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## **Outsourcing and Offshoring: Problems for Price and Productivity Measurement**

Susan N. Houseman  
Upjohn Institute for Employment Research  
[houseman@upjohninstitute.org](mailto:houseman@upjohninstitute.org)

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The lowering of communications costs, transportation costs, and trade barriers coupled with economic reform and rapid development in many countries such as China have stimulated tremendous growth in world trade. Imports and exports expressed as a percent of U.S. GDP grew from 20 percent in 1989 to 29 percent in 2007. Most of the increase in the relative importance of trade in the U.S. economy is accounted for by the expansion of imports, and most of the import growth, in turn, is accounted for by imports from developing countries. Imports from China alone made up 39 percent of the growth in imports since 2000.

Most imports, whether purchased for further processing or for distribution to final consumers, may be broadly classified as intermediate inputs, and it is in this broad sense that I use the term intermediate input in this paper. As communications costs, transportation costs, and trade barriers have fallen and as developing countries have instituted reforms and improved economic capabilities, the optimal sourcing of intermediate inputs has rapidly changed. The shift of the sourcing of intermediate inputs from domestic to foreign producers—often referred to as offshore outsourcing or offshoring in the literature—is driven by factor price arbitrage. The substitution of lower-cost auto parts from Mexico and China for domestically produced parts is an example of offshore outsourcing or offshoring of intermediate inputs in manufacturing (auto assembly) as well as services (auto repair). The move from suppliers with domestic production to suppliers with production in lower-cost countries such as China illustrates offshore outsourcing of “inputs” in the retail or wholesale trade sectors in which imported goods do not undergo further processing.

The growth of offshore outsourcing and offshoring and associated growth in imports from low-wage countries has spurred numerous academics and policy analysts to study its implications for U.S. economy, most notably for productivity, employment, wage levels, and inequality. The purpose of this paper is not to weigh in on the costs, benefits, or distributional impacts of the trade. Rather, it is to argue that the data are not suitable for making such assessments.

Input price declines, which are the salient feature of offshore outsourcing and offshoring, are not generally captured in import price statistics. As a consequence, the value of real imports is understated and GDP, industry value-added output measures, and productivity will be overstated. This mismeasurement will tend to bias studies against finding employment and wage effects from import growth.

I begin the paper by reviewing previous studies that also have argued that the growth of imports from developing countries may significantly bias prices, output, and productivity measures. In an early study, Mishel (1988) noted that, as a result of outsourcing, imported inputs were becoming increasingly important in manufacturing, yet import prices were not used in the construction of real Gross Product Originating (GPO) statistics. At the time, Mishel was particularly concerned that price deflators were not capturing the appreciation of the dollar against other currencies and hence that manufacturing value-added was overstated. A more recent literature models the growth in trade as resulting in an increase in product variety for consumers. Because the increase in consumer surplus from any increase in product variety is not measured in price statistics, it is argued that import prices are overstated (Broda and Weinstein 2006; Feenstra, Reinsdorf, and Slaughter 2008).

Building upon observations made in an earlier paper (Houseman 2007), I draw a sharp distinction between the previous literature on import price measurement and the principal measurement issues arising from the growth of offshore outsourcing and offshoring, which are primarily motivated by the reduction of input costs for any given product—not by the introduction of new products. I discuss two types of problems in measuring input price drops with outsourcing. In the first instance an organization outsources a task previously performed in-house. This unbundling of the production process results in a “new” input, whose price was not previously observed. In the second type, an organization obtains an input through an arms-length transaction, but switches sources. Because the construction of input price deflators assumes stable sourcing, this price drop is not captured either (Mandel 2007, Alterman 2008). Although

the focus of this paper is on foreign outsourcing, I note that the measurement issues are similar in cases of domestic outsourcing.

The bias in input price indexes that results from switching sources for intermediate inputs is analogous to the outlet substitution noted in the literature pertaining to biases in Consumer Price Index. Just as the outlet substitution bias can be addressed by sampling consumers on their purchase prices, the bias resulting from changes in sourcing may be addressed through the construction of an input price index, as proposed by Alterman (2008). In other words, in both instances, biases resulting from changes in the sourcing of purchases may be addressed by sampling the purchasers rather than the sellers. Addressing biases that result when organizations outsource tasks previously performed in-house is more challenging, because the input price for that task may not be observed in the preceding period and may not be easily constructed.

The biases to import prices affect aggregate and industry level output and productivity statistics as well as the validity of studies based on these statistics. Recent evidence of substantial growth in the use of imported intermediate inputs among manufacturers suggests that biases to estimates of output and productivity may be greatest in this sector. In addition, although numerous studies have sought to determine the effects of foreign outsourcing on the U.S. economy and its workers, I argue that the data are not suitable for examining these issues. I illustrate the problems the data pose for the methodologies utilized in several prominent studies and point out that failure to measure input price drops that result from foreign outsourcing tend to bias studies against finding effects of such outsourcing.

## **1. Prior Literature on Measurement Issues related to the Growth of Imports**

The idea that output and productivity, particularly in the manufacturing sector, are overstated due to the growth of imports is not new. Two decades ago Mishel (1988) asserted that manufacturing output and productivity growth in the 1980s were lower than government estimates, in part, because of the growth in imported intermediate inputs. Mishel argued that because, at the time of his writing, import price indexes were not used to deflate purchased inputs

and import prices had risen less rapidly than domestic inputs, estimates of manufacturing value-added and productivity were overstated. Although international price series were subsequently used in conjunction with the PPI to deflate intermediate inputs, input price declines resulting from offshore outsourcing and offshoring were still not measured for the most part, as is explained below.

A more recent literature focuses on price measurement problems associated with import growth in the context of trade models that assume product differentiation and monopolistic competition. The essential argument in this literature is that the growth in imports results in an increase in product variety and that consumer surplus from the increase in product variety is not measured. As a consequence, import price growth is overstated and the growth in real imports is understated. This, in turn, implies that domestic output and productivity are overstated (Feenstra 1994, Broda and Weinstein 2006, Feenstra, Reinsdorf and Slaughter 2008). Broda and Weinstein develop a methodology for measuring the welfare gains from increases in product variety associated with the growth of imports. Extending the work of Broda and Weinstein, Feenstra, Reinsdorf and Slaughter estimate the overstatement of domestic output and productivity growth from the growth in product variety due to increased imports.

Both the Broda and Weinstein and the Feenstra, Reinsdorf and Slaughter papers define a variety as a particular product from a specific country. For mathematical tractability, their models assume that imported goods are separable from domestic goods in consumers' utility functions and hence the substitution of foreign for domestic goods is not explicitly considered. This approach has been criticized on the grounds that growth in trade does not necessarily increase total product variety when domestic variety is taken into account (Arkolakis et al. 2008, Baldwin and Forslid 2004). In addition, Arkolakis et al. show that welfare does not depend on variety under different model assumptions.

More important for the purposes of this paper, any mismeasurement of prices owing to the growth of import variety generally is not applicable to the circumstances of offshore outsourcing

or offshoring. If new varieties are close substitutes for existing or disappearing varieties, there is little gain to consumers from the introduction of the new variety and hence little distortion to price indexes. In the limit, if the new product is the same as the domestically produced product, there is no increase in product variety and no distortion to prices. This may be seen from the term that captures the bias to the exact price of a good with the introduction of product variety in Broda and Weinstein (2006, equation 11):

$$\left( \frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{1/(\sigma_g - 1)}$$

The term  $\lambda_{gt}$  is the ratio of expenditures on varieties that are available in both periods relative to the full set of varieties available in the current period  $t$ . If there is no change in varieties over time, the expression inside the bracket is 1, and there is no bias to the price index. Similarly,  $\sigma_g$  is the elasticity of substitution between varieties of the good. As varieties become closer substitutes,  $\sigma_g \rightarrow \infty$  and  $1/(\sigma_g - 1) \rightarrow 0$ , and there is little or no bias in price measurement.

True new varieties are difficult to observe in the data. The literature on import growth and product variety typically defines variety as a detailed product imported from a specific country. In addition to the Arkoloks et al. (2008) critique that these imports may displace domestic varieties, Krugman (2008) points out that there may be a problem of product aggregation in the data. With the growth of offshore outsourcing, imports of a particular product category from various countries may simply represent the same product at different stages of processing. Krugman cites examples of this phenomenon from the IT sector, which is the focus of the import product variety study by Feenstra, Reinsdorf, and Slaughter (2008). Furthermore, the literature implicitly assumes that the market is in equilibrium at any point in time. Yet, the introduction of a new, lower-cost imported input or consumer product does not displace its imported or domestic counterpart instantaneously. The coexistence of imports and domestic products at a detailed classification level at any point in time may represent the equilibrium

coexistence of different varieties, or it may represent a point along an adjustment path in which the import is displacing an import from another country or a domestically produced good.

In sum, it is difficult to observe the degree to which the increase in imports represents new product variety and the degree to which it represents the substitution of relatively homogeneous, lower-cost foreign inputs for domestic inputs, with little or no change in product variety offered to consumers. However, I present some evidence suggesting that the latter characterizes much of the growth of trade. Import price growth is overstated when such offshore outsourcing and offshoring occurs, but, as detailed below, the measurement issues are distinctly different from those discussed in the import variety literature.

## **2. Changes in Sourcing of Intermediate Inputs: Some Definitions and Evidence of Growth**

The measurement problems associated with offshore outsourcing and offshoring are part of broader set of price measurement problems that result when organizations change sources for intermediate inputs. Although the focus of the paper is on foreign outsourcing and the associated growth of imports, I discuss the analogous problems that arise from domestic outsourcing.

An organization may outsource the production of a particular task or input previously performed in-house to a domestic supplier (domestic outsourcing), to a foreign supplier (offshore outsourcing), or to a foreign affiliate (offshoring). A manufacturer that uses a staffing agency in lieu of directly hiring workers is an example of domestic outsourcing; a bank that outsources back office functions to an Indian company is an example of offshore outsourcing; and a manufacturer that sets up a factory in China to produce the first stage of a good and finishes it in the United States is an example of offshoring.

In addition, I consider the case in which the organization already purchases the good or service in an arms length transaction, but switches from a domestic to a foreign supplier. A retailer that shifts from a domestic to foreign supplier to stock a particular good exemplifies this type change in sourcing, which sometimes is also labeled offshore outsourcing.

The driving force behind outsourcing, offshoring, and other changes in input sourcing is factor-price arbitrage: the substitution of a lower-priced input for an input produced internally or purchased from a domestic supplier. The salient feature of outsourcing and offshoring thus is the reduction of production costs for any given good or service. Although a change in the sourcing of inputs may result in some change in product quality, for ease of exposition and to distinguish from the product variety literature, below I assume that the inputs acquired through outsourcing or offshoring are identical to those they replace.

In the international trade literature, models of changing comparative advantage are appropriate for understanding the dynamic process of offshore outsourcing and offshoring, which to a large degree involves outsourcing to developing countries. Vernon (1966) described a process by which the optimal location of production might change from advanced to developing countries as a product matured and became standardized. The process of offshore outsourcing and offshoring is different in important respects than that originally conceptualized in Vernon's product cycle theory of international trade, however. About 46 percent of trade occurs among financially related parties, and often offshoring involves not the shift in location of an entire product or service, but rather a particular task or stage of production. This dividing up of the production process across countries—or what variously has been termed the “slicing up of the value chain (Krugman, Cooper, and Srinivasan 1995) and “disintegration” of the production process (Feenstra 1998)—poses special measurement problems, as discussed below.

In addition, changes in comparative advantage and the optimal location of production were previously seen as occurring relatively slowly. However, over the last couple of decades a combination of factors has lowered the costs of trade and hence appears to have driven the growth in offshore outsourcing and offshoring. A series trade agreements, including the Tokyo Round of the General Agreement on Tariffs and Trade (GATT) in 1979, the Uruguay Round of GATT in 1993, and the North American Free Trade Agreement (NAFTA) of 1994, have reduced trade barriers. The reduction in transportation costs, in large part due to the development of container

shipping, greatly improved the competitiveness of developing countries as a location for manufactured goods (Levinson 2005). Similarly, the development of the Internet and the lowering of other communications costs have enabled the offshoring of many services tasks previously considered “un-tradeable”. Economic and political reforms in China, Russia, and Eastern European countries over the last two decades have opened up large areas of the world to trade. At the same time, rapid economic development in China and other Asian and Latin American countries have made them more competitive as locations of production. Economic reforms and development coupled with declining transportation and communication costs, not reduction of trade barriers, likely explains the explosive growth in trade with China (Hummels, Ishii, Yi 2001, Krugman 2008).

Figure 1 illustrates the growing importance of trade in the U.S. economy. Total trade—imports and exports of goods and services—as a percent of GDP increased from about 20 percent in 1989 to 29 percent in 2007. The growth in the relative importance of trade is primarily attributable to the growth of imports, which as a percent of GDP increased from under 11 percent in 1989 to 17 percent in 2007. Moreover, imports from developing countries accounted for the majority and an increasing share of that growth. From 1989 to 2000, developing countries accounted for 56 percent of the growth in non-oil imports and 70 percent of the growth from 2000 to 2007. The growth in imports from China has been particularly dramatic. Imports from China, which made up just 13 percent of the growth of non-oil imports from 1989 to 2000, accounted for 39 percent of the growth from 2000 to 2007 (Figure 2). Because imports are expressed in nominal dollars and imports from developing countries tend to be priced significantly lower than comparable goods and services produced domestically, these figures underestimate the importance of the growth of imports in terms of real goods and services, as is discussed further below.

The growth of imports from China and other developing countries is only suggestive that these imports may be substituting for domestically produced inputs and that problems in measuring the real value of these imports is potentially important. Recent studies by Yuska

Strassner, and Mediros (2008) and Kurz and Lengermann (2008) provide more direct evidence of substantial substitution of imported for domestic inputs over the period from 1997 to 2005. Both studies find that the growth in imported intermediates was especially strong in manufacturing and accelerated over the 1997 to 2005 period. Kurz and Lengermann estimate that over two-thirds of imported intermediate commodities are used in manufacturing. Moreover, both studies find dramatic growth in the share of intermediate inputs sourced from overseas by manufacturers, particularly since 2002. Yuskavage, Strassner, and Mediros estimate that the import share of intermediate inputs in manufacturing grew by 48 percent between 1997 and 2006, increasing from 13.5 percent to 20.0 percent.

In addition, Yuskavage, Strassner, and Mediros find substantial growth in domestic providers of outsourcing services—which they define as a subset of purchased services for functions that an establishment could itself perform. Yuskavage, Strassner, and Mediros estimate that from 1982 to 2006 domestic providers of outsourcing services increased from 7 percent to 12 percent of GDP. They estimate that domestic outsourcing was especially strong in durable goods manufacturing.

The findings of both studies are subject to caveats concerning the data underlying the estimates. Estimates for the entire 1997 to 2005 time period are based on the structure of input use in the BEA 1997 benchmark input-output tables and hence assume that input structure has not changed. In addition, use of imported versus domestic inputs are not distinguished in the data. Consequently, these studies, like all previous studies of imported intermediate inputs, assume that the fraction of any particular imported good or service used as an input in an industry is the same as the overall fraction of that good or service used in the industry—the so-called import comparability assumption. Particularly when sourcing patterns are rapidly changing, as appears to be the case over the estimation period, both assumptions are likely to be violated in non-trivial ways. Nevertheless, these studies generally provide strong evidence of the importance of the

growth of domestic outsourcing and imported intermediate inputs in the domestic economy, even if the estimates for specific industries may be imprecise.

### **3. Price Measurement Problems Associated with Changes in Sourcing**

Factor price arbitrage to a large degree drives changes in input sourcing. Yet, the price drops intrinsic in outsourcing, offshoring, and other changes in the sourcing of inputs, for the most part, are not captured in national statistics. As a result, the real value of these new inputs is understated, the growth of real sector value-added or of sector value-added and domestic output is overstated, and associated productivity growth overstated.

#### **3.1 Outsourcing and Offshoring**

Consider first measurement problems associated with domestic and foreign outsourcing and offshoring, which I addressed in Houseman (2007). In these cases, there is a shift from domestic, internal production of an input to the production of that input by a domestic contractor or an offshore producer. This unbundling of the production of a good or service often entails the reclassification of inputs, and any input price drop is not measured across input categories.

In Houseman (2007) I discussed a simple example of domestic or offshore outsourcing of labor by a manufacturer. If a manufacturer cuts its employees' wages there will be no first order effect on productivity. In particular, although there may be reallocation among inputs in response to the price change, if the quantity of each input does not change, nothing real has changed and measured productivity is the same. If instead the manufacturer implements, in effect, a wage cut by purchasing labor services from a domestic or foreign contractor, the labor input is now labeled purchased services input, the input price drop is not measured, and labor cost savings from the outsourcing are factored into productivity growth.

Formally, the KLEMS multifactor productivity model for manufacturing may be written as:

$$\dot{A} = \dot{Q} - [w_k \dot{K} + w_l \dot{L} + w_{lp} \dot{IP}]$$

$\dot{A}, \dot{Q}, \dot{K}, \dot{L}$  and  $\dot{IP}$  measure the change in the logarithm of multifactor productivity, output, capital, labor, and intermediate purchases, respectively, in time  $t$  and  $t-1$ ; the weights,  $w$ , are computed as the average share of production costs in adjoining periods  $t$  and  $t-1$ . Thus, the rate of change in multifactor productivity is the rate of change in real output less a weighted average of the rate of change of inputs. If the manufacturer cuts the wages of its employees, there should be no first order effect on measured productivity. If all real input use remains the same, labor (measured in hours worked) will remain the same, and  $\dot{A} = \dot{Q} = \dot{K} = \dot{L} = \dot{IP} = 0$ . Similarly, if the manufacturer contracts out certain labor tasks and the cost of the contract labor, relative to its productivity, is the same as employees, then measured productivity will remain the same if all other input use remains the same,  $w_l \dot{L} = w_{ip} \dot{IP}$ . If, however, the manufacturer contracts out labor services to take advantage of lower-priced labor (relative to its productivity), then the effective input price drop is not measured because it occurs across input categories—labor and purchased services—and there will be a first order effect of the input price drop on measured productivity. Even if all real inputs remain the same, labor is now measured as purchased services and  $|w_l \dot{L}| > |w_{ip} \dot{IP}|$ . Consequently, the outsourcing of labor will result in an increase in measured productivity even if no change in real input use occurs.

As I previously noted, in effect, when an organization outsources certain inputs, the construction of the productivity statistics implicitly assumes that any lower payment for that factor of production reflects lower productivity (Houseman 2007). Yet, the growth of outsourcing and offshoring presents *prima facie* evidence that this is not the case. In essence, the price and productivity statistics are not designed in a way that permits capturing the dynamic adjustment process that occurs in outsourcing and offshoring.

The outsourcing of labor is an example of a broader phenomenon in which factor price arbitrage and associated input price drops, a driving force of the outsourcing and offshoring phenomenon, are not captured in price statistics. Mann (2004) points out that when an organization offshore outsources or offshores a particular task, the price of that service input was not previously observed but rather was bundled into the production of the product. While the old domestic price of the service is not measured, neither is the new international services price; initiatives to develop international service prices in the area of business and professional services were discontinued owing to budget constraints. Mann points to the growth of services offshoring to argue for development of such international services price statistics. To actually fully capture the drop in the price of the service when services offshoring occurs, however, one would have to develop an implicit domestic price prior to offshoring and link the two.

The problem is not limited to services outsourcing. Take, for example, a company that offshores the first stage of production of a product but keeps the final processing in the United States. The import of the semi-finished product enters as a new input; its implicit domestic price was never previously observed because it was bundled into the production of the final product, and the price change that occurs with the offshoring of that component is not measured. Note that although the imported product was never previously observed, it does not constitute a new good or an increase in variety for the consumer, as assumed in the international trade and product variety literature.

### **3.2 Change in Suppliers**

Domestic and foreign outsourcing, which involves the unbundling of inputs in the production process, represents one way in which the sourcing of inputs in production is changing. In addition, organizations that already acquire inputs through arms length transactions may change suppliers. Here I focus on shifts from domestic to foreign suppliers, which also is sometimes referred to as offshore outsourcing. As with outsourcing, a change from domestic to foreign suppliers is typically driven by lower prices and the input price drop is not measured.

BLS maintains an index of imported goods as part of its International Prices Program (IPP), and an index of domestically produced inputs in its producer price index (PPI). Because there is no link between the two indexes, any input price drop resulting from the shift from domestic to foreign supplier is not measured (Mandel 2007). Analogous to the situation discussed above in which labor is treated as a different input (purchased services) when it is outsourced, the foreign and domestically produced goods are treated as different intermediate inputs in the price statistics.

Besides shifting from a domestic to a foreign supplier, organizations may shift among foreign suppliers. The IPP program measures import prices through a survey of importers. Hence, a drop in the imported input price will be captured if the importer itself shifts sources. However, it will not be captured if an organization acquires new inputs from a different importer.

#### **4. Parallels to Outlet Substitution Bias in CPI Literature and Possible Solutions**

The fact that price indexes do not record drops that occur when organizations change sources for their intermediate inputs is similar in many respects to the bias in the CPI that occurs when consumers shift from one retail outlet to another to take advantage of lower prices—the so-called outlet substitution bias (Reinsdorf 1993, Diewert 1993, Hausman 2003). Discount stores such as Wal-Mart, Best Buy and Circuit City have captured a growing share of the retail sales market in the United States, driving out higher-priced, often smaller retailers. The basic unit of observation in the construction of all price indexes is the change in price of a specific product from one period to the next period at a specific retailer (for the CPI), producer (for the PPI), or importer (for the IPP). In other words, prices for specific products are not averaged in a particular period across retailers, producers or importers. Although constructing price indexes in this way better ensures that measured price changes are between identical goods, it does mean that the price indexes fail to capture price drops associated with shifts in “sourcing” by consumers or producers.

Giving a greater weight to discount chains in the CPI as they expand market share does not solve the problem; the lower price growth consumers experience by shifting from one retailer to a lower-priced retailer is not captured in the CPI because the same goods purchased at different retail outlets are implicitly treated as different goods and hence the price drop resulting from outlet substitution cannot be captured (Hausman 2003). In the same way, giving greater weight to international prices in constructing estimates of intermediate inputs does not solve the problem of overstated output and productivity measures that result from foreign outsourcing because the imported inputs implicitly are treated as different inputs from the domestic inputs for which they are substituted.<sup>1</sup> Just as lower-priced goods at Walmart implicitly are treated as inferior in the construction of the CPI (Hausman 2003), lower-priced foreign inputs implicitly are treated as less productive in the construction of domestic output and productivity measures (Houseman 2007).<sup>2</sup> And just as the rapid growth in the share of sales accounted for by discount retail outlets suggests that such an assumption is not fully justified, the rapid growth of foreign intermediate inputs from developing countries indicates that lower prices of foreign inputs are not fully offset by lower productivity.

In order to capture price declines that result from changes in sourcing, the purchaser rather than the seller must be the source for price information on specific products. Indeed, emerging research that collects data directly from consumers who use home scanners is designed to address the problem of outlet substitution bias, among other measurement problems, in the CPI (Hausman and Leiptag 2007). Similarly, Alterman (2008) has proposed constructing an input

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<sup>1</sup> Partly as a response to criticisms by Mishel (1988) and others that sectoral output and productivity measures were overstated due to the growth in outsourcing, the BEA began estimating foreign and domestic input use and separately deflating them. See Yuskavage, Strassner, and Medeiros (2008) for a discussion of these changes.

<sup>2</sup> In Houseman (2007) I discussed effects on productivity measurement in manufacturing. The gross output measure used in labor and multifactor productivity measures in manufacturing, which only nets out purchases made among manufacturers—not other intermediate input purchases including imports—is not biased.

price index to address the failure of the PPI and IPP to capture shifts in the sourcing of intermediate inputs.

Note, however, that the construction of an input price index will not, by itself, resolve problems in measuring price changes that result from outsourcing and offshoring in which the production process is unbundled. As discussed above, in these cases, prices for the tasks being outsourced may not have been previously observed as input prices. Although the observed outsourced inputs may be new, the final product produced for consumers may essentially be the same, and hence the analogy to the “new goods” problem in the CPI literature is not appropriate. Using the terminology from that literature, the “virtual price” of the new imported input in the period prior to its introduction equals the price of the domestically produced input for which it is substituted in cases where the two inputs are exact substitutes. To capture any implicit price drops resulting from outsourcing presumably would require that information be collected directly from the organizations engaging in the outsourcing on the magnitude of the cost savings.

## **5. Implications of Measurement Problems for Statistics and Research**

Price declines resulting from the substitution of imported for domestically produced inputs results in an understatement of real imports. The understatement of real imports, in turn, leads directly to an overstatement of GDP, sectoral value-added, and productivity measures. The overwhelming majority of imports are manufactured goods and an estimated 65 percent are used as intermediate inputs by domestic manufacturers.<sup>3</sup> Recent studies point to evidence of particularly strong growth of imported intermediate inputs in the manufacturing sector. Hence, the overstatement of output and productivity measures caused by mismeasurement of imports is likely to be particularly important in manufacturing industries.

Arguably, as important as the direct effect of import price measurement problems on aggregate and industry output and productivity statistics are the implications for the research that utilizes these statistics to draw causal inferences about the effects of offshore outsourcing,

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<sup>3</sup> Robert Yusavage provided this unpublished BEA estimate.

offshoring, and associated growth of imports from developing countries on the U.S. economy and its workers. Although numerous studies have endeavored to examine the effects of trade on employment and wages, particularly in the manufacturing sector, the data on which they are based are not suitable for studying these effects in a period when the structure of sourcing of intermediate inputs is rapidly changing.

Consider, for example, the decomposition proposed in Baily and Lawrence (2004) to study the effects of import growth on employment growth in manufacturing industries:

$$e_i = w_d(d_i - v_i) + w_x(x_i - v_i) - w_m(m_i - v_i)$$

where  $e$  is the rate of growth of employment,  $d$  the growth rate of domestic demand,  $x$  the growth rate of exports,  $m$  the growth rate of imports,  $v$  productivity growth rate,  $i$  indexes industry, and the  $w$  represent shares of domestic demand, exports and imports in the base period. This identity states that the rate of growth of employment  $e$  in industry  $i$  equals a weighted average of the difference between the growth rate of labor productivity in industry  $i$  and the growth rate of domestic demand, exports, and imports.

However, because the growth in the real value of imports is understated and the growth rate of productivity is overstated, the role of imports in dampening employment growth is underestimated and role of productivity growth in slowing employment growth is overestimated. Indeed, the main conclusion of the paper is that, in an accounting sense, the decline of manufacturing jobs is primarily attributable to high productivity growth relative in manufacturing relative to the growth in domestic demand, not to import growth.

Several studies have addressed the effects of import growth on wage inequality, in particular the extent to which the growth in imports from low-wage countries can explain the growing inequality among low and high skilled workers. The basic premise is that imports from low-wage developing countries should be concentrated in less skill-intensive industries. As U.S. labor is reallocated from less skill-intensive to more skill-intensive industries in response to

import competition, the demand for low-skilled labor relative to high-skilled labor should fall, resulting in larger wage differentials among skill levels. The leading competing hypothesis is that technological change has been biased in favor of high-skilled workers.

Lawrence and Slaughter (1993) and Sachs and Shatz (1994) draw on Heckscher-Ohlin-Samuelson trade theory, which posits a relationship between factor prices and product prices, to study this issue. Both studies examine whether there is correlation between import price changes and skill intensity of the domestic industry. If the growth of imports is in part responsible for the increase in inequality between high and low skilled workers, then the price index of imports of less skill-intensive products, produced in relatively low-wage countries, should rise more slowly than import prices of products that compete with products produced in skill-intensive industries. While Sachs and Shatz (1994, Table 16) find no significant relationship, Lawrence and Slaughter (1993, Figure 8) actually find import prices rose faster in products that compete with skill-intensive industries.

Given measurement problems in the import price index, the lack of significant results in Sachs and Shatz and even counterintuitive results in Lawrence and Slaughter are perhaps not surprising. The price declines associated with outsourcing to low-wage countries—i.e. precisely the cases these studies are trying to capture—generally are not measured in the import price index.<sup>4</sup>

Lawrence and Slaughter (1993) and Sachs and Shatz (1994) also examine the relationship between an industry's skill intensity and the domestic price index for that industry's product. Import competition could contribute to the growth of inequality by lowering the relative domestic price of goods in less skill intensive industries. To control for productivity growth in an industry, which would increase the payments to factors in the industry all else the same, both studies

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<sup>4</sup> Sachs and Shatz suggest that the reason for the lack of significance is that the import price index is poorly measured, but do not elaborate on this point.

construct an effective price, equal to the actual price index of products in industry multiplied by the total factor productivity in the industry:

$$P_i^e = P_i TFP_i$$

Lawrence and Slaughter (1993, Table 4) suggest that the effective price of less-skill intensive goods actually rose relative to that of more skill-intensive goods, while Sachs and Shatz (1994, Table 16) find weak evidence that it declined.<sup>5</sup> Note, however, that examination of the effects of imports on factor prices as they operate through domestic product prices does not skirt the import price measurement problem. When import price indexes fail to pick up declines in import prices, as typically occurs with outsourcing, growth of total factor productivity in the industry that uses these imports as intermediate inputs is biased upward. If less skill-intensive industries also disproportionately use inputs from less skill-intensive industries, this bias on industry productivity will also bias findings against showing any link between imports and wage inequality as it operates through effective prices.

Feenstra and Hanson (2001) critique Lawrence and Slaughter (1993) for their focus on differences in domestic or effective domestic price changes across industries. Instead, they argue that because virtually all imports are used as intermediate inputs somewhere in the value chain, the appropriate comparison is between trends in domestic prices and the imported good prices within industries. Yet, biases in import price indexes limit the value of such comparisons.

More generally, the growth of offshore outsourcing and offshoring motivated by lower-cost foreign intermediate inputs has spurred numerous studies to examine the role that import growth, particularly from low-wage countries, may have had on employment and wage inequality in the United States. Yet the key variable—the drop in input price resulting from the outsourcing—is not adequately captured in the price statistics. Quite simply, the data are not

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<sup>5</sup> Sachs and Shatz (1994) obtain different results than do Lawrence and Slaughter (1993) primarily because they include a dummy variable in their regression models for the computer industry, whose price index was an outlier due to product quality adjustments and because they examine a somewhat different time period and include only industries for which a complete time series exists.

constructed in a way that permits such analysis, and studies generally will be biased against finding any effect of imports on employment and wages. Without adequate data, it is impossible to know what influence the growth of foreign outsourcing and imports from low-wage countries have had on U.S. labor markets. The rapid growth of imports from China and other developing countries since 2000, however, suggests that it is becoming more important to address this and other measurement problems related to the growth of globalization.

## **6. Conclusion**

Available evidence indicates that much of the rapid growth in imports from developing countries, particularly since 2000, has been driven by what I broadly term offshore outsourcing and offshoring. The substitution of lower-cost imported intermediate inputs for domestically produced products has been prevalent in all sectors of the economy, but has been especially great in manufacturing (Yuskavage, Strassner, and Meideros 2008; Kurz and Lengermann 2008). Because the lower input prices driving this substitution are not captured in price statistics, the real value of imports is understated and consequently the real value of GDP, industry value-added, and productivity measures are overstated. This measurement problem is analogous to the outlet substitution bias discussed in the literature on the Consumer Price Index.

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.

In closing, I note that although I have focused on problems associated with measuring input prices and the real value of imports, this is not the only challenge to the accurate construction of statistics posed by the growth of globalization. The treatment of intangible assets and transfer prices has potentially important implications for national statistics given the growth of multinational corporations and their incentives to record profits in countries with low corporate

tax rates. Measurement of prices and even nominal values for services trade, which is growing rapidly, albeit from a small base, is especially difficult. Long lags in the development of benchmark input-output tables for the economy are problematic for the accuracy of statistics in an economy in which rapid growth of outsourcing and offshoring are changing the structure of input use. Frequent updates of industry classification for organizations are important when, for example, many companies are shifting their focus from manufacturing to wholesale import. Together, these measurement issues render it more difficult to produce accurate economic statistics and to assess the effects of globalization on the U.S. economy.

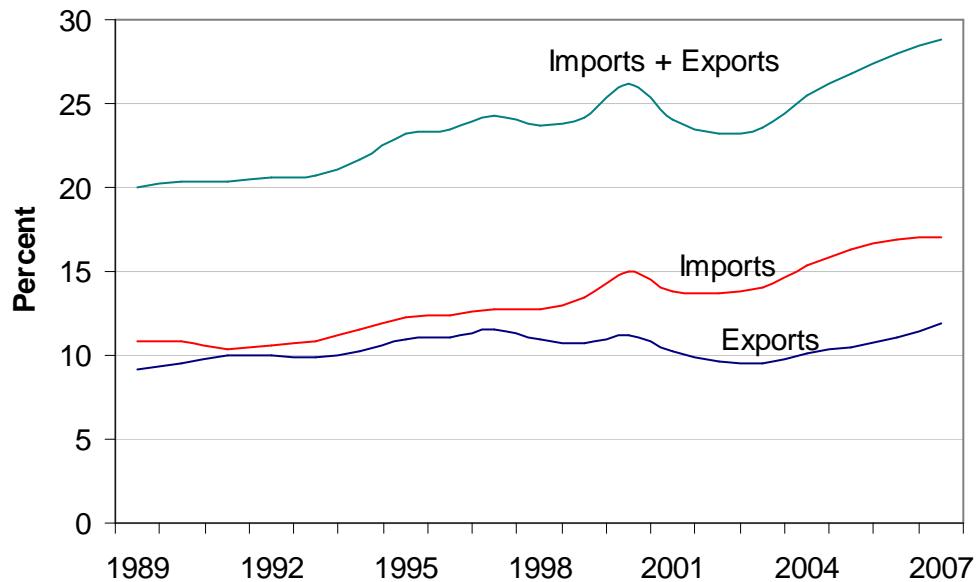
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**Figure 1: Imports and Exports as a Percent of GDP**



**Figure 2: Imports from Advanced and Developing Countries**

