivity growth in this industry to 2.01 per cent per annum, an upward adjustment of about 12 per cent. Raising productivity growth by this much is an important adjustment for industries MN, but has a much smaller impact on aggregate economy TFP growth. Industries MN account for about 12 per cent of GDP. Adjusting the aggregate deflators to take account of these adjustments to industries MN would raise total economy TFP by 0.022 and the market economy by 0.034 percentage points per annum. This is small relative to the nearly 1 percentage point slowdown in TFP growth comparing 2005-2015 to the previous decade and so contributes very little to explaining the productivity slowdown.

The article also explored using measures of opportunity cost as an alternative to TB methods, where opportunity cost was measured using wages of people in professional services occupations in outside industries. The results for some services are consistent with a bias due to using TB methods, but this is not the case for all services where such comparisons were feasible. There are concerns that the services produced in-house in firms are not comparable to the tasks performed by external suppliers. While an interesting idea, it is unlikely that the data will become available that would show a convincing use of opportunity cost for like-for-like services.

In order to meet the requirements of the Framework Regulation Integrating Business Statistics (FRIBS), SPPIs for EU countries will need to change from a business to business and government to a business to all basis, including final consumers and exports. O'Mahony and Samek (2021) considered available data for France and the United States on extending the current focus on business to business prices to include also business to consumers or exports. The data suggest there are some services for which price growth appears to be very different between services sold to businesses and those to consumers or exported. It would be surprising if these differences were due entirely to measurement methods and the most likely explanation is that firms and consumers are purchasing different services. In turn this also implies that an increase in the granularity of

the supply-use framework might focus on differentiating between business and consumer goods. This aspect of the measurement of services prices warrants further investigation. In addition further work might extend the analysis to other industries such as wholesale and retail trade and financial services which use margin pricing.

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