Services and the Treatment of International Trade: New Economy Data Needs and Challenges

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1. Introduction

In section 2 of this paper, we will provide a bit of an overview of some of the measurement problems that arise whenever we want to measure the productivity growth of an establishment, firm, industry or economy. This overview will show that the KLEMS framework is not the end of the story but it is a good beginning.

In section 3, we will consider some of the problems with the production accounts in the *System of National Accounts 1993* (*SNA 1993*) that make one cautious about the validity of industry Total Factor Productivity (TFP) growth estimates that use national statistical agency real input output tables as inputs into their productivity estimates.

In section 4, we will consider some of the problems that are associated with the measurement of service sector outputs.

Section 5 offers a brief conclusion.

2. Total Factor Productivity and General Measurement Problems

In this section,[1] we will look at some of the general problems that arise when we attempt to measure the Total Factor Productivity of an enterprise, industry or economy. The methodology for measuring the TFP of a production unit is due to Jorgenson and Griliches (1967) (1972) and will not be repeated here. Basically, TFP growth between two time periods for a production unit is equal to a quantity index of output growth (or net output growth) divided by a quantity index of input growth.[2] In section 3 below, we will briefly discuss the respective merits of a gross outputs measure of TFP growth versus various net measures.

2.1 Gross Outputs

[1] This section draws heavily on Diewert (2001).

[2] Diewert and Morrison (1986) and Kohli (1990) provide an exact index number justification for this methodology based on flexible functional form production theory. Note that no separability assumptions about outputs and inputs are required in this methodology.

In order to measure the productivity of a firm, industry or economy, we need information on the outputs produced by the production unit for each time period in the sample along with the average price received by the production unit in each period for each of the outputs. In practice, period by period information on revenues received by the industry for a list of output categories is required along with either an output index or a price index for each output. In principle, the revenues received should not include any commodity taxes imposed on the industry's outputs, since producers in the industry do not receive these tax revenues. The above sentences sound very straightforward but many firms produce thousands of commodities so the aggregation difficulties are formidable. Moreover, many outputs in service sector industries are difficult to measure conceptually: think of the proliferation of telephone service plans and the difficulties involved in measuring insurance, gambling, banking and options trading.

2.2 Intermediate Inputs

Again, in principle, we require information on all the intermediate inputs utilised by the production unit for each time period in the sample along with the average price paid for each of the inputs. In practice, period by period information on costs paid by the industry for a list of intermediate input categories is required along with either an intermediate input quantity index or a price index for each category. In principle, the intermediate input costs paid should include any commodity taxes imposed on the intermediate inputs, since these tax costs are actually paid by producers in the industry. On the other hand, taxes that fall on the outputs produced by the production unit should be excluded for productivity measurement purposes.[3]

The major classes of intermediate inputs at the industry level are:

- materials
- business services
- leased capital.

The current input–output framework deals reasonably well in theory with the flows of materials but not with intersectoral flows of contracted labour services or rented capital equipment. The input-output system was designed long ago when the leasing of capital was not common and when firms had their own in house business services providers. Thus there is little provision for business services and leased capital intermediate inputs in the present system of accounts. With the exception of the manufacturing sector, even the intersectoral value flows of materials are often incomplete in the industry statistics (due to the lack of surveys).

This lack of information means the current input–output accounts will have to be greatly expanded to construct reliable estimates of real value added by industry. At present, there are no surveys (to our knowledge) on the interindustry flows of business services or for the interindustry flows of leased capital. Another problem is that using present national

[3] These conventions for the treatment of indirect taxes on outputs and intermediate inputs when measuring productivity date back to Jorgenson and Griliches (1972; 85).

accounts conventions, leased capital resides in the sector of ownership, which is generally the Finance sector. This could lead to a large overstatement of the capital input into Finance and a corresponding underestimate of capital services into the sectors actually using the leased capital unless some care is taken in reconciling the primary and intermediate input accounts for owned and leased capital services.

There are related problems in the national accounts with respect to the treatment of interest flows and the banking sector. The 1993 version of the System of National Accounts (SNA) recognized that banking sector output seemed to be understated in the SNA production accounts as they were originally designed. It is worth quoting in some detail the solution that SNA 1993 suggested for this problem:

"Some financial intermediaries are able to provide services for which they do not charge explicitly by paying or charging different rates of interest to borrowers or lenders (and to different categories of borrowers and lenders). They pay lower rates of interest than would otherwise be the case to those who lend them money and charge higher rates of interest to those who borrow from them. The resulting net receipts of interest are used to defray their expenses and provide an operating surplus. This scheme of interest rates avoids the need to charge their customers individually for services provided and leads to the pattern of interest rates observed in practice. However, in this situation, the System must use an indirect measure, financial intermediation services indirectly measured (FISIM), of the value of services for which the intermediaries do not charge explicitly.

"The total value of FISIM is measured in the System as the total property income receivable by financial intermediaries minus their total interest payable, excluding the value of any property income receivable from the investment of their own funds, as such income does not arise from financial intermediation. Whenever the production of output is recorded in the System, the use of that output must be explicitly accounted for elsewhere in the System. Hence FISIM must be recorded as being disposed of in one or more of the following ways—as intermediate consumption by enterprises, as final consumption by households, or as exports to non-residents. ...

"For the System as a whole, the allocation of FISIM among different categories of users is equivalent to reclassifying certain parts of interest payments as payments for services. This reclassification has important consequences for the values of certain aggregate flows of goods and services—output, intermediate and final consumption, imports and exports—which affect the values added of particular industries and sectors and also total gross domestic product (GDP). There are also implications for the flows of interest recorded in the primary distribution of income accounts." Eurostat, IMF, OECD, UN and the World Bank (1993, pp.139-140).

As can be seen from the above, it is not a trivial matter to make an imputation in the SNA. Unfortunately, the banking imputation solution suggested by SNA 1993 was soon attacked on the details of its implementation; it proved to be difficult to figure out how to do the imputations for banking services, taking into account the exclusion of the property income generated by the banking sector's own funds.[4] Our conclusion at this point is that a some work remains to be done before we can be confident about our data on intermediate and primary input use by industry, taking into account the complications caused by the FISIM imputations.

It should be noted that at the level of the entire market economy, intermediate inputs collapse down to just imports plus purchases of government and other nonmarket inputs.

[4] See Hill (1996) for an early influential criticism of the SNA's FISIM imputation and Sakuma (2006) for a comprehensive review of the criticisms of the FISIM imputation. See also Schreyer and Stauffer (2003) for a general discussion on how to measure financial outputs.

This simplification of the hugely complex web of interindustry transactions of goods and services explains why it may be easier to measure productivity at the national level than at the industry level. We will pursue this point in more detail in section 3 below.

2.3 Labor Inputs

Using the number of employees as a measure of labour input into an industry will not usually be a very accurate measure of labour input due to the long term decline in average hours worked per full time worker and the recent increase in the use of part time workers. However, even total hours worked in an industry is not a satisfactory measure of labour input if the industry employs a mix of skilled and unskilled workers. Hours of work contributed by highly skilled workers generally contribute more to production than hours contributed by very unskilled workers. Hence, it is best to decompose aggregate labour compensation into its aggregate price and quantity components using index number theory. The practical problem faced by statistical agencies is: how should the various categories of labour be defined? Alternative approaches to this problem are outlined in Jorgenson and Griliches (1967), the Bureau of Labor Statistics (1983), Denison (1985), Jorgenson, Gollop and Fraumeni (1987) and Jorgenson and Fraumeni (1989) (1992). Dean and Harper (1999) provide an accessible summary of the literature in this area.

Another important problem associated with measuring real labour input is finding an appropriate allocation of the operating surplus of proprietors and the self employed into labour and capital components. There are two broad approaches to this problem:

- If demographic information on the self employed is available along with hours worked, then an imputed wage can be assigned to those hours worked based on the average wage earned by employees of similar skills and training. Then an imputed wage bill can be constructed and subtracted from the operating surplus of the self employed. The reduced amount of operating surplus can then be assigned to capital.
- If information on the capital stocks utilised by the self employed is available, then these capital stocks can be assigned user costs and then an aggregate imputed rental can be subtracted from operating surplus. The reduced amount of operating surplus can then be assigned to labour. These imputed labour earnings can then be divided by hours worked by proprietors to obtain an imputed wage rate.

The problems posed by allocating the operating surplus of the self employed are becoming increasingly more important as this type of employment grows in many countries. Fundamentally, the problem appears to be that the current SNA does not address this problem adequately.

2.4 Reproducible Capital Inputs

When a firm purchases a durable capital input, it is not appropriate to allocate the entire purchase price as a cost to the initial period when the asset was purchased. It is necessary to distribute this initial purchase cost across the useful life of the asset. National income accountants recognize this and use depreciation accounts to do this distribution of the

initial cost over the life of the asset. However, national income accountants are reluctant to recognize the interest tied up in the purchase of the asset as a true economic cost. Rather, they tend to regard interest as a transfer payment. Thus the user cost of an asset (which recognizes the opportunity cost of capital as a valid economic cost) was not regarded as a valid approach to valuing the services provided by a durable capital input by many national income accountants and in SNA 1993 in particular. However, if a firm buys a durable capital input and leases or rents it to another sector, national income accountants regard the induced rental as a legitimate cost for the using industry. It seems very likely that the leasing price includes an allowance for the capital tied up by the initial purchase of the asset; i.e., market rental prices include interest. Hence, it seems reasonable to include an imputed interest cost in the user cost of capital even when the asset is not leased. Put another way, interest is still not accepted as a cost of production in the SNA, since it is regarded as an unproductive transfer payment. But interest is productive; it is the cost of inducing savers to forego immediate consumption. This difficulty with SNA 1993 has been recognized in the current revision process for the internationally approved System of National Accounts and the next version of these accounts will probably allow for a decomposition of gross operating surplus in the accounts into price and quantity components where the price of capital services will be a user cost concept; see Schreyer (2007) for the latest proposal.

The treatment of capital gains on assets is even more controversial than the national accounts treatment of interest. In the national accounts, capital gains are not accepted as an intertemporal benefit of production but if resources are transferred from a period where they are less valuable to a period where they are *anticipated* to be more highly valued, then to user cost proponents, a gain has occurred; i.e., capital gains are productive according to this view.

However, the treatment of interest and capital gains pose practical problems for statistical agencies. For example, which interest rate should be used?

- An ex post economy wide rate of return which is the alternative used by Christensen and Jorgenson (1969) (1970)?
- An ex post firm or sectoral rate of return? This method seems appropriate from the viewpoint of measuring ex post performance.
- An ex ante safe rate of return like a Federal Government one year bond rate? This method seems appropriate from the viewpoint of constructing ex ante user costs that could be used in econometric models.
- Or should the ex ante safe rate be adjusted for the risk of the firm or industry?

Since the ex ante user cost concept is not observable, the statistical agency will have to make somewhat arbitrary decisions in order to construct expected capital gains. This is a strong disadvantage of the ex ante concept. On the other hand, the use of the ex post concept will lead to rather large fluctuations in user costs, which in some cases will lead to negative user costs, which in turn may be hard to explain to users. However, a negative user cost simply indicates that instead of the asset declining in value over the period of use, it rose in value to a sufficient extent to offset deterioration. Hence, instead

of the asset being an input cost to the economy during the period, it becomes an intertemporal output. For further discussion on the problems involved in constructing user costs, see Diewert (1980; 470-486) (2005a) (2006) and Schreyer (2001) (2007). For evidence that the choice of user cost formula matters, see Harper, Berndt and Wood (1989).

A further complication is that our empirical information on depreciation rates for reproducible assets is weak. We do not have good information on the useful lives of assets. The UK statistician assumed that machinery and equipment in manufacturing lasts on average 26 years while the Japanese statistician assumed that machinery and equipment in manufacturing lasts on average 11 years; see the OECD (1993; 13).[5]

A final set of problems associated with the construction of user costs is the treatment of business income taxes: should we assume firms are as clever as Hall and Jorgenson (1967) and can work out their rather complex tax–adjusted user costs of capital or should we go to the accounting literature and allocate capital taxes in the rather unsophisticated ways that are suggested there?

2.5 Inventories

Because interest is not a cost of production in the national accounts and the depreciation rate for inventories is close to zero, many productivity frameworks neglect the user cost of inventories. This leads to misleading productivity statistics for industries where inventories are large relative to output, such as retailing and wholesaling. In particular, rates of return that are computed neglecting inventories will be too high since the opportunity cost of capital that is tied up in holding the beginning of the period stocks of inventories is neglected.

The problems involved in accounting for inventories are complicated by the way accountants and the tax authorities treat inventories. These accounting treatments of inventories are problematic in periods of high or moderate inflation. A treatment of inventories that is suitable for productivity measurement can be found in Diewert and Smith (1994). These inventory accounting problems seem to carry over to the national accounts in that for virtually all OECD countries, there are time periods where the real change in inventories has the opposite sign to the corresponding nominal change in inventories. This is difficult for users to interpret.[6]

2.6 Land

The current SNA has no role for land as a factor of production, perhaps because it is thought that the quantity of land in use remains roughly constant across time and hence it

[5] The Economic and Social Research Institute (ESRI), Cabinet Office of Japan, under the direction of Koji Nomura, has implemented a new survey on retirements and sales of assets which should lead to better estimates of depreciation rates for capital stocks in Japan. Canada, the Netherlands and New Zealand have similar surveys.

[6] See Diewert (2005b) for a more coherent framework for measuring inventory change and the user cost of inventories.

can be treated as a fixed, unchanging factor in the analysis of production. However, the quantity of land in use by any particular firm or industry does change over time. Moreover, *the price of land can change dramatically over time and thus the user cost of land will also change over time and this changing user cost will, in general, affect correctly measured productivity*.[7]

Land ties up capital just like inventories (both are zero depreciation assets). Hence, when computing ex post rates of return earned by a production unit, it is important to account for the opportunity cost of capital tied up in land. Neglect of this factor can lead to biased rates of return on financial capital employed. Thus, industry rates of return and TFP estimates may not be accurate for sectors like agriculture which are land intensive.

In many countries, the long run trend in the price of land can be higher than the opportunity cost of capital for the sector that is using the land as an input into its production function. This means that even the ex ante user cost of land can be negative which can lead users to question the user cost methodology. The problem of negative user costs can also arise in the context of finding a price for the use of an owner occupied dwelling unit. In this CPI context, Diewert (2007a; 27) suggested the following solution to the negative user cost problem:

> We conclude this section with the following (controversial) observation: perhaps the "correct" opportunity cost of housing for an owner occupier is not his or her internal user cost but the *maximum* of the internal user cost and what the property could rent for on the rental market. After all, the concept of opportunity cost is supposed to represent the *maximum sacrifice* that one makes in order to consume or use some object and so the above point would seem to follow. If this point of view is accepted, then at certain points in the property cycle, user costs would replace market rents as the "correct" pricing concept for owner occupied housing, which would dramatically affect Consumer Price Indexes and the conduct of monetary policy.

The same logic could be applied to the problem of finding prices for the use of commercial and industrial land in productivity accounts: the "correct" *opportunity cost price* is the *maximum* of the financial opportunity cost for using the land during the accounting period (its ex ante user cost) and the market rent for the use of the land during the period. If this point of view were adopted, the problem of negative user costs would vanish.

As a final complication, property taxes that fall on land must be included as part of the user cost of land. However, it may not be easy to separate the land part of property taxes from the structures part.

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[7] Diewert and Lawrence (2000; 285) in their Canadian TFP study showed that neglecting land and inventories decreased the TFP growth rate by about 20%; i.e., when land and inventories were omitted as factors of production with their own user costs, the Canadian TFP growth rate fell from 0.68 percent per year over the period 1962-1996 to 0.55 per cent. In a similar study for Japan, Nomura (2004; 347) showed that the Japanese TFP growth rate fell from 1.54 percent per year over the period 1960-2000 to 0.80 percent per year when land and inventories were omitted. These studies indicate the importance of including land and inventories as productive factors in productivity studies. Due to lack of data, EUKLEMS does not have land or inventory services as primary inputs in its data base; see Timmer, O'Mahony, and van Ark (2007).

2.7 Resources

The costs of using up nonrenewable natural resources should also be included in a productivity framework as should environmental degradation and pollution costs. However, since the current SNA 1993 makes no provision for these costs and most countries have not developed data on these costs, we will just mention this topic as one that deserves attention in the next revision of the System of National Accounts. When data on natural resource stocks and environmental "bads" are made available in the SNA, then we will be able to measure TFP growth in a more satisfactory manner.

2.8 Other Stocks and the Capitalization of R&D Problem

There are also additional types of capital that should be distinguished in a more complete classification of commodity flows and stocks such as knowledge or intellectual capital, patents, trademarks, working capital or financial capital, infrastructure capital and entertainment or artistic capital.[8] Knowledge capital, in particular, is important for understanding precisely how process and product innovations (which drive TFP growth) are generated and diffused. Basically, knowledge capital is society's set of recipes or blueprints for production functions.

R&D expenditures generally add to society's stock of knowledge. The immediate importance of R&D expenditures is that the current revision process for the international System of National Accounts will recommend capitalizing R&D expenditures. There are many unresolved issues surrounding exactly how to measure the benefits of R&D expenditures and exactly how to depreciate the costs of R&D investments over time.[9] A major problem is that there is a tendency in the R&D literature to treat R&D stocks as just another form of reproducible capital which depreciates just like structures or machines. However, R&D depreciation is not at all like wear and tear depreciation: knowledge capital depreciates due to obsolescence (new and better goods and processes replace existing new goods and new processes) or to shifts in household tastes. Moreover, the *competitive model of producer behavior* serves as the backbone of the existing SNA production accounts but the development of new goods and processes is all about obtaining a competitive advantage and producers must recover their R&D expenditures by setting prices above the marginal costs of production; i.e., *innovation almost always involves noncompetitive pricing and monopolistic markups*. Thus the capitalization of R&D expenditures in the revised SNA is far from straightforward and doing this job properly will lead to big changes throughout the national accounts. The present Jorgenson and Griliches (1967) (1972) growth accounting methodology will also have to be extensively revised in order to account for knowledge expenditures in a realistic manner.

3. The Treatment of Exports, Imports and Indirect Taxes in the SNA

[8] See Corrado, Haltiwanger and Sichel (2005) for papers on these topics.
[9] See Diewert (2005a; 533-537) for a discussion of these accounting problems.

The measurement problems that were discussed in the previous section are general problems that arise when we attempt to measure the productivity of any establishment, industry or economy. However, there are additional measurement problems that arise when the gross output and intermediate input accounts in the *System of National Accounts 1993* are used to measure the productivity growth of industrial sectors. In particular, in this age of globalization, we would like to see how exports and imports contribute to the productivity growth of particular industries in the economy. The production accounts in *SNA 1993* does not allow us to do this.

The main problem areas with the production accounts in SNA 1993 are as follows:

- The main supply and use tables in the production accounts[10] do not show exports produced by industry and imports used by industry;
- The supply and use tables concentrate on the allocation of values of outputs produced and inputs used but do not give any guidance on how to construct real supply and use tables and
- The role of indirect taxes on outputs and intermediate inputs is not completely spelled out nor is the reconciliation of estimates of real GDP at final demand prices built up from final demand components versus estimates of real GDP built up using information on industry outputs and intermediate inputs.

We will briefly discuss each problem in turn.

The first problem is easy to remedy, at least conceptually: all that is needed is a refinement of the commodity classification that is used in the present supply and use tables: a gross output that is being produced by a particular industry in a particular commodity category would be further distinguished as being supplied to the domestic market or as an export while an intermediate input that is being used by a particular industry in a particular commodity category would be further distinguished as being purchased from a domestic supplier or from a foreign supplier and hence in the latter case, would be classified as an import into the sector. Making the above changes to the main production accounts in SNA 1993 would not be a dramatic methodological leap since the present SNA already suggests the above treatment of intermediate inputs as a supplementary table; see Table 15.5 in Eurostat, IMF, OECD, UN and the World Bank (1993). However, implementing the above extension of the commodity classification in the main production accounts would entail a considerable increase in the costs of producing the national accounts.[11] However, if we want to trace through the implications of globalization and outsourcing to its effects on particular industries (and in particular, its effects on productivity by industry), the above suggestion would seem to be the only way forward.[12]

[10] See Table 15.1 in Eurostat, IMF, OECD, UN and the World Bank (1993)

[11] In particular, the country's Producer Price Index program would require extra funding along with increased expenditures on import and export surveys. The proposed IMF *Export Import Price Index Manual* will be methodologically consistent with the existing PPI Manual; see the IMF, Eurostat, ILO, OECD, World Bank and the UN (2004) for the PPI methodology.

[12] For a more detailed discussion of how exports and imports could be introduced into the production accounts, see Diewert (2007b) (2007c).

The second problem is methodologically much more difficult. Since the *SNA 1993* does not give much advice on how to construct real supply and use matrices, countries that produce constant dollar input output matrices tend to use the following methodology that has evolved over the years:

- Construct gross output price indexes using a PPI methodology for the 200 to 1000 commodities that are distinguished by the statistical agency in its supply and use tables;
- Use these output based PPI indexes to deflate the cells in the corresponding commodity row along all of the industry columns of the matrix of gross output values produced during the accounting period in order to obtain a matrix of real gross outputs by commodity and industry (which is a real make matrix) and
- Again use the output based PPI indexes to deflate the cells in the corresponding commodity row along all of the industry columns of the matrix of intermediate input values purchased during the accounting period in order to obtain a matrix of real intermediate inputs by commodity and industry (which is a real use matrix).

The statistical agency then may note that total real supply by commodity does not equal the corresponding total real demand by commodity and various balancing exercises are made in order to achieve balance between supply and demand.

Unfortunately, the above procedures used to construct real supply and use matrices are not conceptually sound. The main problem is this: *not all of the transactions in a single homogeneous commodity take place at the same price*. A seller of a commodity will often change the selling price during the reference period and since purchases of the commodity will be somewhat sporadic over the period, different purchasers will face different average prices for the same time period. This problem could be handled in one of two ways:

- Across the commodity row of the make and use matrices, we could have industry specific prices or
- We could expand the make and use tables so that we distinguish the delivery of goods and services by the purchaser and the seller.

In the second method, the average price for the buyer and seller, arranged in bilateral pairs, would always be the same but of course, the dimensionality of the supply and use tables would be expanded enormously.[13]

The above problem is not the only one with existing statistical agency methods for constructing real use and make matrices. Another important problem is *aggregation*

[13] This second method of arranging the make and use matrices was followed in Chapter 19 of the PPI Manual and in Diewert (2005c) (2007b) (2007c). This second method seems to be the most conceptually sound but of course, it would be impossible for statistical agencies to implement it in practice. However, it could be partially implemented and the method serves as a useful benchmark for evaluating possible biases in existing methods.

bias; i.e., the commodity classification used in real use and supply matrices is not "pure"; each commodity category will consist of hundreds if not thousands of specific products or items. Since producers will generally not make each of the products in each of the commodity classes and purchasers will not purchase each item in fixed proportions, again we see that the assumption that a *single* price index can be used to deflate *every* entry along a commodity row in a supply or use matrix is very dubious indeed.

The tentative conclusion that we can draw from the above considerations is that real use and supply matrices as presently constructed will generally have substantial aggregation errors imbedded in them. *Hence industry productivity estimates must be viewed with some caution*. Economy wide productivity estimates are likely to be much more accurate because statistical agencies have generally devoted considerable amounts of resources in order to obtain good deflators for the components of final demand whereas the problem of finding PPI deflators has not had a high priority until recently when more accurate productivity estimates by industry have been requested by users.

The third problem with the SNA production accounts that we mentioned at the beginning of this section had to do with the role of indirect taxes on outputs and intermediate inputs and the reconciliation of estimates of real final demand GDP with estimates of real GDP built up from the production accounts. We will not explain these problems in detail except to say that they can be solved with the addition of a bit more information on indirect taxes by commodity and industry in some expanded supply and use tables.[14]

4. Problems in the Measurement of Services

It is a fact that statistical information on the outputs produced and inputs used by service sector industries has been rather poorly developed in all OECD countries.[15] The problem is that the current system of national accounts came into being about 70 years ago when service sector industries were a smaller part of an economy and as the importance of service sector industries grew, the statistical system (with some recent exceptions) did not invest resources to improve service sector measurement.

To take Canada as an example, Statistics Canada (2001) has a monthly publication on industry price indexes, but the entire publication is devoted to goods prices: there are no service sector output prices in this publication. Detailed consumer price indexes for approximately 160 commodities are available from Statistics Canada (1997) on a monthly basis. Of these 160 consumer price indexes, only about 40 are devoted to service prices. Of course, the situation in Canada has improved in recent years. Canada, the United States and Mexico have switched from the old Industrial classification (which had very few service industries) to the North American Industry Classification System (NAICS), which has many service industries. Specific price indexes to deflate the

[14] See Diewert (2005c) for a treatment of these problems in a closed economy context and Diewert (2007b) (2007c) for an open economy treatment.
[15] This section draws extensively on Diewert (2003).

outputs of these new industries[16] are not available for all industries but resources are being allocated to this task and industry specific deflators are gradually being developed.

There are some 926 NAICS 6-digit industries. Of these, 381 are goods industries. A further 29 industries are in public administration and 10 more are religious, grant-making, civic and professional services. Given the theoretical difficulties involved in measuring these public sector and nonprofit institution sector outputs, and given our focus on measuring and comparing the productivity of private sector industries, for the present paper, we regard these 39 industries as out of scope. The remaining 506 service sector industries break down as follows:

- Education, health and social assistance industries (49 industries).
- Wholesale and retail trade (147 industries).
- Transportation (51 industries).
- Services 1 (Communication Services consisting of 37 industries), including postal and courier services, warehousing, periodicals and books, software publishers, movies, music, radio and television, telecommunications, news and data processing.
- Services 2 (Business Services consisting of 98 industries) including property leasing, real estate management, car and other rental and leasing, lawyers, accountants, architectural engineering, drafting, design and similar business services, computer services, administrative services, consulting and R&D services, advertising, photography, veterinary services, head office services, employment agencies, telephone call centers, collection agencies, travel agencies, security services, janitorial and cleaning services, and waste collection and disposal services.
- Services 3, (Personal Services consisting of 79 industries), including performing arts, professional sports, museums, parks, zoos, gambling, sports facilities, hotels and other accommodation, food services, drinking places, auto repair, car washes, equipment maintenance and repair, barber shops and beauty salons, funeral homes, laundries, pet care, photo finishing and parking lots.
- Finance and insurance, (45 industries), including the Bank of Canada, banking and related services, brokerages, exchanges, investment advice, accident, property and life insurance agencies, brokerages and carriers, pension funds and other financial services.

Statistics Canada has very rough and ready price indexes for the wholesale and retail trade industries (147 industries) and more accurate price indexes for the 51 transportation industries.[17] Statistics Canada also has approximately 60 indexes from the Consumer Price Index that it uses to deflate the outputs of some of the remaining service sector industries. This leaves about 250 industries for which we have no specific deflator at present.

[16] Most of these "new' industries are not really new in the sense that they did not exist say 10 years ago: they are new in the sense that they have been singled out for disaggregation from a larger grouping of industries.

[17] The methodology for measuring the prices of transportation outputs is generally well developed.

If we examine the products of the above service sector industries and think about the difficulties of measuring these outputs, certain difficulties emerge repeatedly. We list below some general categories of difficult to measure service products (the categories overlap).

- *Unique products*. This is a pervasive problem in the measurement of the prices of services.
- *Complex products*. Many service products are very complicated; e.g., telephone service plans.
- *Tied products*. Many service products are bundled together and offered as a single unit; e.g., newspapers, cablevision plans, banking services packages. In principle, hedonic regression techniques could be used to price out these first three types of service products.
- *Joint products*. For this type of product, the value depends partially on the characteristics of the purchaser; e.g., the value of a year of education depends not only on the characteristics of the school and its teachers but also on the social and genetic characteristics of the student population.
- *Marketing and advertising products*. This class of service sector outputs is dedicated to influencing or informing consumers about their tastes. A standard economic paradigm for this type of product has not yet emerged.
- *Heavily subsidized products*. In the limit, subsidized products can be supplied to consumers free of (explicit) charges. Is zero the "right" price for this type of product?
- *Financial products*. What is the "correct" real price of a household's monetary deposits? Somewhat surprisingly, this question has not yet been resolved in a definitive manner.
- *Uncertain products*. What is the correct pricing concept for gambling and insurance expenditures? What is the correct price for a movie or a record original when it is initially released?

What is somewhat surprising to me is that academics have not been more interested in the above questions.

5. Conclusion

From the list of problems that were discussed above, it can be seen that we are some distance away from being able to accurately measure the productivity performance of service sector industries and we are also have some distance to travel before we can assess the effects of globalization on the productivity performance of industries.

However, I do not mean to imply that it is not worthwhile undertaking productivity studies by industry; it is just that we have to realize that better data in the future may make the currently available estimates obsolete. I very much endorse the EU KLEMS initiative and the parallel efforts by Japanese and Korean academics to construct productivity estimates for Japan and Korea by industry using the same 76 industry

structure that is being used by EU KLEMS. However, in order to improve the quality of these estimates, I suggest that the authors of these studies undertake the following two checks on the reasonableness of their estimates:

- The balancing rate of return for each sector should be published; i.e., allow the interest rate in the user costs to be an endogenous variable for each industry and find the rate which will equate the value of outputs to the value of inputs. If these endogenous rates of return are very high or very low or unusually variable, this may be an indication that there are problems with the value data that is being used for that industry.
- Check the industry rates of TFP growth. If these rates of growth are substantially negative for long periods of time (e.g., 5 to 10 years in a row), this could be an indication that there may be problems with the price and quantity data that is being used for that industry.[18]

A second point that I wish to make in conclusion is that we must ask that governments provide more resources to statistical agencies so that we can better measure economic growth, welfare and the productivity contributions of industry to improving welfare. It is not the fault of statistical agencies that the pace of technical progress has greatly increased in recent years, leading to a proliferation of new products and leading to difficulties with traditional matched model methods for constructing price indexes. On the other hand, it seems necessary that statistical agencies and international organizations concerned with economic measurement provide governments and the public a well thought out plan for improving economic measurement in coming years.

Academics can also play a role in improving economic measurement by providing practical methodologies for measuring the prices of goods and services in difficult to measure areas.

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[18] If an industry is declining, then negative rates of productivity growth may be plausible due to the difficulties in scrapping industry specific capital. However, the point being made here is to have a story that will help to explain the negative productivity growth rates to users. It will also be useful to users for tables of the price and quantity of labour and capital input by industry and detailed type of labour and capital be made available to users on request. This will also help users judge the plausibility of the data. In other words, providing users with just an aggregate price and quantity of labour and capital is not sufficient for users to judge the data quality; more detailed disaggregated information is required.

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