

## MEASURING PRODUCER PRICE INDICES AND PRODUCTIVITY GROWTH IN SERVICES

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Preliminary version, April 2012

### *Abstract*

Empirical evidence points to relatively low productivity growth rates over long periods for several service industries, including those characterised by rapid technological change and increasing competitive pressures. For some services, however, the evidence may reflect an under-estimation of service productivity growth, notably due to difficulties measuring volume series of services value added. Different to manufacturing industries, it is relatively difficult for services industries to track price changes over time and to separate pure price changes from changes in quality. Still, over the past ten years, much progress, in terms of methodological and practical work, has been made by OECD countries in measuring service producer price indices (SPPIs) in particular in business sector services. This has significantly increased the availability of SPPIs and has improved their comparability across countries. The objective of the paper is to investigate to what extent measuring productivity growth in services industries benefits from recent progress made in measuring SPPIs. It highlights the main difficulties in measuring SPPIs and analyses the importance that producer price index measurement may have for measured productivity growth through a sensitivity analysis. Throughout the paper, the analysis is presented for two selected business sector services, telecommunication services and legal and accounting services.

**Keywords:** Price index measurement, Producer price indices, Real value added, Volume measures, Productivity, Business sector services, Cross-country comparability.

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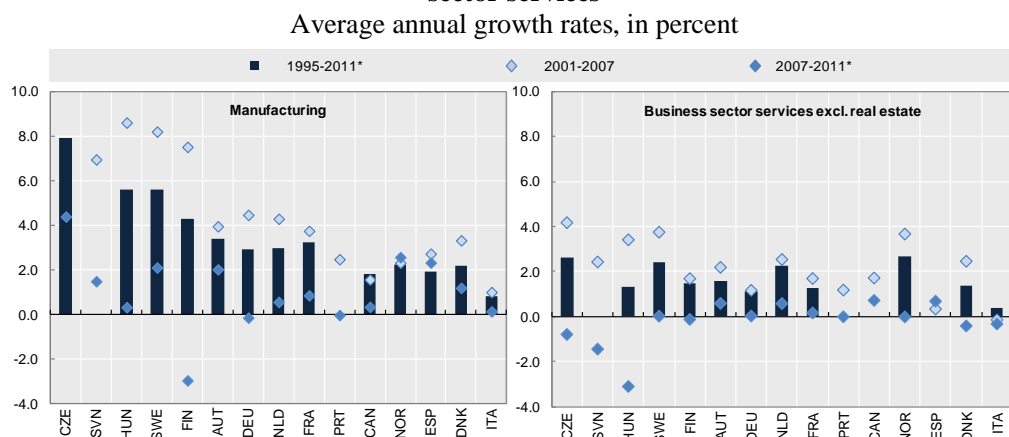
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## MEASURING PRODUCER PRICE INDICES AND PRODUCTIVITY GROWTH IN SERVICES

### 1 The price index-productivity link

1. Empirical evidence points to relatively low productivity growth rates over long periods for several service industries as compared to those for manufacturing (Figure 1). This is true even for some business sector services for which rapid technological change and increasing competitive pressures may argue for an opposite trend.

**Figure 1: Growth in value added per hour worked in manufacturing and business sector services**



Source: OECD Productivity Database, 2012.

2. In some services, however, the evidence may indicate an under-estimation of service productivity growth, notably due to problems measuring producer price indices and hence computing the volume series of value added (Wölfl, 2003). While problems estimating an appropriate price index may arise in several manufacturing industries, there are reasons that measurement problems may be stronger in the service sector than in manufacturing. Because of the difficulty in measuring SPPIs, different methods are used in OECD countries to compute volume series of value added. Moreover, even if producer price indices can be computed, different methods are typically used depending on the type of the service under consideration as well as data and availability.

### 2 General measurement issues when tracking price changes for services

3. Measurement of price changes in services is not trivial, in large part complicated by the way businesses provide and charge for services, by problems identifying quality change, through the provision of bundled services, and by the difficulty identifying separate price indices per end-user.

#### *Pricing methods*

4. The way businesses provide and charge for services make it difficult for the statistician to observe prices for a repeated service transaction. As such, standard price measurement methods designed for repeated products can be difficult to apply for services. In practice, price statisticians are then obliged to use a number of methods to track price changes in services, with the methods typically varying across countries, depending on pricing mechanisms used, and also on the producing industry or product.

5. However, over the last ten years, considerable efforts have been made by price statisticians to give coherence to practical measurement issues and to provide a

better understanding of the variety of methods used by countries to facilitate international comparability. The three main classes of pricing methods<sup>2</sup> are:

1. *Price of final service output*: Price observations refer directly to specified service outputs and result in prices of final services output; examples are: *direct use of prices of repeated services, contract pricing, unit value, percentage fee, component pricing and model pricing.*
2. *Time-based prices*: price observations refer to the time used for the provision of the service rather than to the service itself. Several time-based methods can be distinguished: *hourly charge out rate, hourly list rate, wages rates and working days.*
3. *Margin prices*: price observations refer to the price that would have to be paid by the service provider for the good or service they provided and the price paid by the final consumer.

6. It is important to bear in mind that the variety of the pricing methods applicable to a particular industry may hamper the reliability of the index for this industry. For example, when price indices are either based on a specified service output or are time-based, results of pricing methods can have a different interpretation. In the first case, the volume of output is, in principle, correctly measured (albeit depending on how well price-determining factors are specified). However, this is not necessarily the case for time-based methods, particularly whenever quality changes have occurred, or productivity changes impact on the input (hours spent). Indeed, for pricing based on working time, the price of the service finally provided is not identified. Rather, service provision is assumed to correspond directly or predominantly to different types of chargeable hours, actually worked for a client. The validity of the method depends on how realistic this assumption is, i.e., to what extent the quantity and quality of one chargeable hour's work remains the same in consecutive periods.

#### *Quality changes*

7. While in principle, the same quality adjustment methods can be used for goods and services, in practice, for services, fewer options are available and much more difficult to implement (Loranger, 2012). First, over time, the way in which a certain service is provided may change (e.g. a service is delivered in less time or by a better qualified employee). Second, the structure of services that are provided in a certain service industry will vary from one period to the next. Third, many service products are unique. In this case, prices cannot be observed over multiple periods requiring assumptions about quality changes that are mostly based on convention rather than reflecting "reality"; typically, constant quality is assumed.

#### *Treatment of bundled services*

8. Services are frequently (and increasingly) bundled with either another service or a good. This is particularly true in the case of Transport and storage and Information and communication. Two main alternatives are commonly used: *i)* breaking down the bundle into components and price these separately, or *ii)* pricing bundled services together as a group. Each of these alternatives poses difficulties that are likely to imply biased measure of prices. A particular concern is keeping the bundle constant over time either through quality adjustment or regular updating of the selected bundled services. The ability to reflect the non monetary benefits of the bundle in the price index may also be a complicated task. Finally, the treatment of

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2. A pricing method is a procedure put in place by statisticians to make price data eligible to be entered in an index which is largely determined by the *pricing mechanism*. (Fraisie, 2013)

bundled services may lead to a heavy calculation and response burden, in particular where bundle components are priced separately.

#### *Decomposition by type of end-users*

9. Breaking down SPPIs by type of user is an important requirement for the national accounts when price discrimination occurs which feeds through into heterogeneous price changes. Currently, decompositions of SPPI by type of end-users focus mainly on Business to Business (BtoB), Business to Consumers (BtoC) and Business to All (BtoAll) transactions. The main difficulties regarding decomposition lies on the following: *i*) the availability of reliable weight data (such as turnover); *ii*) the assessment of the potential for business prices to display different trends to those charged to household consumers; *iii*) the appropriate use of CPI data to cover households transactions, i.e., to adjust CPI data to basic prices by deducting any taxes including VAT and trade margins.

### **3 Measuring SPPIs in ‘telecommunication services’ and ‘legal and accounting services’**

10. In order to analyse the potential impact of price index measurement on measured productivity growth this paper compares a set of different volume series of value added for two services: telecommunication services, on the one hand, and legal and accounting services, on the other. These two services have been chosen as they are *i*) characterised by very different factors of service output and the way they are provided, and *ii*) by different availability of producer price indices and underlying methods.

#### *Telecommunication services<sup>3</sup>*

11. Telecommunications is a very dynamic service industry, susceptible to both rapid changes in regulation, technology and customer movement to new services, with a highly competitive market. The telecommunications industry is typically capital intensive, with very high start up costs that cover the construction of base stations, user networks and telecommunications licenses. Due to these high start-up costs, telecommunications service providers tend to have strong economies of scale with the market structure tending to be close to a natural monopoly or oligopoly market. This implies that several huge service providers have the power to dominate or at least affect the market using their partly highly differentiated services.

12. Traditionally, prices are determined based on the cost of using the service (such as cost per minute). However, as the industry develops and competition increases, providers are developing alternative pricing packages that aim to entice potential customers to their service. Bundled services are becoming a popular way to provide, and thus charge for telecommunications services. Bundling allows telecommunication service providers to offer households and businesses a price structure that provides financial or other benefits that are contingent on the consumption of any or all service elements included in the services bundle. A further complication which pricing bundled services is the likely inclusion of hardware in the final bundle. Traditionally, a bundled package for the telecommunications industry will likely include hardware such as a phone, router, modem etc. Conceptually, for an SPPI this hardware should be removed from the bundle so that the price index is only capturing services.

13. There are a number of potential options for pricing telecommunication services (for households and business customers): the most commonly used are the *component pricing method* (bill or rate) and the *unit value method*. Note that a disadvantage of the use of unit value method for telecommunication is that the mix of

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3. Based on Jenkins and Kikegawa (2013).

service-products in groups does not satisfy the strict requirements of a Laspeyres index. A unit value approach will not guarantee a pure measure of price change, but will provide an approximation. Using *directly prices of repeated services* or *CPI data as proxy* may also be alternative methods.

#### *Legal and accounting services*<sup>4</sup>

14. Pricing mechanisms within the legal and accounting industry are based on the cost of time spent in service provision, and can vary depending on the mix of staff and experience of staff that are involved in the service delivery. For example, many accountants will combine, for each level of professional whose time is charged to the particular contract, a time-based rate (i.e. hourly/daily rate) with the amount of time billed (i.e. chargeable time) in order to arrive at the total price for a particular accounting contract.

15. Price measurement is commonly carried out by using *hourly charge-out rates, percentage fee methods and model pricing*. Methodologically speaking, hourly rates are considered less preferred than others as e.g. lawyers charge per hour independently of their performance or success in the case; the output of their services is not precisely defined. From a deflation perspective, the price index measures the price of hourly rates and the resulting volume measure is the number of working hours and not the volume of the service itself. Therefore, the main problem with the charge-out rates method is that changes in service quality and productivity are not reflected in the measures.

16. Quality changes in the legal industry are difficult to identify. Technological progress in the information and communication sector (e.g. PC-equipment, velocity of data transfer) has an impact on the work of lawyers and notaries, but complex legal systems may well outbalance any technological progress or quality changes in legal works. Their measurement is then difficult to conduct. While an improvement in productivity in which the service is provided is a quality concern regarding the collection and measurement of charge-out rates, it is very difficult to identify and make appropriate adjustments for any change in productivity.

17. Accounting services is an industry where the technological development is fast. There has been a rapid change in productivity during the last 10-15 years as computers and new accounting programs have been developed, and this productivity change is likely to continue. Hence, pricing based on working time cannot be considered best practice in this industry. When calculating price indices for accounting services, it is common to divide the staff into different categories according to work experience and field of expertise. In this way, the quality to some degree is held constant, but the productivity change within each category is still not considered.

#### **4 The potential role of price measurement for measured productivity growth**

18. Figures 2 and 3 provide some indication of the potential effects on volume series of value added that may result from using different deflators for the two services that are discussed in this paper, *i.e.*, telecommunications services, and legal and accounting services.<sup>5</sup> It provides evidence for France and the United States, for which time series data are available for a large range of input and output variables, such that several different price and volume indices can be derived. The different deflators compared are those that are commonly used in countries either directly for a deflator or as a reference for the computation of producer price indices:

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4 . Based on Jenkins and Schuch (2013) and Loranger (2013).

5 . This exercise is of a purely hypothetical nature. Its aim is to simulate how value added volume series and hence productivity growth could be affected if different pricing methods were used.

- *Producer Price Indices (SPPI)*. From a methodological point of view, using PPIs, especially in the form of a *price of final service output* as defined above, would represent the most appropriate way to deflate value added if the aim is the computation of productivity growth. Ideally, SPPIs would exist for both, gross output and intermediate inputs used in producing the good or service under consideration, and SPPIs would adjust for quality changes so that the resulting value added volume series reflect productivity growth changes properly.
- *Consumer Price Indices (CPI)*, for goods or services that are close to the services analysed, or the *CPI All items*. Using CPI's for deflation may result in measurement biases vis-à-vis SPPIs as they cover only household consumption and are not valued in basic prices. This may be particularly relevant for those services where the share of final household consumption in total output is low, and where price changes differ significantly between intermediate (business) and final use (consumption) (Eurostat, 2001).
- *Wage rate indices* per employed person or per hour worked (WRIE, WRIH). The latter can be seen as a proxy for a *time-based producer price index* as defined above. Productivity growth rates based on wage rate indices may underestimate true productivity developments.

19. Table 1 together with Figures 2 and 3 suggest four main results.

**Table 1: Average annual growth rates in gross value added per person employed using different deflators of value added, in %**

Service activity	Deflator	Base	Wage rates - employment	CPI - All items	CPI - related service	SPPI	
	Period						
France	Telecommunication services	2000-2010*	6.37	0.55	2.71	6.32	
		2005-2010*	4.73	-2.01	0.22	4.92	8.60
	Legal and accounting services	2000-2010*	-0.24		1.17	1.02	
		2005-2010*	-1.18	-3.26	-0.88	-1.58	-2.70
United States	Broadcasting & telecommunication	2000-2011*	6.82	2.28	1.88	7.41	6.00
		2005-2011*	5.64	0.40	0.85	5.67	3.12
	Legal services	2000-2011*	-1.60	-0.28	0.53	-1.65	-2.68
		2005-2011*	-3.00	-1.13	-0.36	-1.88	-4.12

Note: All results based on double deflation. \*: closest period available; "Base": value added deflator as given in National Accounts.

Source: OECD STAN database, INSEE, Bureau of Labour Statistics.

20. *First*, the choice of the implicit value added deflator, or the pricing method for computing producer price indices, may matter significantly for measured labour productivity growth. For instance, in telecommunication services, average annual labour productivity growth rates over the 2000-2011 period would differ by between 5 percentage points (United States, both periods) and 10 percentage points (France, 2005-11) using different deflators. In the case of legal services, the overall variation is with 1 to 4 percentage points lower, but still significant, especially seen the generally lower level of productivity growth in this services activity.

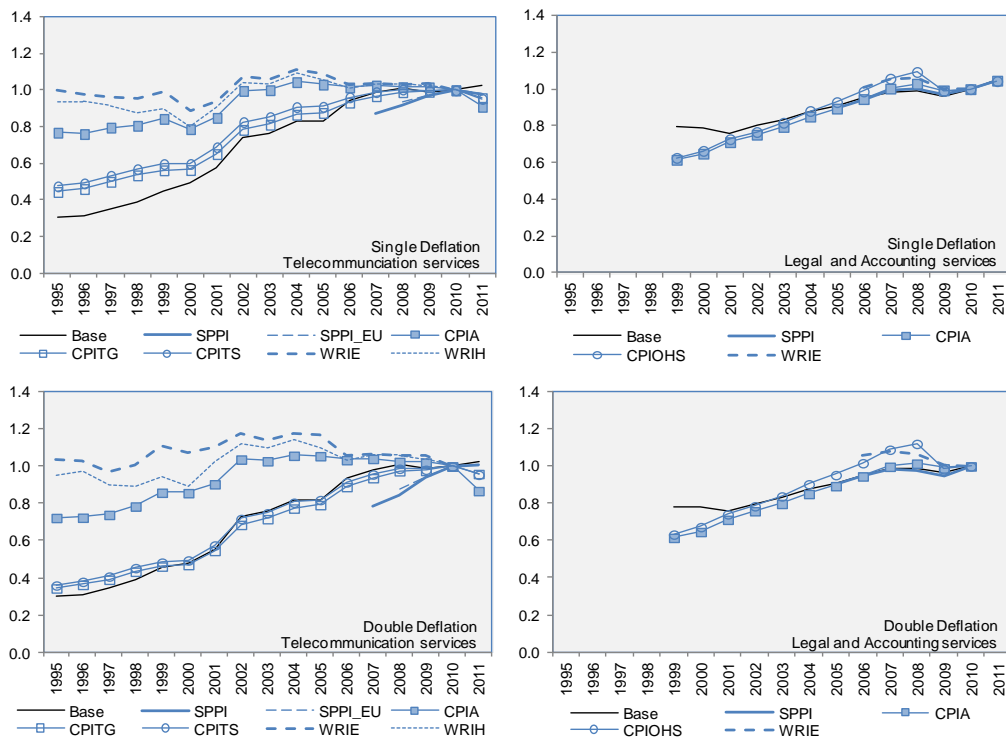
21. *Second*, the impact of the pricing method on measured value added and hence, productivity growth depends critically on the extent to which intermediate inputs are used in the production of the particular service and how much price developments of these intermediate inputs differ from those of output prices. This becomes evident when comparing the volume series of value added using single deflation with that using double deflation. In the first case, nominal value added is directly deflated with the respective price index. In the second case, volume series of value added results from the difference of deflated output and deflated intermediate inputs, using the respectively appropriate price indices for the goods and service

involved. In both countries, intermediate inputs have a higher share production in legal services than in communication services.

22. *Third*, for those services for which true “output based” SPPIs can be derived, using a proxy may indeed result in significantly mis-measured productivity growth. It appears to matter particularly whether a producer price index can be computed that properly reflects quality changes of the services. The Figures suggest that using the SPPI results in the strongest growth in the value added volume series. Communication services are typically developing rapidly, and SPPIs can be measured relatively closely to the actual output produced. In contrast, the different volume series of legal and accounting services follow a similar pattern to that of a wage-rate index, which can be seen as a proxy for an input- or time based price index. As described above, hourly charge-out rates are among the pricing methods most frequently used for SPPIs in legal and accounting services; they may not properly reflect improvements in productivity, though, which could actually be quite significant in these services.

23. *Fourth*, if it is difficult to compute producer price indices that would be close to a *price of final service output*, CPIs for related services may provide a good approximation. For both services and both countries, but particularly in the case of the United States, value added volume series using related CPIs are similar to those using SPPIs. Still, the CPI based value added volume series show lower growth than those using an SPPI. This may reflect that businesses react more to price changes than consumers, *e.g.*, due to competition among the service using firms, resulting in weaker increases of SPPIs over time. Using the *CPI All item* may give rise to significant measurement bias vis-à-vis SPPIs, especially if the latter was computed as a price of final output. This result points to very different product compositions of the baskets underlying the CPI or SPPI in terms of characteristics of end users.

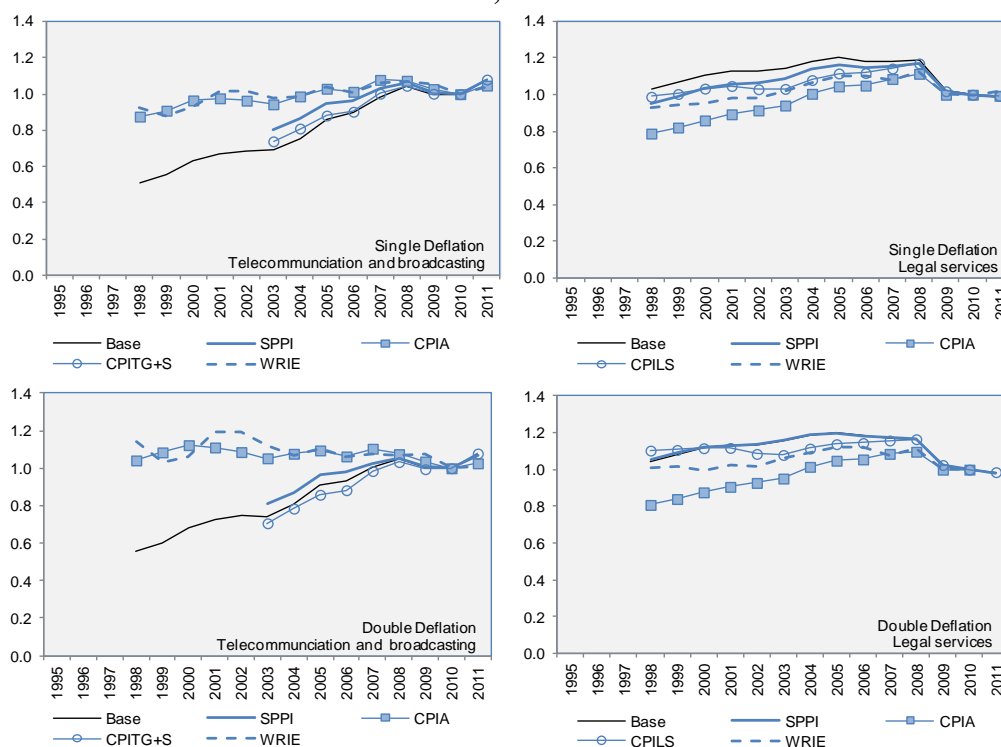
**Figure 2: Volume series of Value added using different deflators – France, Index, 2010=1**



Note: Base: value added deflator as given in National Accounts; SPPI: SPPI, national series, SPPI\_EU: SPPI, Eurostat series; CPIA: CPI all items, CPITG: CPI telecommunication goods, CPITS: CPI, telecommunication services, CPIOHS: CPI, other household services, including legal services; WRIE/WRIH: index of wage rates per employed person/ per hour worked.

Source: OECD STAN database, INSEE.

**Figure 3: Volume series of Value added using different deflators - United States, Index, 2010=1**



Note: Base: value added deflator as given in National Accounts; SPPI: SPPI, national series; CPIA: CPI all items, CPITG+S: CPI telecommunication goods and services; CPILS: legal services; WRIE: index of wage rates per employed persons.

Source: Bureau of Labour Statistics.

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