Producing an Input Price Index[1]

William Alterman
Bureau of Labor Statistics

November 2009

Introduction

This paper is designed to address the need, and especially the feasibility, of producing an input price index at the U.S. Bureau of Labor Statistics (BLS). These price indexes would serve to provide more accurate estimates of several key indicators of the state of the U.S. economy, including gross domestic product (GDP), productivity and inflation.

The current interest in these types of price indexes arose due over concerns that the BLS does not adequately measure shifts in prices resulting from offshoring (or its corollary, onshoring) in its industrial price programs. BLS has three indexes that cover the production of goods, the International Price Program's Import Price Index (MPI) and Export Price Index (XPI), and the Producer Price Index (PPI). The MPI only covers goods that are being imported, the XPI only covers the export of goods, and the PPI only covers goods and services that are produced domestically. Thus, a good that had been domestically produced and repriced by the PPI, and has had its production sent overseas, will no longer be tracked in the PPI. Correspondingly, the MPI index will not begin to price that particular item until after it has become an import. Therefore neither program will directly show the price change that occurs when the item goes from domestic production to foreign (or vice versa).

An example of how BLS constructs an import price index and a producer price index will help to illuminate the problem. Let us look at how both indexes might reflect price changes in the manufacturing of furniture. Below I've constructed a table showing prices for four different chairs. All chairs that are being produced domestically sell for $10, while all imported chairs sell for $5. Chair A is only produced domestically, while Chair D is only imported. During the year, the remaining two chairs shift from domestic production to being imported, Chair B in March and Chair C in May.

The PPI only tracks Chair A for the entire period, and Chairs B and C for the months that they are domestically produced. The Import Price Index (MPI) only tracks chair D for the entire period, and chairs B and C only for the months they are imported. Thus both the PPI and the MPI for chairs would both reflect no change during the entire reference period.

[1] This paper was prepared for the "Measurement Issues Arising from the Growth of Globalization" Conference held November 6-7, 2009 in Washington, DC. The author wishes to thank Maureen Doherty, Ted To, Mina Kim, Jenny FitzGerald, David Friedman and Steve Paben for their contributions and comments. I would also like to thank Shawn Klimek and Lynn Riggs at the Census Bureau for their assistance in gaining access to Census data. All views expressed in this paper are those of the authors and do not necessarily reflect the views or policies of the U.S. Bureau of Labor Statistics or the U.S. Census Bureau.

One suggested option was to some combine the two indexes. However, since the indexes themselves are always unchanged, no amount of recombining or reweighting will produce anything other than an unchanged series. The only way to construct a price index that would show the price decline associated from the offshoring of chairs B and C would be to construct a price index that would directly track the price changes of items as they move from domestic to foreign and vice versa. This is not possible under the methodology (and concepts) currently in use in the Bureau's two industrial price programs.[2] The PPI does currently construct output price indexes for wholesalers and retailers, which presumably includes data on both imported and domestically produced goods. However, these indexes are only gross margin indexes, and only represent the difference between their selling price of a good and the acquisition price for that same item. The data collected does not lend itself to delineating import goods from domestic goods.

		Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09
Chair A	Domestic	$10	$10	$10	$10	$10	$10
Chair B	Domestic	$10	$10				
Chair B	Imported			$5	$5	$5	$5
Chair C	Domestic	$10	$10	$10	$10		
Chair C	Imported					$5	$5
Chair D	Imported	$5	$5	$5	$5	$5	$5
PPI		100	100	100	100	100	100
MPI		100	100	100	100	100	100
Combined Index		100	100	100	100	100	100
Input Index		100	100	85.7	85.7	71.4	71.4

Although BLS was aware of the potential data gaps between XPI, MPI and PPI, it appeared that shifts over time between domestic and foreign production have been gradual enough that it was not evident that the limitation of the indexes was seriously biasing estimates of productivity as well as gross domestic product figures and other components of the National Accounts. The potential shortcomings in the BLS indexes, however, were highlighted in an article in the summer of 2007 in Business Week, and by a study funded by the Sloan Foundation.[3] Presumably this potential gap in BLS data becomes more serious as the proportion of the U.S. economy tied into the global economy has grown and especially in conjunction with the perception that U.S. jobs are being lost to foreign competition.

In order to address this limitation, BLS needs to develop an entirely new set of 'input' price indexes, which would price goods and services that are inputs into a domestic companies production function. Indeed, BLS itself recognized the need for this type of series over thirty

[2] Note that the consumer price index is designed to pick up these price changes, and is reflected in prices paid by domestic consumers. In addition, the Bureau has conducted a preliminary analysis of PPI data that provides some evidence that prices from domestic producers are influenced by the degree of import penetration in their industry.

[3] "The Real Cost of Offshoring" http://www.businessweek.com/magazine/content/07_25/b4039001.htm Information on the Sloan Foundation study can be found here: http://www.upjohninstitute.org/publications/newsletter/SNH_109.pdf

years ago when the old "wholesale price index" was transformed into the more comprehensive and systematic output-based producer price indexes.

This paper will review both the concepts and uses of an input price index, as well as assessing additional evidence centering on the need for these data. In addition, the paper will also focus on the practical aspects and limitations of attempting to produce such an index. This will include surveying the data sources necessary for drawing a sample of establishments and items to reprice, evaluating possible sources for appropriate weights in an input price index, determining a proper index estimation formula, and verifying the publication structure necessary to support the different uses of these series.

Why an Input Price Index is Important

As mentioned, an accurate estimate of the prices paid for inputs of both goods and services is crucial to a number of broad and critical measures of the economy. This includes estimates of GDP, inflation, and productivity. For example, in order to properly estimate GDP by industry, constructed by the Bureau of Economic Analysis (BEA) and industry productivity estimates constructed by BLS, the producers of these economic data must properly account for input costs. Although these data are available on a current dollar basis (though sometimes with a considerable lag), in order to estimate their 'real' (that is inflation-adjusted) values, they need to be deflated by changes in price levels. However, the appropriate price measures paralleling these input values are not currently being produced by BLS. Consequently, BEA and BLS must make use of whatever price data are available. Generally this has required the agencies to make use of the PPI output price indexes and/or the IPP import price indexes. It has been speculated that using these next best sources may lead to significant mismeasurements in the economy. For example, the Business Week article estimates that the increase in 'real' GDP from 2003 to mid-2007 may have been overestimated by $66 billion. This article focused on import prices not picking up price changes when a good goes from being domestically produced to being imported. It summarizes the example of the furniture industry, pointing out the apparent contradictory behavior of consumer prices for furniture, which have been falling at the same time the indexes for domestic producer prices as well as import prices for this category have both been moving higher.

Equally important, the article also inferred that the lack of an input price index may lead to a significant overestimate of productivity in U.S. industry. A rise in a Nation's productivity is considered the key factor in an economy's ability to improve its standard of living. It is further assumed that increases in real hourly earnings are often tied to gains in productivity. If, in fact, GDP and productivity are being overestimated, this implies that the gains from trade (i.e. the terms of trade) are being underestimated and that in 'real' terms, the value of imports is greater than currently measured.

Recent Work

A growing body of literature has now looked into the increasing role of imports in intermediate inputs in the U.S. economy as well as concerns associated with the methodology in constructing U.S. estimates of GDP and productivity. Kurz and Lengermann (2008) note that foreign inputs

accounted for one-third of growth in the manufacturing sector between 1997 and 2005, while Yuskavage, Strassner and Medeiros (2008) estimate from 1997 to 2006 the import share of intermediate inputs increased from 13.5 to 20.0 percent. Feenstra, Reinsdorf and Slaughter (2008) attribute a substantial portion of the apparent acceleration in productivity gains after 1995 to gains in the terms of trade and tariff reductions. Nakamura and Steinsson (2008) find limitation in the import and export price indexes associated with "product replacement bias". Finally, Houseman (2009) states, "The measurement problem has broad implications not only for various aggregate and industry statistics, but also for the research that relies on them. Although the growth of imports from developing countries has spurred great interest in academic and policy circles about their effects on the U.S. economy and its workers, credible research into these issues cannot be conducted without accurate data on real import values."

Additional Evidence

In order to provide additional evidence for the need for a set of input price indexes which incorporate both domestic and foreign sourcing, I analyzed the most recent available data on the role of imports in domestic supply. In analyzing the data from the BEA, I estimated that not only has the contribution of imports to intermediate inputs in the U.S. increased, but that it increased at a faster rate during the past decade. In 1975 imports represented less than 7 percent of inputs into manufacturing. By 2007 the figure had climbed to almost 28 percent. [See Chart A.] Equally important, between 1997 and 2007, the percent of imports in inputs increased by an average of over 0.4 percent a year, while in the prior decade, the percent had increased by less than 0.25 percent a year. This point is critical because it infers that there is an acceleration in companies shifting their products from domestic sourcing to foreign sourcing, making the need for additional data more critical. In addition, if the rate of change was consistent over time, it might have been easier to model a 'discount" factor to apply to import prices in order to adjust for this shift.

Indeed, the speed of globalization is perhaps happening so quickly that the ability of traditional measures to capture these shifts has become increasingly problematic. For example, the household wood furniture manufacturing industry—the industry highlighted in the Business Week article--recorded a dramatic increase in the value of imports during the past decade, jumping from $13.2 billion in 1999 to $27.0 billion in 2007. Despite this increase, in 2006 the preliminary estimate from the Annual Survey of Manufactures for the household wood furniture sector recorded an increase in value of domestic production, up to $13.5 billion. However, when the final figures were revised the following year, the number was adjusted substantially downward to only $8.6 billion. Possibly this may be due in part to the difficulty of properly (and in a timely manner) coding companies to the correct NAICS (North American Industry Classification System) number when they shift from being a manufacturer to being essentially a wholesaler.

Limitations

It is important to point out that the construction of an input price index will not alleviate directly the potential mismeasurement issues associated with an *import* price index. This is important to note because GDP can be estimated using two different methods: It can be constructed by calculating the total of final sales in the U.S. economy and subtracting out imports (the familiar $Y = C + I + G + X – M$) as well as by the value-added approach, where the total value added of each industry is aggregated ($Y = \Sigma VA_{j,}$ where VAj = Sales for industry j minus Purchases of

Materials and Supplies by industry j. The current methodology in the U.S. focuses on the former.

In order to understand why the Bureau cannot construct an import price index that directly registers these price changes, it helps to review the current methodology. The procedure for producing import price indexes starts out with a very robust frame from which to draw a sample. It includes nearly the entire set of transactions of all merchandise brought through U.S. Customs and into the United States. It breaks it out by individual shipments, product categories, and of course, companies. A sample of specific companies and the items they imported is then drawn from this frame and the Bureau attempts to collect prices on a monthly basis for these items. Note, however, that the sample only consists of goods that are already being imported. It is not practical to ascertain from an importer (who in many cases may only be an intermediary) if in the past he sourced an item domestically. It would also be hard to get the reverse, asking an importer who no longer imports, if the sampled good is now produced domestically and if so, what is the price. Presumably, constructing an input price index may potentially provide some indication of the magnitude of any differences in price trends being missed by import prices or producer prices as sourcing shifts from one to the other. This might be possible if, as the pricing data was being collected, the respondent was able to take note of whether the item was bought domestically or from a foreign source. From a practical standpoint, however, it is not clear if this information could be successfully incorporated into the index production process.

It should also be pointed out that an input price index will not alleviate problems arising from when goods and services which had been previously produced in-house are now shifted to being outsourced (either domestically or to a foreign source). This, too, is considered a growing phenomenon, but unless data on prices associated with the in-house cost of producing an item can be directly compared with the outsourced price, it is not clear how BLS could evaluate shifts in prices associated with this phenomenon.

BLS and Input Price Indexes

The seminal 1961 Report of the NBER Price Statistics Review Committee, the so-called Stigler Report, made a number of recommendations surrounding the Wholesale Price Indexes, which was the name of the industrial price series then being produced by BLS. One of the recommendations was that the Bureau should rely on buyer's prices and not on seller's prices. A second recommendation was for the creation of a set of conceptually rigorous input and output price indexes. The report also included an empirical study which concluded that buyer's prices were more likely than list prices to accurately reflect prices of actual transactions.

Buyers Prices

Prior to the Stigler Report, the PPI had done some work in evaluating the use of buyers' prices. In 1942, the PPI did a study of buyers' prices for 8 selected items of steel mill products for six time periods and compared them to list prices. The results of the study showed that the buyers' prices moved differently than list prices for short periods of time but longer term list and invoice prices were comparable. Experiences with the study showed that purchases of an item by an individual company included many different transaction terms and detailed specifications.

In response to the Stigler Report and subsequent reports, the BLS Commissioner as well as others expressed concerns that the cost of collecting buyers prices would outweigh the potential benefits due to potential problems such as buyers' prices from an invoice sometimes not reflecting real transaction prices, difficulties capturing retroactive price adjustments based on cumulative volume and financial assistance given by sellers to buyers for advertising and other expenses. The BLS did agree that the project had merit on a selective basis to allow analysis of price trends in industries where transaction pricing was difficult.

A more detailed study looking into the advantages of buyer's prices was published in Stigler and Kindahl (1969) which pointed out the differences in price trends between buyers' and sellers' prices. Note that much of the concern with the then BLS Wholesale Price Index continued to focus on the use (or potential misuse) of so-called *list prices*.
BLS Economists continued to work with the sellers who were participating in the PPI survey to encourage the reporting of actual transaction prices and made substantial progress in some industries in improving the quality of the received prices. The PPI also began the process of evaluating specific products where buyers' prices should be collected due to the unavailability of transaction prices from sellers. As a result of this study, in January 1972 the PPI began publishing a commodity index for aluminum ingot using buyers' prices from a judgmentally selected sample of reporters.

Building on this work, in 1974 the PPI attempted a systematic sampling approach to obtaining buyers' prices. This project was undertaken with the goal of determining the feasibility and cost of collecting prices directly from buyers in order to either calculate output indexes or evaluate the quality of the transaction prices being reported by sellers. The project identified highly weighted products where sellers refused to provide transaction data or the quality of current transaction data was questionable and where there were homogeneous products frequently purchased by buyers in consistent quantities. The projected focused on titanium forgings because the PPI was able to create an unrefined frame and document the typical transaction characteristics of buyers in this product area. After significant resources were spent on this project, pricing issues remained and a process had not been defined to refine and systematically sample from the frame. As a result, the project was dropped and the program switched focus back to obtaining good transaction prices from sellers even in these more difficult cases. No further work was done on buyers' prices and in 1980 when indexes calculated using sellers' transaction prices were introduced from the systematic sample for the Primary Aluminum industry output index, the buyers' price commodity index for aluminum ingot was dropped.

Input/Output Indexes

In response to the Stigler Report, the PPI also began examining approaches to creating input and output [price] indexes for industries. For example, in the early 1960's the PPI built output Industry-Sector Price Indexes (ISPI) for some industries by combining the judgmentally sampled data collected for the commodity indexes using different classification structures and weighting. In the mid 1970's, however, the PPI began a comprehensive revision in order to plan and implement many improvements that had been recommended over the years including in the Stigler Report. The long term goal of the revision was to expand the PPI's coverage to every industry in the private economy and to publish a system of indexes that included;

- Industry output indexes
- Industry input price indexes

- Detailed commodity indexes
- Industry based stage of processing indexes

In the late 1970's the PPI began systematically sampling industries and starting in 1980 began introducing industry output indexes on a regular basis.[4] Throughout the years, the PPI continued expanding the number of industry output indexes and now covers 82% of all in scope production.

As an attempt to fulfill the recommendations of the Stigler report, and as a component of its stage of processing indexes, the Bureau did publish a set of input price indexes from 1988 to 2003. These indexes were calculated by reweighting output prices using input weights. This allowed the use of output price indexes at great level of detail. However, these indexes did not include imports, nor did they directly account for substitution from a buyer's perspective. Thus they assumed that sellers' prices are a good proxy for buyers' prices and that prices for imports and domestic production move similarly. These series were discontinued in 2003, but is still a method used in BEA and BLS for constructing input price indexes where necessary. [See Table A.] With the bulk of the PPI's coverage expansion now completed, the PPI has resumed work on this project.

Note that the Bureau *does* have extensive experience with constructing an input price index, as both the import price as well as the consumer price indexes are collecting purchasers prices.

Current Uses and Users of the Data

The fundamental question facing the BLS, of course, is, "Can the Bureau produce a input price series that will meet the needs of its primary users?" In order to answer this question, one must first delve into the intricacies of the construction of the outputs of the two primary potential users of these data, the Office of Productivity and Technology (OPT) at BLS, and the Industry Sector Division of BEA.

BLS

We will start with OPT, which publishes two types of productivity measures: 1) labor productivity, or output per hour of labor, and 2) multifactor productivity, or output per unit of combined inputs. Labor productivity indexes and multifactor productivity indexes are produced in two different divisions in BLS.

Labor Productivity

Measures of labor productivity are produced in two divisions of the Office of Productivity and Technology: the Division of Major Sector Productivity (DMSP) and the Division of Industry Productivity Studies (DIPS). The estimates of labor productivity (and unit labor costs) for major sectors are published quarterly, while estimates for industries are published annually. Labor productivity estimates do NOT explicitly measure shifts in the quantity (or constant dollar value)

[4] While the practical work focused on an output price index, work did proceed on the theory of an input price index, culminating in a BLS working paper by Robert Archibald in 1975.

of material inputs, and therefore do not require estimates of the changes in the prices of those inputs, be they domestically sourced or imported. Note that outputs *are* adjusted for inflation.

Multifactor Productivity

Multifactor productivity measures are also produced in both DMSP and DIPS.

DMSP publishes, albeit with little detail, multifactor productivity estimates for the private business and private nonfarm business sectors of the economy. These series represent 77 percent of U.S. GDP. In calculating these series, outputs are measured on a value-added basis, which are then compared to just two inputs, capital and labor. The value of material inputs is excluded from these calculations. However, staff uses detailed price indexes to deflate capital expenditures. Physical capital, as measured by DMSP, consists of 42 types of equipment and software, 21 types of nonresidential structures, 9 types of residential capital, inventories (manufacturing available for 3 stages of fabrication), and land. Deflation of each capital expenditure category is actually done at the detailed 5 or 6 digit-I/O level. (The actual derivation of value-added by sector entails adjusting the value of inputs to account for changes in prices. This work, however, is done at BEA.)

DMSP also publishes annual multifactor productivity measures for total manufacturing and 18 broad three-digit NAICS manufacturing industries, comparing sectoral output (total output excluding intra-industry or intrasector transactions) to a broad set of inputs, including capital, labor, energy, materials and business services (KLEMS) inputs. [Note that on a value-added basis manufacturing represented 12 percent of GDP in 2007.] In the manufacturing sector of the economy and in individual industries, intermediate purchases constitute the largest component of inputs. The nominal dollar and constant dollar values of energy, materials and services used by DMSP are derived by BEA.

DIPS publishes more detailed annual multifactor productivity measures for 86 four-digit NAICS manufacturing industries, plus air transportation, and line-haul railroads. These productivity measures also compare industry sectoral output to a broad set of combined inputs. DIPS publishes estimates of intermediate purchases, capital and labor for each of the detailed manufacturing industries. The index of intermediate purchases for each industry is constructed by combining separate quantities (or constant dollar costs) of electricity, fuels, materials, and purchased services. In order to deflate nominal dollar cost inputs for each industry, weighted deflators for materials and for services are calculated by combining detailed price indexes using weights derived from the cost of commodities consumed by each industry, as shown in the detailed benchmark I/O (Input-Output) tables produced by BEA. I/O commodities from the benchmark I/O tables generally relate to the primary products of 6-digit NAICS industries, or occasionally a combination of industries. For materials commodities that are heavily imported, DIPS combines PPIs and import price indexes using weights from BEA's import matrix. DIPS also uses PPIs in creating weighted deflators for deflating annual fuels purchases of each industry.

DIPS also uses PPIs and import price indexes to deflate capital expenditures. Price deflators for each equipment asset category are constructed by combining detailed PPIs with weights from the BEA capital flow tables at the roughly 6-digit level. For the DIPS detailed manufacturing industry measures, physical capital consists of 25 categories of equipment, two categories of structures, three categories of inventories, and land.

Note that BLS makes use of product-specific data in constructing deflators for a set of input price indexes for a given industry's material costs. Ideally, an input price index would be industry-specific, but that may prove cost-prohibitive.

Since industry MFP calculations are based on annual data, the nominal input values are adjusted by annual PPIs (average of 12 monthly price indexes).

BEA

The Industry Sector Division at BEA is responsible for producing the annual industry accounts and the benchmark input-output accounts. These accounts, which shed critical light on the relationships between U.S. industries, take a value-added approach to, and are consistent with BEA's flagship GDP estimates. Although BEA does not publish detailed annual real I-O estimates, they do publish annual price and quantity indexes for 65 detailed industries, including 19 manufacturing industries, which do require data on the real value of inputs.

As in the work at BLS, BEA attempts to make their adjustments at the most detailed level possible. For example, at BEA, the effort to construct updated values for intermediate inputs of goods and services entails making adjustment to approximately 3,500 different items, of which roughly 2,300 represent categories of goods. Ideally, and like BLS, BEA would like input price indexes *by industry for* each of the 1,179 six-digit NAICS level of detail. In practice, since the cost of producing that many separate price indexes could be prohibitive, like BLS, BEA would accept a set of *product-based* input price indexes. In addition, at a minimum, category definitions should be consistent with the 12 expense categories recently added to the Census Bureau's ASM forms (most of which are services inputs). While BEA currently only produces *annual* estimates of GDP-by-industry, there has been growing interest in providing these estimates on a *quarterly* basis.

In sum, although superficially the level of publication required to produce the currently published set of economic data is comparatively high, in actuality the detail necessary to properly support these estimates may be considerably more disaggregated.

Steps to Produce an Input Price Index

While there is little dispute over the potential advantages of adding an input price index to the family of price indexes produced by BLS, there is the fundamental question of both feasibility and cost of producing a usable and comprehensive set of indexes.

Developing a Sample

From a practical standpoint, the first and perhaps the biggest hurdle in developing an input price index is developing a frame from which to draw a sample of establishments. Although BLS has any number of frames from which to draw a sample of companies, the Bureau does not currently have access to data on the expenses and purchases of individual companies necessary to produce a representative sample. Without these data, a BLS field agent attempting to initiate a respondent into a survey would have no information on what that establishment buys in order to produce its outputs. While, in theory, the establishment might be able to supply these data, in

practice it is expected that this type of data collection would be very problematic given the voluntary nature of BLS programs.

All is not lost, however, as the Census Bureau does collect detailed data on purchases by individual establishment. In particular, in the Economic Census, which the agency conducts every 5 years, all manufacturing firms are asked to include detailed data (by 10 digit NAICS code) on their cost of materials, parts and supplies consumed in the reference year. The most recent data available covers the calendar 2007 Economic Census and became available in mid-2009. The dataset includes information for 340,000 manufacturing establishments in the United States, and the Census Bureau records the total cost of materials purchased by these establishments as approximately $2.5 billion in calendar 2007. Table B is part of the collection form for the MC-33702 Manufacturing, Household Furniture and Wood Housings sector where establishments report on their material costs. In addition, Table C has an example of the type of data that is publically available from Census. For NAICS 333111, one can find data on the number of companies and their total purchases and expenses, as well as an indication of their relative size. Table D shows data on cost of materials by type of material for that same industry, while Table E reflects the total purchases for ALL manufacturing industries of a given commodity.

In addition, the less comprehensive but timelier Annual Survey of Manufacturing, which is based on a sample of 50,000 manufacturing establishments, includes a limited amount of data on purchases, providing one category for total cost of materials, parts, containers, packaging, etc.

One shortcoming of these surveys is that, while data on capital expenditures is also collected, it is only split three ways: a) motor vehicles, b) computers and c) other. Another potential shortcoming of this source of data is its timeliness, or lack thereof. Since the detailed data is only collected once every five years, it may be that, by the time the BLS is able to draw a sample and initiate these establishments into a market basket, the establishments and/or the products that they buy may be out of date and no longer reflective of their current market.

Although much of the focus has been on the manufacturing sector, it should be recalled that the manufacturing component only accounts for a small and shrinking sector of the economy; services represent nearly 2/3 of GDP. The amount of detailed cost data collected by Census for the service industry surveys is more limited. In general the collection forms include some detailed data on purchased services, but only limited data on purchased equipment and materials.[5] Interestingly, while the Census collects very little detailed data on material costs in the non-Census years for manufacturing industries, the level of detailed data collected for the cost of business services, though limited, is roughly the same, whether it is for an annual survey or the every 5 year Census. In general, the surveys break out the purchases of business services into 5 categories: computer services, communication services, advertising and related services, professional and technical services, and repair and maintenance services.

Due to the more detailed cost of materials data available for the manufacturing sector, much of the current assessment of a potential sampling frame has focused on this sector. Unfortunately,

[5] For example, in contrast to the forms for the furniture manufacturing industries, the collection form for the parallel furniture wholesale (Table F: WH-42305) sector does not provide the same level of detail on material costs, while the collection form for the retail furniture industry (Table G: RE-44201) does not collect ANY information on the cost of materials.

because many of the datasets at the Census Bureau have data that has been 'commingled' with Federal Tax return Information (FTI) data from the Internal Revenue Service (IRS), getting access to the necessary data has been somewhat problematic. Work has continued for several years on what is referred to as 'Companion Legislation.'[6] Regardless, BLS staff have recently been able to access these data at the Census Research Data Center in Suitland and have begun the process of assessing the utility of using these data to draw samples which would permit the publication of input price indexes for the 471 six digit NAICS manufacturing industries. One concern is that a large percentage of the cost of materials purchased is in a miscellaneous purchase category.

Assuming BLS is able to use the Census data, this would allow BLS, using establishment sampling methodologies with which the Bureau is already quite familiar, to construct a sample of establishments, and detailed product areas within the given establishment, that the Bureau would need to collect the necessary pricing data. The selection of the actual item that the Bureau would need to reprice on a periodic basis would normally be done by a BLS field economist during a so-called **initiation** visit to the establishment. This procedure is one that is already done by staffers when collecting data for the Bureau's PPI and IPP industrial price programs, and involves a number of tradeoffs. Ideally the selection would be based on a probability proportionate to how much of a given item a company purchases within the selected category. Thus if a company buys a certain amount of varying types of steel, the field economist, using data hopefully supplied by the respondent, would be able to select a specific steel product that the BLS would attempt to collect data on. In practice, however, these procedures would likely have to take into account the fact that the selected item may not be purchased on a regular basis, or the respondent may not have any data available on how much of each different type of steel the company purchased in a given period. Since BLS already has experience with these types of issues in its current programs, developing an appropriate fallback procedures does not necessarily present a problem. However, it does lead in to what is perhaps the key issue to be faced, which is the ability of the Program to reprice the same item month after month, quarter after quarter or year after year, from the same source.

Pricing

Maintaining a constant set of items to reprice over time may prove the most intractable barrier to constructing a comprehensive set of input price indexes. While on the output side, companies tend to ship their goods (or offer their services) every month, it is not clear if they buy the same item on a regular basis, especially for capital equipment such as computers. This may place a heavier burden on the imputation method chosen for valuing prices in missing periods.[7] Alternatively, the BLS may have to use an altogether different approach, such as combining prices from different respondents (in cases where the item specifications are identical). A related question is how to handle changes in the pricing specifications. For example, if the product is the same but the supplier is different, do we continue to price it as the same item? What is our general approach towards quality adjustment when a buyer switches products and/or

[6] Legislation to modify the IRS tax code was proposed by the last Administration, with interagency support from the Departments of Treasury, Commerce, and Labor, in 2002-2003 and in 2008. Conversations have begun on the development of an official Obama Administration proposal, with Dr. Rebecca Blank, Under Secretary of Commerce for Economic Affairs, expected to take the lead in this effort.

[7] In constructing a sample for the import price index, the International Price Program has the advantage of accessing the universe of import transactions from the Customs Service, which allows for drawing a sample only of those items and importers who trade consistently over the course of a year.

suppliers? That is, in an ideal situation where we can get the exact information that we desire, what would we ask for? What are the acceptable fallbacks if we can't obtain the desired information? What if, in fact, the buyer uses multiple suppliers? Do we select a specific supplier or use some sort of average? If we select one, how and when do we switch to a price from a different supplier? Should the price include or exclude transportation costs? If other services are bundled with the product (e.g. installation), how do we handle those situations? Do we want to include Government purchases? If so, how would we sample for them since they wouldn't be included in data at Census? How do we coordinate requests for buyers prices with requests for sellers prices within the same firm?

In order to answer these and similar questions, the Bureau will most likely need to make some effort to collect information from a sample of representative companies. A final decision on some of these issues will probably entail balancing the requirements of a price index with the reality of the Agency's sometimes limited ability to collect data voluntarily from private industry.

Estimation formula

With one exception, compared to the questions associated with sampling and repricing, the issues surrounding the estimation formula are comparatively easy. Weights can either be derived from the sampling frame, from the respondents themselves, or from some combination thereof. One concern with using the weights derived from the sampling frame is the age of the data. Since the detailed data is collected only once every five years, the data may be out of date by the time they are actually used in the calculation of the indexes. A comparison of these values from one Census to the next may shed light on the volatility of these figures.

There are various questions associated with the actual formula to use such as using an arithmetic formula vs. a geomeans formula, but these do not present intractable barriers. One interesting aspect of the formula relates to theoretical differences between the price index formula for the output from a production function, versus the index formula for the price index for inputs into a production function. The theory assumes that a firm will attempt to maximize profits by minimizing costs while maximizing revenue. On the output side, theory tells us that an establishment will attempt to shift sales to its goods or services that over time are becoming relatively more expensive compared to its other outputs. In contrast, the firm would attempt to shift costs towards its expense categories that are becoming relatively cheaper. Consequently, a price index of firms' outputs would tend to show at least no decline in the relative quantity of the more expensive goods being sold, while on the cost side, the index should in theory reflect at least no increase in the goods or services that are more expensive. What is interesting, however, is these assumptions are based on partial equilibrium models where the model is only looking at one side of the equation. But, of course, one establishment's sales are another establishment's purchases, and in a general equilibrium model, there is no a priori theory of exactly what constitutes the correct direction of substitution.[8]

The one notable difficulty in estimating these indexes relates to how one goes about constructing industry-specific price indexes. While a product-based input price index would use every establishment's purchases of a specific good (or service), an industry-specific input price index would only use goods or services purchased by establishments in that specific industry. For

[8] For further elucidation, see Kim and To (2009)

example, presumably all establishments must purchase energy, be it electricity, gas, petroleum products, etc. Would the BLS attempt to calculate a separate energy index for each industry, or would it combine all energy data into one generic input energy index? The answer may ultimately be decided on practical grounds, (i.e. do we have enough data for separate energy series, or do each of the different energy series trend nearly the same?) Of course, a proxy for an industry-specific input price index could be constructed using individual product-level price indexes, but aggregating them using the proportions appropriate for a particular industry's purchasing patterns.

Next Step: Reality Check

As previously mentioned, the preliminary step in this effort to produce an input price index is to develop a set of questions for a limited set of respondents who in the past have proven cooperative to the BLS industrial price programs. The questions would be designed, not to collect specific pricing data from the establishments, but to provide BLS with some insights into how respondents are likely to respond to any such data collection requests. For example, some companies have refused to provide BLS with data, citing confidentiality concerns. Thus, one question might be designed to ascertain whether companies would be more likely, less likely, or equally as likely to supply data on costs as they are willing to supply output or import or export price data. Another basic question to ask respondents would be to ascertain if they even keep good data on the cost of their purchases, and if so what is the periodicity of their purchasing.

Developing a Pilot

A longer term effort to produce input price indexes can be broken down into four phases, based on availability of data. This effort will require additional approvals and funding as well. The four phases include:

1) Input Indexes covering manufacturers material costs,
2) Input Indexes covering manufacturers capital equipment costs,
3) Input Indexes covering manufacturers business services costs,
4) Input Indexes covering service industries material, capital equipment and business services costs

Ideally, each phase would start with a pilot prior to going into production. For each pilot, BLS will conduct research and develop the methodology, procedures, and systems associated with each of the following activities:

- Obtain permission from the Office of Management and Budget.
- Select a set of industries for the pilot.
- Evaluate the data sources that are available for a sampling frame. Due to the potential for detailed cost data from the Census of Manufactures, the first phase would focus on input indexes of cost of materials for manufacturing industries.
- Develop the collection materials and procedures and train staff.
- Select a sample of establishments for the pilot.
- Conduct the pilot test and evaluate the results.

- Evaluate the feasibility of producing an input price index for the given phase and develop the requirements for producing an input price index, including publication goals, required sample size, expected burden and estimated resources and timeframe for publication.
- Based on available resources, develop and maintain a production set of indexes for that particular set of input indexes.

Cost

Assuming the methodological and data collection issues can be resolved, and assuming the Bureau is able to collect the necessary data from respondents, there remains the question of the cost of developing and maintaining these new indexes. On the one hand, the collection, review and verification of data for inclusion in price indexes still has a significant labor-intensive component, usually requiring a substantial level of expertise in economics and/or statistics. On the other hand, a significant (but unknown) amount of the necessary resources, both in human capital as well as data processing applications, may be shared with the Bureau's other industrial price programs, (the IPP and the PPI). Any Bureau effort to produce an input price index past the research phase would require resources sufficient cover collecting approximately 15,000 items and publishing approximately 600 6-digit Material Codes (which are similar to NAICS codes). The process for developing these series would extend over several years. Extending the set of indexes to cover the three additional phases would entail an additional annual cost.

References:

Archibald, Robert B., 1975, "On the Theory of Industrial Price Measurement: Input Price Indexes," BLS Working Paper 44, May.

Houseman, Susan N., 2009, "Outsourcing and Offshoring: Problems for Price and Productivity Measurement and Implications for Labor Research," Upjohn Institute for Employment Research, March.

Kim, Mina and Ted To, 2009, "Input Prices Indices with International Trade.", unpublished manuscript, BLS. April

Kurz, Christopher and Paul Lengermann, 2008. "Outsourcing and U.S. Economic Growth: The Role of Imported Intermediate Inputs." Federal Reserve Board, paper prepared for the 2008 World Congress on National Accounts and Economic Performance Measures for Nations.

Nakamura, Emi and Jon Steinsson, 2009. "Lost in Transit: Product Replacement Bias and Pricing to Market." NBER Working Paper No. 15359.

Reinsdorf, Marshall B., Robert C Feenstra and Matthew Slaughter, 2007. "Effects of Terms of Trade Gains and Tariffs Changes on the Measurement of U.S. Productivity Growth."

Stigler, George, ed. 1961, *The Price Statistics of the Federal Government. Report to the Office of Statistical Standards,* Bureau of the Budget. New York, National Bureau of Economic Research.

Stigler, George and James K. Kindahl, 1970, *The Behavior of Industrial Prices*, National Bureau of Economic Research

Yuskavage, Robert E. Erich H. Strassner, and Gabriel W. Medeiros. 2008. "Outsourcing and Imported Inputs in the U.S. Economy: Insights from the Integrated Economic Accounts." Paper prepared for the 2008 World Congress on National Accounts and Economic Performance Measures for Nations.

Chart A:

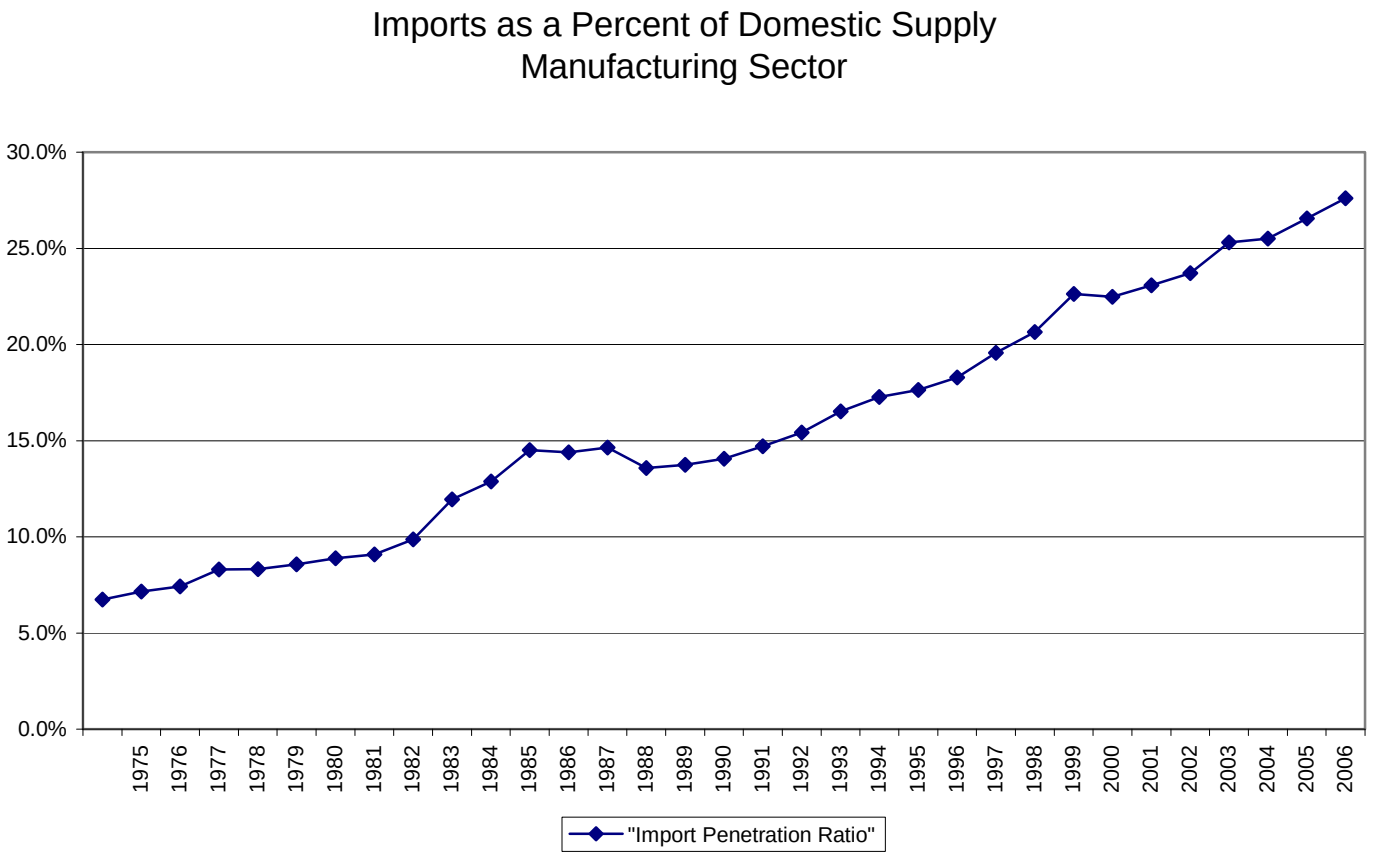
Imports as a Percent of Domestic Supply
Manufacturing Sector
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
"Import Penetration Ratio"

Table A:

Table 11. Producer price indexes and percent changes for net material inputs to industry stage of process and final demand, not seasonally adjusted

(June 1987=100)

Grouping 1/	Relative Importance	Unadjusted Index 2/			Percent changes					
					11 months ending	3 months ending--				Jun. 1996 To
	Jun. 1996	Mar. 1996 2/	Jun. 1996 2/	Jul. 1996 2/	Jul. 1996	Oct. 1995	Jan. 1996	Apr. 1996	Jul. 1996	Jul. 1996
Net material input to:										
Primary processors	100.000	122.5	123.3	123.7	7.7	-0.5	6.6	3.9	-2.3	0.3
Foods and agricultural products	18.073	154.5	176.9	182.1	47.4	6.2	13.7	11.3	9.6	2.9
Crude food and agricultural products	12.810	166.6	196.3	203.9	56.5	6.0	15.1	15.3	11.2	3.9
Processed foods	5.263	138.9	148.9	150.0	29.5	6.5	11.8	2.8	5.9	0.7
Energy	33.965	111.9	108.2	109.5	16.1	-1.7	17.6	10.3	-8.9	1.2
Goods less food and energy	47.963	132.9	131.7	129.9	-7.2	-1.0	-2.4	-2.4	-1.7	-1.4
Mining products less energy	1.222	117.9	118.1	113.7	-5.7	-2.3	0.9	-0.8	-3.6	-3.7
Nondurables less food and energy	32.051	132.0	130.0	128.5	-8.5	-0.9	-3.3	-3.0	-1.7	-1.2
Durables	14.691	136.6	136.9	134.9	-4.3	-1.1	-0.9	-1.1	-1.3	-1.5
Semifinished processors	100.000	119.6	121.8	121.6	0.7	0.5	-0.7	-0.6	1.5	-0.2
Foods and agricultural products	24.614	100.5	107.4	109.0	11.2	3.7	0.1	-0.8	8.0	1.5
Crude food and agricultural products	22.869	99.1	106.1	107.8	11.1	3.6	-0.2	-1.0	8.6	1.6
Processed foods	1.745	119.4	125.0	125.3	11.9	3.9	2.9	2.2	2.4	0.2
Energy	6.486	142.5	151.1	150.5	4.2	-3.3	1.0	4.2	2.3	-0.4
Goods less food and energy	68.900	127.8	127.5	126.6	-2.9	-0.2	-1.1	-0.9	-0.8	-0.7
Mining products less energy	2.075	115.5	116.0	107.3	-11.5	0.4	-3.0	-2.6	-6.8	-7.5
Nondurables less food and energy	30.612	130.1	128.7	128.2	-3.3	0.2	-1.1	-1.4	-1.0	-0.4
Durables	36.212	126.2	126.9	126.2	-2.0	-0.5	-0.9	-0.5	-0.2	-0.6
Finished processors	100.000	120.8	121.4	121.1	0.6	0.2	0.2	0.0	0.2	-0.2
Foods and agricultural products	12.453	124.8	130.7	130.2	13.3	2.9	3.6	2.3	4.0	-0.4
Crude food and agricultural products	4.063	135.0	139.2	139.1	25.8	5.5	11.0	2.9	4.4	-0.1
Processed foods	8.390	120.0	126.7	126.0	7.6	1.7	0.1	1.9	3.7	-0.6
Energy	3.274	144.9	153.2	152.8	3.0	-3.3	0.4	2.9	3.1	-0.3
Goods less food and energy	84.273	120.5	120.2	119.9	-1.1	0.1	-0.2	-0.5	-0.4	-0.2
Mining products less energy	0.067	118.7	119.3	118.0	2.3	-0.1	1.7	1.2	-0.6	-1.1
Nondurables less food and energy	32.856	128.8	128.0	127.7	-1.8	0.2	-0.5	-0.8	-0.5	-0.2
Durables	51.350	115.9	115.9	115.7	-0.6	0.0	-0.1	-0.3	-0.3	-0.2
Final demand	100.000	124.1	125.7	125.5	2.8	0.4	0.7	1.1	0.6	-0.2
Consumers	74.448	125.3	127.5	127.3	3.4	0.2	0.9	1.4	0.9	-0.2
Foods and agricultural products	23.388	123.1	124.9	124.9	5.3	1.3	1.2	0.7	1.9	0.0
Crude food and agricultural products	2.086	160.0	152.3	145.2	19.3	4.4	12.4	3.6	-1.8	-4.7
Processed foods	21.302	120.0	122.5	123.1	4.2	1.1	0.3	0.5	2.2	0.5
Energy	14.534	141.3	150.0	149.3	5.6	-3.4	2.1	6.0	0.9	-0.5
Consumer goods less food and energy	36.526	127.9	128.4	128.2	1.6	1.0	0.3	0.0	0.2	-0.2
Mining products less energy	0.013	123.0	124.7	124.6	2.9	0.2	1.3	-0.3	1.7	-0.1
Nondurables less food and energy	19.914	133.2	134.2	134.2	1.6	0.5	0.5	0.1	0.6	0.0
Durables	16.599	120.5	120.4	120.1	1.5	1.6	0.2	-0.1	-0.2	-0.2
Capital investment	25.552	121.3	121.1	121.0	0.9	0.9	0.2	-0.1	-0.2	-0.1
Special groupings:										
Final demand less foods and agricultural products	76.612	124.5	126.1	125.9	2.1	0.2	0.6	1.0	0.2	-0.2
Final demand less energy	85.466	124.5	125.1	125.0	2.3	1.1	0.5	0.2	0.5	-0.1
Final demand less food and energy	62.078	125.1	125.3	125.2	1.3	1.0	0.2	0.0	0.1	-0.1
Consumer goods less energy 4/	80.477	125.9	126.9	126.8	3.0	1.1	0.6	0.3	0.9	-0.1
Consumer goods less foods and agricultural products 4/	68.585	126.9	129.4	129.1	2.7	-0.2	0.7	1.7	0.5	-0.2
Consumer nondurables less food and energy 4/	46.272	131.1	135.0	134.7	3.1	-1.1	1.1	2.5	0.7	-0.2

[1] The indexes in this table are derived from the product indexes in table 5. These indexes are composed of the goods used by the industries in each of the industry stage of process output indexes as shown by the 1977 input/output

[2] The indexes for March 1996 have been recalculated to incorporate late reports and corrections by respondents. All indexes are subject to revision 4 months after original publication.

Table B:

2007 Economic Census: MC-33702 Manufacturing, Household Furniture and Wood Housings

17 DETAILED COST OF MATERIALS, PARTS, AND SUPPLIES

Materials, parts, and supplies 0634	Census material code 0630	Consumption of purchased materials and of materials received from other establishments of your company — Cost, including delivery cost (freight-in) $ Bil. 0631	Mil.	Thou.
Wood furniture frames	337215 00			
Lumber, rough and dressed				
Hardwood	321000 25			
Softwood	321000 31			
Plywood, hardwood and softwood	321000 91			
Hardwood veneer	321211 04			
Particleboard (wood)	321219 02			
Medium density fiberboard (MDF)	321219 06			
Hardboard (wood fiberboard)	321219 09			
Hardwood cut stock and dimension (excluding furniture frames)	321912 03			
Furniture and builders' hardware, including cabinet hardware, casters, glides, handles, hinges, locks, etc.	332510 01			
Coated and laminated fabrics, including vinyl coated	313320 06			

Table C:

NAICS 333111
Farm Machinery and Equipment Manufacturing

Companies	Establishments with 100 employees or More	Total Value of Shipments ($1,000)	Total Capital expenditures ($1,000)	Total Cost of, Purchased materials ($1,000)
1,079	104	$21,181,238	$348,399	$9,903,172

Table D:

NAICS 333111
Farm Machinery and Equipment Manufacturing
(Cost of Materials)

Material Code	**Description**	**Delivered cost ($1,000)**
971000	Materials, ingredients, containers, and supplies, nsk	2,718,394
970099	All other materials/components/parts/containers/supplies	967,152
33000019	Engines (diesel/semidiesel/gasoline/carburetor-type/etc.) & parts	680,000
33000067	Fluid power products, hydraulic and pneumatic	607,834
33100022	Steel sheet and strip (including tinplate)	586,586
33200046	Other fabricated metal products (excl. Forgings/castings etc.)	504,553
32621103	Pneumatic tires and inner tubes	389,781
33635003	Transmissions and parts	288,496
33100025	Steel struct shapes & sheet piling (excl castings/forgings/etc.)	286,917
33361200	Mechanical speed changers, gears, & ind. high-speed drives	281,122
33120092	All other steel shapes/forms (exc. castings/forgings/etc.)	280,209
33151001	Iron and steel castings (rough and semifinished)	268,893
33632200	Engine electrical equip. (incl. spark plugs/magnetos/etc.)	226,547

Table E:

Expenditures on Fluid Power products (Material Code 33000067) by Industry

NAICS Code	Description	Delivered cost ($1,000)
333111	Farm machinery and equipment manufacturing	607,834
333112	Lawn and garden equipment manufacturing	218,356
333319	Other commercial and service industry machinery manufacturing	422,091
333512	Machine tool (metal cutting types) manufacturing	66,118
333513	Machine tool (metal forming types) manufacturing	43,371
333516	Rolling mill machinery and equipment manufacturing	12,355
333518	Other metalworking machinery manufacturing	29,007
333611	Turbine and turbine generator set units manufacturing	4,687
333618	Other engine equipment manufacturing	284,283
336312	Gasoline engine and engine parts manufacturing	268,662
336330	Motor vehicle steering and suspension parts	89,222
336340	Motor vehicle brake system manufacturing	47,397
336350	Motor vehicle transmission and power train parts manufacturing	237,914
336399	All other motor vehicle parts manufacturing	405,854

Table F:

2007 Economic Census: WH-42305 Wholesale, Furniture and Home Furnishings

11–15 Not Applicable.

16 SELECTED EXPENSES

	Mark "X" if None	2007 $ Bil.	2007 Mil.	2007 Thou.
A. Operating expenses *(Include payroll. Exclude cost of goods sold and interest expense.)* 0140	☐			
B. Purchases of merchandise for resale, net of returns, allowances, and trade and cash discounts *(Include amounts allowed for trade-ins.)* 1160	☐			

C. For the value reported on line B, were any of these goods ordered over an Internet, Extranet, Electronic Data Interchange (EDI) network, electronic mail, or other online system?

0441 ☐ Yes

0442 ☐ No

0443 ☐ Do not know

Table G:

2007 Economic Census: RT-44201, Retail Furniture Stores

Form RT-44201 (12/01/2006)

If not shown, please enter your 11-digit Census File Number (CFN) from the mailing address. ▶
8–**18** Not Applicable.
19 KIND OF BUSINESS Which ONE of the following best describes this establishment's principal *(Mark "X" only ONE box.)*