

International Productivity Comparisons: An Examination of Data Sources

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As productivity has become an ever more important policy issue in developed countries, a demand has arisen for detailed cross-country comparisons — but the required data are often difficult to obtain. Even in the simple case of labour productivity, a measure of the volume of output (usually real GDP) and of the labour input (say employed persons) are required for each country to be compared, as well as purchasing power parities (PPPs) so that the output measures can be expressed in common currency units. A more informative measure of labour productivity is output per hour, which additionally requires data on hours of work, not as easily available as employment data. Total factor productivity (TFP, also called multi-factor productivity) further requires data on all other factors of production as well as the share of these factors in total output. These data requirements are exacerbated when making comparisons at a more disaggregated level than the total economy, such as by industry.

Since finding data for suitable time periods and countries is an onerous task for many researchers and policy makers interested in productivity comparisons, this article is meant to acquaint researchers with data bases that have already been produced with these issues in mind. After a brief word on data comparability, this article discusses

several sources of internationally comparable productivity data, many of which are available free of charge on the world wide web.

Data Comparability and PPPs¹

Considerable effort has been expended in the past several years in creating standards and common definitions for collecting data that are harmonized across countries. The System of National Accounts (SNA), for example, sets standards for the collection and reporting of national income/output data. The SNA was developed by international organizations including the United Nations and the Organization for Economic Cooperation and Development (OECD) and is adhered to by these organizations as well as national statistical agencies, although not all countries have updated their national accounts to the most recent revision of the SNA.

The International Labour Organization (ILO) publishes guidelines for the collection of labour force statistics. For analysis at the industry level, the International Standard Industrial Classification of All Economic Activities (ISIC) has been developed. There has been less work done in harmonizing capital stock data due to,

for example, different depreciation rates and methods across national statistical agencies. Even with these standards in place, however, there is still the possibility of definitional differences across countries. Hours actually worked, for example, may not be exactly comparable across some countries if it is not possible to strictly meet the ILO guidelines for the treatment of vacation time or part-time coverage of the labour force. There may also be discrepancies in output data due to lags in the implementation of recent standards in the treatment of software and the underground economy.

It is important to realize, when considering the data sources presented below, that these comparability issues may be dealt with differently by different sources, and consequently that a comparison based on any one data source is not necessarily an “absolute truth.” This is of course an issue with most real-world data, but is compounded even in the simplest international productivity comparisons due to the breadth of data necessary and the diversity of countries.

Even when data collection standards are strictly met across countries, it is necessary to convert output data to a common currency before meaningful comparisons can be made. Purchasing power parities (PPPs) are ratios that equate the price of a basket of goods across countries, and are hence the rate at which the currency of one country must be exchanged for the currency of another to leave the cost of an identical set of goods the same in each country. They are superior to market exchange rates in converting income and related variables to a common currency because they indicate, for example, the value in U.S. dollars of what one Canadian dollar can buy in Canada rather than just the number of U.S. dollars it can buy. However, the calculation of PPPs requires detailed price data, making estimates for long time periods and some countries unavailable or less reliable than estimates for recent years and countries that collect more comprehensive price data.

There are two basic methodologies for converting national currency-denominated statistics into a common currency using PPPs. The first is to convert a nominal (not adjusted for price changes) series, that is, the nominal value in each year is converted using the PPP for that year. The second methodology involves converting a constant price series, that is the real value in each year is converted using the PPP for the base year of the constant price series.

A strength of the first methodology is that current dollar series capture shifts in the shares of expenditure components. A disadvantage is that the converted series is in current price common currency units, making it impossible to calculate growth rates in real terms. There are two solutions to this problem. One can avoid use of the current price common currency series for growth comparisons, relying instead on constant price national currency series for this purpose. Alternatively, one can convert the series in current price common currency units to a real series using the appropriate deflator from the common currency country. For example, PPPs would be used to convert Canadian GDP in current Canadian dollars to current U.S. dollars, and the U.S. GDP deflator would then be applied to convert the series to constant U.S. dollars. It should be noted that growth rates calculated from the converted constant price common currency series will likely not correspond to growth rates of the official constant price national currency series.

The second methodology is to convert a constant price national currency output series to a real common currency series by applying the PPP in the base year of the constant price series to the values in all years. The converted series retains the same growth rates as the series in national currency units, with the added benefit that only one PPP estimate is necessary. A disadvantage of this methodology is that base year expenditure shares are applied to all years in the

series, ignoring shifts over time in expenditure patterns. This can be particularly problematic for very long periods. Given the advantages and disadvantages of each method, there is no professional consensus on which should be preferred.

This discussion raises an important distinction between comparisons of productivity levels and comparisons of productivity growth rates. By comparing productivity growth rates only it is possible to avoid some comparability problems and the need to convert to a common currency. But when commentators refer to an exceptional or poor productivity performance relative to another country they would generally like to frame the argument in terms of both levels and growth rates.

Data Sources²

The Organization for Economic Cooperation and Development (OECD)

The natural starting point for internationally comparable data for most developed countries is the OECD, which is actively involved in collecting and producing several types of data, some of which are available free of charge on their website (www.oecd.org). The OECD regularly updates two productivity series, one for the business sector and one for the total economy. Growth rates for the business sector series are published twice annually, in June and December, in the statistical annex of the *OECD Economic Outlook*. The December 2002 edition of the *Outlook* contains data for 1985 through 2001 with projections for 2002 through 2004 and averages for 1975-1985 for all OECD countries and selected groups of OECD countries. Access to the statistical annex tables in spreadsheet form is available by selecting “Economics” from the left menu at www.oecd.org and from there following the “Economic

Outlook” link. The underlying data as well as data for the total economy are found in the *Economic Outlook* data base, access to which is available through SourceOECD, the OECD’s online dissemination service.³

It is also possible to construct productivity statistics from OECD data on inputs and outputs, or to use productivity statistics developed for the numerous OECD working papers on growth and productivity, many of which contain detailed data appendices. By choosing the “Growth” link from the left menu at www.oecd.org, several new working papers related to economic growth can be directly accessed as well as information on and data from the Firm Level Data Project. To restrict attention to papers dealing specifically with productivity, the “Economic Growth and Productivity” link on the left menu can be followed, or to access all the papers from the OECD Growth Project, follow the “Working Papers on Growth” link on the right. Scarpetta et al. (2000) contains extensive appendices with both labour productivity levels and growth rates, as well as TFP estimates and estimates by industry in some cases, OECD (2003), and is the final report of the Growth Project and contains summary data.⁴

The OECD also provides access to several sources of data that can be used to construct productivity estimates that can be compared across countries. Output and employment data are found along with PPPs in the National Accounts quarterly and annual data bases. A large portion of these data bases are available free online, first by choosing “Statistics Portal” from the menu on the left at www.oecd.org, then by choosing “National Accounts” on the right. Annual data are available from 1970-2001 and quarterly data generally from the first quarter of 1980 to the fourth quarter of 2002. A broader selection of variables than that available for free, including some data on capital, is available from the publication *National Accounts of OECD Countries*. Annual data are published in two volumes each

year, the first showing main aggregates and the second showing tables with more detailed statistics. The quarterly publication contains data for the past 14 years, to the most recent quarter available. The same data are also available on the *Quarterly National Accounts* CD-ROM, and the OECD's online dissemination service SourceOECD, for all years in the OECD database, with data for some countries available as far back as 1955.⁵

More detailed employment statistics are available quarterly and annually from the *Labour Force Statistics* publications and CD-ROMs, and again via SourceOECD, but can also be accessed directly from the Labour Market Statistics Database. This is available by following the "Statistics" link at the top of the OECD homepage (www.oecd.org), and from there the "Statistics Portal" link on the left-side menu.⁶ Users can query the data base for labour force statistics by age, gender, educational attainment, class of worker, and so on. Also available from this data base are the OECD estimates of average actual annual hours of work per person employed, which are published for selected years in the annual *OECD Employment Outlook*.

Data for TFP and industry level productivity calculations are also available from the OECD. The Structural Analysis (STAN) data base contains data on employment, hours of work, output, intermediate inputs, capital stock and wages by industry, where the industry breakdown is consistent across countries. The STAN data base also includes data on value added so that productivity statistics calculated from this data can be used to measure the contributions of individual industries to aggregate productivity growth. The National Accounts also contain some data by industry, but the breakdown is less detailed. For the most part these statistics are not available for free access, although some sample data from STAN are available by choosing "Statistics Portal" at the left of www.oecd.org, then choos-

ing "Industry and Services" from the menu at the right, and following the "Industrial Performance Statistics" link from there.

The United States Bureau of Labor Statistics (BLS)

The BLS's Foreign Labor Statistics program produces internationally comparable data in several categories, namely hourly compensation in manufacturing, labour force statistics, production and unit labour costs in manufacturing, and GDP per capita and per employed person. The Foreign Labor Statistics program also collects and makes available consumer price index information for 16 countries. All data are available free of charge at www.bls.gov/fls.

Labour force statistics are updated twice annually, in the spring and fall, and are currently available from 1959 to 2001 for the United States, Canada, Australia, Japan, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom. Besides estimates of the labour force, employment and working age population (adjusted to those aged 16 and over as far as possible), estimates of unemployment rates are also provided and are updated monthly, with quarterly unemployment estimates available from 1995 onwards.

Internationally comparable output data are available, along with employment and population data, for these same ten countries (except Australia) plus Korea, Austria, Denmark, Belgium and Norway. This data set is available for 1960-1998, but has not been updated since March 2000. The nominal domestic currency GDP series is converted to common currency with a PPP estimate in every year (PPP estimates between benchmark years are extrapolated based on movements of each country's GDP deflator relative to the U.S. GDP deflator) and the output series are then converted to 1998 U.S. dollars with the U.S. GDP deflator. Growth rates

calculated from these series do not match growth rates calculated from official GDP estimates produced by these countries' statistical agencies.

Productivity and cost data for manufacturing are presented in index form for fourteen countries from 1950 to 2001. The strength of the index form is that conversion to a common currency becomes unnecessary and differences in definitions of hours worked do not affect growth rates if the definitions do not change over time. The obvious weakness is that only growth rates of productivity can be compared, not levels.

Groningen Growth and Development Centre (GGDC) and the Conference Board

The Groningen Growth and Development Centre at the University of Groningen in the Netherlands, with sponsorship from the U.S. Conference Board, maintains three separate data bases for international productivity comparisons, at the total economy level, by ten broad sectors of the economy, and at the detailed manufacturing level. The total economy data base is based primarily on the work of Angus Maddison,⁷ and contains estimates of GDP, population, employment, average annual working hours, GDP per capita, GDP per person employed, and GDP per hour. All GDP series are available in 1990 U.S. dollars, based on 1990 PPPs calculated by Angus Maddison, and many are also available in 1999 U.S. dollars, based on 1999 PPPs calculated by the OECD and Eurostat. The method of conversion to a common currency is hence the application of a single PPP estimate from the base year of a constant price series to the value in each year.

These series are available for 74 countries (covering all OECD members and various countries in Eastern Europe, Asia, Latin America, Africa and the Middle East), from 1950 to 2002 for OECD countries and generally from 1950 to 2000 for other countries (although some variables are not

available for some countries). All data are posted and available for free download at www.eco.rug.nl/ggdc/indexdseries.html. Source and methodology notes are also available, and capital stock and TFP estimates may soon be available.

The sectoral data base contains output, employment, and for some countries average hours estimates, for 20 countries from 1950 to 1996 (or slightly longer or shorter time periods for some countries). For OECD countries these data are accessible in spreadsheet format, and data for Asian and Latin American countries as well as all documentation are accessible from articles and working papers, all available from the GGDC website. Estimates of PPPs by sector are not yet available so only growth rate comparisons are presently possible, but in the second half of 2003 the GGDC plans to update the sectoral data base including PPP estimates.

At the industry level the GGDC has developed PPP estimates that take into account relative price differences between industries. The International Comparisons of Output and Productivity (ICOP) Industrial Database includes comparable estimates of output, employment, hours, and output per person employed and per hour for the manufacturing industry in 30 countries from 1950 to 2000 (van Ark and Timmer, 2001). All of these series, detailed methodology notes and related research reports are available from the GGDC website referred to above. The OECD is the main source for data provided by the GGDC and the data used in constructing the productivity statistics, although national sources are also used, particularly at the industry level, and detailed sources provided.

Other Sources of Productivity, Output, and Employment Data

The International Labour Organization maintains the Key Indicators of the Labour Market data base, including data on output per

hour and per employed person for the total economy, manufacturing, transportation and communications, and wholesale and retail trade. Data are presented both in index form and in 1990 U.S. dollars and are available from 1980 through 2000 for 44 developed or transition economies. These series are based on data collected by the GGDC. In 2003, data for the agricultural sector for about 100 countries should become available. Also available are data on employment, standardized unemployment rates, long-term unemployment, and labour force participation rates. Data are disseminated via the ILO's publication *Key Indicators of the Labour Market*, published annually and available in print or on CD-ROM from the ILO website (ilo.org), and via KILMnet, an online data base which can be subscribed to from the ILO website. Most employment-related variables are available for virtually all countries in the world, with many available for 1980-2000. The ILO also provides a free online data base known as LABORSTA, available at www.laborsta.ilo.org which provides convenient access to nationally collected employment related statistics for virtually every country in the world.

The National Bureau of Economic Research (NBER) provides access via their website (www.nber.org) to the Penn World Table Version 6.1 data base, prepared by Alan Heston, Robert Summers and Bettina Aten, which contains data on GDP and a number of related variables, including PPP adjusted GDP per person employed, for 152 countries for 1950 through 2000.⁸ Two other data bases maintained by the NBER may also be of interest: the Macrohistory Database presents, among other variables, output and employment data for the pre-World War I period for the United States, with limited coverage of some European countries; and the Manufacturing Industry Productivity Database, maintained jointly with the Center for Economic Studies of the Bureau of the Census, contains a

number of variables such as output, employment, hours, capital stock and TFP, for each of the 459 manufacturing industries in the United States for 1958-1997. These data can be accessed by choosing "Data" at the top of www.nber.org and following "Data Links" from the menu that appears. Also available from the NBER website under the "Programs" link is information on and publications of the NBER Productivity Program, and, under "Publications," access to or ordering information on all NBER books and working papers.

It is also important to mention the data provided by two other international organizations, namely the World Bank and the International Monetary Fund (IMF). The World Bank publishes its *World Development Indicators* annually, available in print, on CD-ROM, and via an online subscription. Information and a free trial online data service are available at www.worldbank.org/data. Data on roughly 800 variables for 1960 onwards and for virtually all countries in the world are available. The IMF produces data on output and trade for its semi-annual publication *World Economic Outlook*, and free access to the data base is available by searching for this publication at www.imf.org. The *International Financial Statistics* yearbook and CD-ROM can be ordered from the IMF website and contains data on financial variables for all countries in the world, presented both annually and quarterly, with some series starting in 1948 (although not all years for which data are available are included in the print edition).

Besides these major international sources, some private research organizations provide productivity and related data for smaller sets of countries. Although quite likely far from exhaustive, two are mentioned here. The first source is the National Institute of Economic and Social Research in London (NIESR), whose website is found at www.niesr.ac.uk. The NIESR provides labour productivity and capital data for 48 sec-

tors with additional detail in manufacturing for 1950 onwards for the United Kingdom, the United States, Germany, France and Japan. These data can be obtained by following the “research” link followed by the “productivity and competitiveness” link.

The second source is the Centre for the Study of Living Standards (CSLS), which provides regularly updated productivity data for Canada and the United States from 1976 onwards. For the total economy and manufacturing, both level and growth rate comparisons of output per hour and per employed person are available, as well as growth rate comparisons of capital productivity. Growth rate comparisons of output per hour and per employed person for the business sector are also available from 1946 onwards annually and from 1987 onwards quarterly. The data are accessible by choosing “Data” from the top menu at www.csls.ca and from there the “Personal Income and Productivity Trends” link. The CSLS productivity data base also contains annual estimates of labour, capital, and total factor productivity growth rates and levels for Canada and by province for a detailed set of industries for the 1987-2001 period.

Comparing the Comparisons

Given on the one hand the growing demand for international productivity comparisons, and on the other hand the challenge of finding suitable data, it would seem efficient to separate the task of finding the data from the task of making the comparisons. This article is an attempt to fulfill this first task, but in a sense it can only be partly successful. Considered as a whole, the data sources discussed here supply not a single truth, but rather a range of estimates for any particular country pairing. This is due to the numerous data comparability issues to be faced and the numerous ways in which each can plau-

sibly be addressed. Hopefully, through continued research it will eventually be possible to have fully harmonized data collection standards and agreement on calculation methods. Until this happens, however, what is “suitable” must be defined as a range.

Notes

- * The author would like to thank Andrew Sharpe for the opportunity to write this article and for constructive comments, and also Bart van Ark, Paul Schreyer and Dirk Pilat for useful suggestions. The list of data sources discussed here is quite likely not exhaustive, and due to frequent website updates the precise locations described here may change over time. Additions and corrections are welcome at jersmith@cyberus.ca. The author is currently undertaking his Master of Arts in Economics at Queen’s University and worked as a Research Assistant at the Centre for the Study of Living Standards from May 2001 to August 2002.
- 1 For a detailed discussion of these and other issues faced in constructing productivity estimates, see Scarpetta et al. (2000) and OECD (2001a). An abridged version of the latter appeared in Schreyer (2001).
- 2 This article is posted at www.csls.ca under the *International Productivity Monitor* along with a page of hotlinks to all internet data sources discussed here.
- 3 SourceOECD is a convenient service since virtually all data produced by the OECD can be downloaded instantaneously, for the most recent period available, and from a user-friendly interface. However, users must subscribe to SourceOECD, with rates varying according to access requirements (although some institutions have subscriptions available to all their members). It is possibly more cost effective for some users to purchase data via CD-ROM since this avoids paying for unnecessary data, and these products also generally have user-friendly interfaces and can be purchased directly from the OECD online bookshop. SourceOECD is available at www.sourceoecd.org and the bookshop can be accessed from the right menu at www.oecd.org.
- 4 This publication and other work of the Growth Project was summarized in Pilat (2001). Also see OECD (2001b).
- 5 It is also useful to note that these statistics are available on other OECD CD-ROM publications as well. For example, the OECD Health Data CD-ROM contains PPPs, output data, and employment data, but not data on hours of work.
- 6 The data base is available directly from http://www1.oecd.org/scripts/cde/viewbase.asp?DBNAME=ifs_data.
- 7 *The World Economy: A Millennial Perspective* by Angus Maddison (published by the Development Centre of the OECD in 2001) was reviewed by Sharpe (2001, 2002). Besides providing population and output data for virtually

all countries in the world, with some series extending 2000 years into the past, Maddison presents employment and hours estimates for the years 1870, 1913, 1950, 1973, 1990 and 1998 for most major developed countries. The method of currency conversion is the second discussed above, namely the conversion of a real series using the PPP of the base year. Despite the limited development of productivity statistics relative to GDP and GDP per capita, the book is a valuable source for international productivity comparisons due to its wide country coverage, long time coverage and detailed discussion of sources and methods. Sample tables and ordering information are available at www.theworld-economy.org.

- 8 This data base with associated documentation is available directly from pwt.econ.upenn.edu.

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