Outsourcing and U.S. Economic Growth: The Role of Imported Intermediate Inputs*

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Abstract

In spite of the burgeoning literature on outsourcing in both the popular and academic press, so far little work has been done to frame the debate in a more macroeconomic context and identify outsourcing's contribution to overall U.S. economic growth. This paper takes an initial step in this direction by focusing on the contribution of imported intermediate inputs to U.S. economic growth. More specifically, using a neoclassical growth accounting framework, we study the use of imported intermediates at the detailed industry level and then show how these inputs contribute to growth. While our primary measure of purchased intermediate inputs is derived from BEA's GDP-by-Industry accounts, we also make use of detailed industry and commodity values for imported intermediates and their respective prices. We find that between 1997-2005 roughly 15 percent of the growth of U.S. private industry can be attributed to imported intermediates. Moreover, about one-third of the growth of the manufacturing sector stems from its increased reliance on foreign inputs. The contribution of imported intermediates accelerated over our sample period, a trend which stems, in large part, from durable goods manufacturing. Finally, using a basic regression framework, we find that growth in the use of imported intermediates relates positively to manufacturing employment growth. A link between imported intermediates and multifactor productivity growth, however, appears to be tenuous.

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1. Introduction

Much of the focus of the recent academic literature on foreign outsourcing has concerned itself with three subjects: the size and pervasiveness of outsourcing, the effects of outsourcing on wages, and the productivity implications of outsourcing. In spite of recent improvements in measuring outsourcing, an additional area of research that has received less coverage in the literature is the relationship between outsourcing and overall economic growth.[1,2] Without a doubt, a large quantity of growth in international trade is due to the ongoing integration of production across borders; indeed, much of the recent increases in trade shares appears to be attributable to vertical specialization (Hummels, et al, 2001)

Given its significance in driving international trade, it is surprising that the impact of outsourcing on overall economic growth has not received more attention. This paper takes an initial step towards filling this void by focusing on the contribution of imported intermediate inputs to the growth of the U.S. economy during the period 1997 to 2005. Towards this end, we adopt a neoclassical growth accounting framework, an approach which has been widely used in recent work on productivity (Triplett and Bosworth, 2004, 2007; Jorgenson, Ho, and Stiroh, 2005a, 2005b, 2008). Using this framework, we also decompose the aggregate sources of growth into contributions from detailed industries and sectors of the economy.

Our work continues in the tradition of Corrado et al, (2006, 2007) who—although they outlined an approach for measuring the contribution of imported intermediate—ultimately performed their analysis using an amalgam of domestic and foreign components, which they found to be an important driver of growth during the past decade. In this paper, we first parse out the importance of foreign and domestic inputs, before turning to look more closely at outsourcing in the manufacturing sector. Our analysis makes use of detailed Bureau of Economic Analysis (BEA) industry and commodity values for imported intermediates and their respective prices from 1997 to 2005.[3] The value and price data are aggregated,

[1] The terms foreign outsourcing, offshoring, and vertical integration refer to trade in intermediate goods. As defined by Krugman (1995), foreign outsourcing is the geographic separation of activities involved in producing a good (or service) across two or more countries.

[2] For studies on the relationship of trade and wages see Feenstra and Hanson (1996, 1999, and 2002). For studies on the importance of outsourcing, see Hummels, Ishii, and Yi (2001), Feenstra (1998), Yeats (2001), and Campa and Goldberg (1997). For work covering the relationship between outsourcing and productivity, see Kurz (2006) for micro-level results, Amiti and Wei (2006) for industy level results, and Olsen (2006) for a review of the literature.

[3] A recent Bureau of Economic Analysis work that pertains to foreign outsourcing, albeit services outsourcing, is from Yuskavage, Strassner, Medeiros (2008).

concorded, and transformed into real-valued indexes which are then integrated into our growth accounting framework.

We find foreign intermediates are an important source of growth for the U.S. economy. Specifically, between 1997-2005, roughly 15 percent of the growth of U.S. private industry can be attributed to imported intermediates. In addition, about one-third of the growth of the manufacturing sector stems from its increased reliance on foreign inputs. We also find that the contribution of imported intermediates accelerated over our sample period. Because most of this acceleration stems from the manufacturing sector, we then turn our attention to the sources of growth for 19 manufacturing industries. We find that producers in numerous durable goods industries increased their reliance on both foreign and domestic intermediates. In contrast, nondurable goods industries appear to have substituted away from domestic intermediates towards foreign intermediates. Finally, using a basic regression framework we find that increased use of imported intermediates relates positively to manufacturing employment growth. A link between imported intermediates and multifactor productivity growth, however, appears to be tenuous.

The paper proceeds as follows. The next section briefly describes the data we employ throughout the paper. Section 3 summarizes our measures of imported intermediates. Section 4 presents our methodology for decomposing output growth and estimating multifactor productivity (MFP). Section 5 presents our empirical findings for U.S. private industry, while section 6 presents our results for detailed manufacturing industries. Section 7 presents basic regression results linking outsourcing to productivity and employment. Section 8 concludes.[4]

2. Data

Multiple data sources are required in order to estimate industry-level multifactor productivity and the contribution of foreign intermediates. Gross output, intermediate inputs, and their respective prices source from the Bureau of Economic Analysis' (BEA) GDP-by-industry accounts. Industry-level capital stock was derived from BEA's detailed asset-by-industry net stocks. Asset-by-industry capital stocks are aggregated using ex-post rental prices following the Jorgenson-Griliches approach used by the BLS. The detailed capital asset types are aggregated into two components, information technology (IT) and other capital (equip-

[4] A forthcoming appendix will further describe our data, notation, and methodology.

ment, structures, and inventories), for the sources of growth analysis.[5] Our industry-level labor input is measured by changes in the hours worked of all persons (employees and self employed) with no explicit differentiation by characteristics of workers. Instead, following Corrado et al (2007), the hours worked series from the BEA are implicitly adjusted using the Census Bureau's County Business Patterns file, which provides additional information on employment and payrolls at the detailed industry level.

Our measures of imported intermediate inputs and their respective prices are derived from a combination of published and unpublished BEA data. The value of imported inputs is available at the detailed commodity and industry level for the years 1997 through 2005. The BEA calculates the value of imported commodities used by each industry by assuming that each industry uses imports of a commodity in the same proportion as the overall ratio of imports-to-domestic supply of the same commodity. This approach has been used in multiple studies pertaining to offshoring and the use of imported intermediate inputs, starting with Feenstra and Hanson's outsourcing work (1996 and 1998). The Bureau of Economic Analysis also provided us with detailed imported commodity price indexes. These indexes are constructed through the use of a concordance between the Bureau of Labor Statistics' SITC import price indexes and BEA's commodity (item) codes. Where there is not a concordance between the BLS price measures and the BEA commodity codes, the BEA constructs its own end-use import price index.

3. The importance of foreign outsourcing

As countries increasingly specialize in stages of production instead of specific goods, the importance of foreign outsourcing in both overall production and in international trade continues to climb. Perhaps not surprisingly, this phenomenon is particularly pronounced in the manufacturing sector. This section presents several updated statistics on the importance of foreign outsourcing in U.S. trade during 1997-2005, summarizes the imported commodities data used in our analysis, and presents an overview of the use of imported intermediates by U.S. manufacturing industries.

The importance of trade in production has been steadily increasing for the United States, particularly of late as international demand compensates for lower domestic consumption. While imports are netted out from the computation of domestic production, it is instructive

[5] Information technology is defined as computers, communications equipment, and software.

to look at their share of gross domestic product. As seen in the first row of table 1, the ratio of imports to gross domestic product has increased from 12 to 16 percent. While much work has been performed regarding the increased importance of trade in services, our time span of analysis includes little change in the fraction of services trade, as the second row of table 1 exhibits a relatively constant share of goods imports relative to total imports for the U.S.[6] Within goods imports, the vast majority of goods imports are of manufactured goods, as seen in row 3, averaging roughly 85 percent over our sample period.[7] Over our sample period, and for longer time horizons, imports, and particularly manufacturing imports, play a important role in the US economy.

Intermediate imports are measured as imports utilized in the production process and are consistent with the definition of the geographic separation of the production process, providing a good proxy for foreign outsourcing. A large fraction–roughly 40 percent–of both total imports and manufacturing imports, as seen in rows 4 and 5 of table 1, can be attributed to the vertical integration of production between the U.S. and other countries.

Table 2 presents summary statistics for the 272 detailed imported commodity series we received from BEA. For ease of exposition, these series have been aggregated to 29 commodity sub-aggregates which correspond to the aggregates published by the BEA in their GDP-by-industry accounts. The second column in the table indicates the total number of detailed commodity codes (atoms) that each aggregate is comprised of, while the subsequent columns show the value and shares in 2005, and the percent changes in values and in prices between 1997 and 2005.[8]

Several striking characteristics stand out in table 2. First, more than 65 percent of imported intermediate commodities fall within the manufacturing sector. Of the intermediates imported in manufacturing, the commodities with the largest fraction of imported intermediates were paper products, petroleum and coal products, food, beverage, and tobacco products, and other transportation equipment. In terms of the largest growth between the two periods of time, we see extremely large growth in the entertainment industry, albeit from

[6] In addition, roughly 60 percent of all trade in services is related to travel, 8 percent royalty and license fees, and 6 percent education related. The remaining 25 percent of services imports include business, professional, and technical services, and financial, insurance, and tellecomunication services.

[7] One reason for small decline in the share of manufacturng in goods trade is the crowding out of manufacturing products by the increasing value share of petroleum-related imports.

[8] It is important to note that not all commodities are imported. The 272 imported commodity atoms represent more than half of all the detailed commodity codes that exist for domestically produced commodities.

a low initial value, and large increases in oil and gas extraction, motor vehicles, and plastics and rubber products. In terms of prices, large increases can be seen in the price indexes for oil and gas extraction, wood products, and motor vehicle related commodities.

In order to perform our growth accounting exercise, it is first necessary to concord our commodity-level imports data to the industry level. This permits an analysis of each industry's total use of imported intermediates as well as the prices for those intermediates. For each of the 65 industries in the GDP-by-industry accounts we also construct a measure of "own-industry" imported intermediate use. The own-industry measure of intermediate imports is a closer proxy for outsourcing because if we think of outsourcing as a plant or firm importing inputs that they used to produce themselves, it is most likely that those inputs are categorized by the same industry as the user.[9] For example, the own-industry imports by the fabricated metal products industry consist of intermediate imports of fabricated metals.

Returning to table 1, rows 6 and 7 contain aggregate-level statistics regarding our measure of own-industry imports. Over our sample period, own-industry imports comprise roughly 30 percent of total intermediate imports, while roughly 40 percent of all the imported intermediates used by the manufacturing sector are own-industry imports. These two shares trended down between 1997 and 2005; although the value of own-imported intermediates increased roughly 30 percent during this period, the value of total intermediate imports (i.e. both own- and other-industry) increased at a much faster pace.

By concording the imported commodities data to the industry level, we can then relate each industry's use of imported intermediates to its use of total intermediates, where total intermediate inputs are the consumption of all goods and services used in the production process (i.e. both domestic and foreign).[10] The last three rows of table 1 contain the import share of total intermediate use for all U.S. private industry, the import share of manufacturing intermediates, and the own-industry import share of manufacturing intermediates. The import share of intermediates has increased both for the overall economy and for the manufacturing sector (rows 8 and 9). The large growth rate of the import share of manufacturing intermediates (row 9) is surprising–the share of manufacturing intermediates that source from abroad increased 40 percent in our sample period alone. However, the proportion of intermediate use in the manufacturing sector attributable to own-industry imports remained

[9] See Feenstra and Hanson (1999)

[10] Technically, intermediate inputs consist of energy, raw materials, semifinished goods, and services that are purchased from domestic industries or from foreign sources.

roughly constant at about 5 percent between 1997 and 2005 (row 10); this proxy for the fraction of intermediate use due to vertical integration is similar to what has been found in previous research.

A more disaggregated summary of intermediate imports by industry can be found in table 3. Because manufacturing goods account for more than 90 percent of non-hydrocarbon-related imported intermediates, we focus solely on the manufacturing sector in this table, which presents the share, value growth, and prices of total and own-industry imported intermediates for 19 manufacturing industries. There is considerable variation both for imported intermediates and for own-industry imported intermediates. However, this variation is especially pronounced for own-industry imported intermediates, whether taken as a share of total intermediates or of imported intermediates. It is particularly interesting to note that roughly 84 percent of all imports used by the primary metals industry are own-industry imports, while 79 percent of the imports used by the computer and electronics are own-industry. It is also interesting to note the often substantial changes in the prices and values of our industry level import measures.

4. Methodology

We employ two related approaches to measure the contribution imported intermediates to economic growth. The first is based upon the concept of sectoral output, that is gross output less the amount produced and consumed within that sector or industry; the second framework employs gross output. The sectoral output approach has several useful properties for aggregation, while the gross output approach allow us to fully account for the substitution between intermediates used within the production process at the detailed industry level.

4.1. Sectoral output

We utilize the original framework of Domar (1961), and further developed by Hulten (1978) and Gollop (1979, 1983) to relate productivity for an aggregate and productivity for individual industries. This framework enables MFP growth at various levels of aggregation to be properly decomposed into contributions from underlying sectors or industries. The Domar framework relies upon the concept of sectoral output as the primary measure of production. Sectoral output is defined as the gross output of an industry or sector less the amount produced and consumed within that industry or sector. Thus, at the very detailed industry

level sectoral output closely resembles gross output in that most intermediate inputs are in fact produced outside of the industry. In contrast, as one moves to higher and higher levels of aggregation, sectoral output more closely resembles the concept of value added as more and more of the intermediates used by the sector are in fact produced within the sector and therefore stripped out.

From a practical perspective, building measures of sectoral output can be difficult because it involves extensive use of input-output relationships. However, Hulten (1978) showed that productivity growth using this framework has nice theoretical properties, in that it can be mapped into the rate of expansion of the social production possibilities frontier. Moreover, because of our focus on the sources of growth at intermediate levels of production, use of a sectoral output framework is critically important to correctly address the many inter- and intra-industry linkages inherent in our intermediate aggregates.

Growth rates will be denoted with hat-notation, where $\widehat{y}$ denotes the real growth rate of y. The following assumes a general aggregate k, either an industry of aggregation over industries, composed of summing over elements X_{ij} from rows i and columns j of an input-output use table. The output and input data required to estimate industry-level multifactor productivity include industry-level growth rates for gross output $\widehat{Q}_k$ and sectoral output $\widehat{S}_k$, industry-level growth rates for the production inputs, i.e. labor $\widehat{L}_k$, capital $\widehat{K}_k$, and intermediate inputs $\widehat{M}_k$.[11]

M_k can be decomposed into several components,

$$M_k = M_{k,D}^{own} + M_{k,F}^{own} + M_{k,D}^{other} + M_{k,F}^{other},$$

where k denotes industry aggregate, D and F denote domestic and foreign intermediates, and *own* and *other* denote whether the inputs source from within the industry aggregate k or from outside of the industry aggregate k. Own-domestic intermediate inputs $M_{k,D}^{own}$ are the shipments of producers in aggregate k to all other producers in aggregate k, which is constructed from information from both rows and columns of the input-output relationship, i.e.

$$M_{k,D}^{own} = \sum_{i \in k} \sum_{j \in k} X_{ij}.$$

We also define the income shares for each input for each industry (s_k^L, s_k^L, $s_k^{M_D^{own}}$, $s_k^{M_D^{other}}$, $s_k^{M_F^{own}}$, $s_k^{M_F^{other}}$), where the weights are two-period averages of the factor cost to the total cost

[11] The definitions and notation presented here are similar to thse presented in Corrado, et. al. (2007).

for all input factors for aggregate k. The foreign aggregate share is $s_k^{M_F} = s_k^{M_F^{own}} + s_k^{M_F^{other}}$.

The nominal value of sectoral output for each industry (S_k) is calculated as the difference between BEA's measure of gross output Q_k from the industry accounts and estimates of own-industry use of intermediates $M_{k,D}^{own}$ calculated from the BEA input-output tables. The estimates of $M_{k,D}^{own}$ and the values for total imported intermediates $M_{k,F}$, where $M_{k,F} = M_{k,F}^{own} + .M_{k,F}^{other}$ are subtracted from BEA data on total intermediate inputs M_k to determine the value of each industry's purchased inputs from other domestic industries $M_{k,D}^{other}$.

The growth of real sectoral output at the industry level $\widehat{S}_k = \widehat{Q}_k - \widehat{M}_{k,D}^{own}$ is determined from the difference in gross output growth and own-industry inputs for that industry. Price indexes for own-industry intermediate inputs are assumed to be equivalent to the price index as each of the outputs produced within the industry. The growth rate of real total intermediate usage $\widehat{M}_k$ can be calculated because both price and quantity measures are available from BEA's industry accounts. Given prices and growth rates for both own and other imported intermediates the growth rates of intermediates purchased from other domestic industries ($M_{k,D}^{other}$) are calculated by chain stripping the real values of $M_{k,D}^{own}$ and $M_{k,F}$ from the real value of M_k.[12]

A basic result in of the Domar/Hulten framework is that the rate of change in multifactor productivity $\widehat{MFP}_k$ at level of aggregation k can be expressed as a weighted average over each $i \in k$ of the rates of change in multifactor productivity $\widehat{MFP}_i$ for the individual industries or sectors of interest.

$$\widehat{MFP}_k = \sum_{i \in k} d_i^k \widehat{MFP}_i \tag{4.1}$$

with the Domar weight defined as a ratio of sectoral output S_i at the two levels of aggregation: $d_i^k = \frac{S_i}{S_k}$. Domar weights measure the effect of an increase in MFP in industry i on the aggregate of interest. The weights have the property that $\sum_{i \in k} d_i^k > 1$ with each industry contributing to aggregate productivity directly through deliveries to final demand and indirectly through deliveries to other component industries of aggregate k.

Another Domar/Hulten result is that productivity at aggregation level k can be equivalently calculated residually, as the difference between the growth in a Divisia quantity index

[12] Chain stripping (chain dissagregation) involves solving for the index residual when the aggregate, the price index of intermediates exists, and one child exists, the price index for imports, with the residual being the price index for domestic intermediates.

of sectoral output $\widehat{S}_k$ and the growth in a share-weighted aggregate of inputs:

$$M\widehat{F}P_k = \widehat{S}_k - (s_k^L \widehat{L}_k + s_k^L \widehat{K}_k + s_k^{M_F^{own}} \widehat{M}_{k,F}^{own} + s_k^{M_F^{other}} \widehat{M}_{k,F}^{other} + s_k^{M_D^{other}} \widehat{M}_{k,D}^{other}) \tag{4.2}$$

This result allows for the standard Solow-Jorgenson-Griliches sources of growth decomposition when k represents the total economy.

We decompose sectoral output growth into the contribution of domestic inputs from outside the sector and a Domar-weighted sum of growth accounting contributions of primary inputs and multifactor productivity of the underlying industries for sector k:

$$\widehat{S}_k = s_k^{M_D^{other}} \widehat{M}_{k,D}^{other} + \sum_{i \in k} d_i^k \left[M\widehat{F}P_i + s_i^L \widehat{L}_i + s_i^L \widehat{K}_i + s_i^{M_F^{own}} \widehat{M}_{i,F}^{own} + s_i^{M_F^{other}} \widehat{M}_{i,F}^{other} \right] \tag{4.3}$$

The first term in equation (4.3) is the share-weighted growth of domestically-produced inputs purchased from outside the sector. As with measuring sectoral output, accounting for purchased inputs is specific to the subaggregate and is derived using input-output relationships.

We first use equation (4.2) in order to calculate the detailed, industry-level sources of growth. We then use equation (4.3) to obtain the sources-of-growth decompositions for the industry aggregates and for the U.S. private business sector. In this decomposition, the contribution of real growth of intermediates from outside the sector, $s_k^{M_D^{other}} \widehat{M}_{k,D}^{other}$ is calculated residually.

4.2. Gross output

One drawback of performing the growth decomposition using the sectoral output approach is the inability to contrast the contribution from domestic own-industry intermediates with foreign own-industry intermediates. This comparison is useful when thinking about the substitution of foreign own-industry intermediates with domestic own-industry intermediates over time, and when we want to quantify the contribution of own-domestic intermediates to industry output. While the sectoral output approach is useful for seeing the contribution of foreign intermediates to overall growth, the two intermediate input categories are not comparable.[13]

In order to analyze the roles both foreign and domestic intermediates play as sources of economic growth, we will perform a similar analysis to the approach-mentioned above,

[13]This argument is similar to that by Jorgenson, et al, (2005a) where the authors favor a gross output sources of growth decomosition over the value-added approach in order to identify the role of intermediate inputs.

but we utilize gross output (Q_k) instead of sectoral output (S_k). In this case, we define productivity growth as:

$$\widehat{MFP}_k = \widehat{Q}_k - (s_k^L \widehat{L}_k + s_k^L \widehat{K}_k + s_k^{M_F^{own}} \widehat{M}_{k,F}^{own} + s_k^{M_F^{other}} \widehat{M}_{k,F}^{other} + s_k^{M_D^{other}} \widehat{M}_{k,D}^{other} + s_k^{M_D^{own}} \widehat{M}_{k,D}^{own}). \tag{4.4}$$

Once the estimates of productivity are made for the industry of interest, and if the aggregate value added and aggregate sectoral output are close, then the gross output measures of productivity can also be used to estimate aggregate productivity by weighting the results by a factor of proportionality equal to the ratio of gross output to sectoral output. In our case, though, we are more interested in calculating the contribution to growth from all intermediates, and will focus on the industry level results.

5. Growth accounting results for U.S. private industry

Our empirical decomposition of sectoral output growth for U.S. private industry and 18 major industry groups appears in tables 4 and 5. Table 4 has four panels. Panel A shows results for 1997-2005, that is the entire period for which the BEA has provided us with their detailed data on imported intermediates. Panels B and C show results for two sub-periods, 1997 to 2002 and 2003 to 2005. Panel D shows changes–in growth rates or contributions to growth–for the 2003 to 2005 period relative to the 1997-2002 period.[14] Table 5 has two panels: Panel A shows result for the entire 1997-2005, while Panel B shows the changes between the two sub-periods.

As in Corrado et al (2007), each row of table 4 is a sources-of-growth decomposition derived from applying equation (4.2) at the detailed industry level and then aggregating to the major industry groups and to total private industry using equation (4.3). As noted above, in addition to measuring the contributions of MFP, capital, and labor, our decomposition also distinguishes the role of purchased foreign intermediate inputs from purchased domestic inputs. The contribution of foreign inputs is further split into "own industry" and "other industry" components. Own-industry intermediates are most likely to reflect purchases of intermediates that were once produced in-house, i.e., a better proxy for outsourcing. The contributions from MFP and each factor input (columns 2-8) sum across the row to equal

[14] Our choice of sub-periods was originally necessitated by lack of a continuous time series for imports, and is clearly less than ideal, given the presence of the 2001 recession, and the fact that most growth accounting studies contrast the 1995-2000 period with the post-2000 period. Since we now have imports data for each year during the 1997-2005 period we intend to investigate the choice of alternative sub-periods

sectoral output growth (column 1). The first row in each panel reports the decomposition for U.S. private industry, while the subsequent rows show decompositions for the major producing sectors.

In contrast, each column of table 5 shows the decomposition of the contribution of the primary factors and MFP to aggregate growth. Thus, the contribution of MFP and the factor inputs to aggregate sectoral output growth, shown in line 1, is decomposed into contributions from goods-producing industries (line 2) and an services-producing industries (line 9). These two components are, in turn, further decomposed into contributions from the other industries (lines 3 through 8 and lines 10 through 19).

As shown in Table 4, we estimate that sectoral output growth for all private industries sector averaged 3.4 percent between 1997 and 2005, with contributions from MFP, capital, labor, and purchased inputs all playing important roles (row 1, panel A).[15] However, the sources-of-growth vary notably across industries (rows 3 through 9). Among goods-producing industries, measured productivity change is negative for construction, and the contributions of labor and purchased inputs more than account for the real output growth of this sector. By contrast, in manufacturing the contribution of the labor input is negative, while the contributions of productivity and both foreign and domestic intermediates are the dominant sources of growth. Among services-producing industries, IT capital plays an important role in industries like information; finance, insurance and real estate; and professional and business services. Foreign and domestic intermediates also play an important role for many services-producing industries, although the contribution of "own industry" imported intermediates only appears to be significant for goods-producing industries. The contributions of productivity are small or negative for educational services; arts and entertainment; and other service but positive and substantial for industries like information, wholesale and retail trade, and transportation.

Our results for productivity confirm the basic findings in Corrado, et al.[16] Specifically, by 2005, the productivity resurgence that started in the mid-to-late 1990s appears to have become relatively broad-based across major producing sectors. However, the timing of the increases in MFP growth rates varied notably within this period. During the 1997 to 2002 period, productivity growth was roughly the same in both goods-producing and services-

[15] Because the private business aggregate falls short of complete coverage of the total economy, accounting for the growth in its purchased inputs from other domestic producers as well as the rest-of-world sector (imports) is important.

[16] Also see Bosworth & Triplett (2007) and and Oliner, Sichel, and Stiroh (2007).

producing industries (table 4, panel B, column 2). More recently, however, while productivity growth remained elevated for goods-producing industries as a whole (panel C, table 4), it appears to have picked up more notably for services-producing industries (panel D, table 4).

Turning to the role of foreign intermediates, five results are especially noteworthy. First, foreign intermediate inputs contributed meaningfully to the growth of U.S. private industry between 1997 and 2005. As shown in Table 4, during this period, we estimate that nearly 15 percent of the output growth for U.S. private industry stems from imported intermediates inputs (line 1, panel A). Although considerably smaller than the contribution of MFP, this contribution is slightly larger than the contribution of labor and roughly the same size as the contribution of IT capital and of other capital inputs.

Second, the contribution of foreign intermediate inputs has accelerated. Comparing the two sub-periods in Table 4, the combined contribution of "other" and "own" foreign inputs to the growth of U.S. private industry output rose from 0.3 percentage point to 0.6 percentage point (line 1, panels B and C). In contrast, the contribution of purchased domestic inputs declined 0.7 percentage point from 0.2 percentage point during 1997-2002 to -0.5 percentage point.

Third, the overall contribution of foreign intermediates stems from both goods-producing industries and services-producing industries. Turning to Table 5, during 1997-2005, goods-producing and services-producing industries contributed about equally to the overall contribution of "other" foreign intermediates (panel A, columns 6 and 7, lines 1, 2, and 9).[17] However, the recent pickup in the overall contribution of foreign intermediates was concentrated entirely among goods-producing industries (Panel B, columns 6 and 7, lines 1, 2, and 9).

Fourth, within goods-producing industries, most of the overall contribution of foreign intermediates stems from the manufacturing sector. As shown in Table 5, between 1997 and 2005, the manufacturing sector is responsible for nearly $\frac{3}{4}$ of the overall contribution of foreign outsourcing from durable-goods industries. Similarly, although the contribution of foreign outsourcing accelerated for industries such as construction and mining, the pickup was most pronounced in manufacturing (panel B, columns 6 and 7, lines 3 through 6).

Finally, within manufacturing, the contribution to growth from imported intermediates is largest in the durable-goods industries. In particular, the pickup in the contribution of

[17] The relatively smaller contribution from "own" imports, however, is concentrated in goods-producing industries.

imported intermediates appears concentrated solely among durable goods industries, where output growth accelerated 0.9 percentage point between the two sub-periods (table 4, panel D, line 7). This acceleration was more than accounted for by a larger contribution from foreign intermediates (both "own" and "other"). In contrast, the contribution of domestic intermediates was unchanged, the contribution of the capital inputs decelerated, and the contribution of MFP and labor picked up a bit.

6. Growth accounting results for U.S. manufacturing industries

Table 6 presents our decomposition of gross output for the 19 manufacturing industries published by the BEA as part of their GDP-by-industry accounts. Our further scrutiny of the manufacturing sector is based on the fact that it has consistently been the largest consumer of imported intermediates and that most of the pickup in contribution of foreign imports to the overall growth of the economy stems from manufacturing. Moreover, the BEA's GDP-by-industry accounts provides more detail on manufacturing industries than any of the other major sectors in the economy.

As in Table 4, each row is a sources-of-growth decomposition. Panel A presents the decomposition for the entire 1997-2005 period, while Panel B show the changes for the 2003-2005 period relative to the 1997-2002 period. As noted above, while we prefer the concept of sectoral output when considering the contribution of individual industries to the growth of the aggregate economy and of major sub-sectors, we view gross output as the more relevant concept for studying trends for individual industries. As such, the decomposition is Table 6 is based on equation (4.4). The gross output concept also permits us to isolate the contribution of domestic "own industry" intermediates and to contrast its role with that of foreign "own industry" inputs.

Looking first at Panel A, during 1997-2005, there was considerable variation in the rates of output and productivity growth, and in the contributions of IT and other capital. The magnitude of the labor contribution also varied considerably but was uniformly negative for all 19 manufacturing industries.[18] However, in general, output growth has more consistently positive for the 11 durable goods industries than for the 8 nondurable goods industries. Moreover, Panel B shows that output growth accelerated during 2003-2005 for many durable

[18]See Corrado et al (2007) for a more detailed discussion of the contributions of productivity growth, capital, and labor to U.S. manufacturing industries. Also see Bosworth & Triplett (2007) and Oliner, Sichel, and Stiroh (2007).

goods industries, with especially notable pickups for primary metals, machinery, electrical equipment, and other transportation equipment. In contrast, output growth decelerated for almost all of the nondurable goods industries.[19]

In terms of the role of intermediate materials, columns 6 through 9 of Panel A highlight an interesting contrast between the contributions of domestic and foreign intermediates. Specifically, between 1997 and 2005, while the contribution of domestic intermediates—both "own" industry and "other"—was negative for many industries, the contribution of imported intermediates was almost uniformly positive. Many industries therefore appear to have cut back on domestic intermediates while simultaneously boosting their use of foreign intermediates.

More specifically, within durable manufacturing, domestic and foreign intermediates both played large roles in industries like computer and electronic products, furniture, motor vehicles, other transportation equipment, and non-metallic mineral products. In contrast, domestic intermediates actually dampened output growth in the primary and fabricated metals, machinery, and electrical equipment industries, where it appears that this effect was only partially offset by a positive contribution from foreign intermediates. Within nondurable industries, the contribution of domestic intermediates was negative in all industries except for food, where it was by far the main driver of overall growth.

The bottom panel of table 6 shows that industries with the largest acceleration in output growth also experienced significant pickups in the contributions of imported intermediates. As noted, the largest gains in output growth were in primary metals, machinery, electrical equipment, and other transportation equipment. Imported intermediates were a key driver for all of these industries, with pickups in MFP, capital, and labor typically being small or negative. For all of these industries, however, it appears as if the contribution of both foreign and domestic intermediates accelerated. Thus durable goods industries appear to have increased their reliance on outsourcing more generally, rather than on either foreign or domestic outsourcing in particular.

One notable exception, however, is the computer industry, where output growth decelerated slightly but remained elevated in both sub-periods. The sustained high rate of growth during 2002-2005 appears to be largely the result of a sharp acceleration in the contribution of both "own" and "other" foreign intermediates; in contrast, the contributions of MFP, cap-

[19] For the apparel industry, although the change between the two sub-periods was positive, apparel output nevertheless posted sizable declines in both periods of 10.2 percent and 8.9 percent respectively.

ital, and labor all decelerated, and the contribution of domestic intermediates was positive but quite small.

Finally, it should be noted that even within nondurables, where output growth decelerated for most industries, the import contribution grew in several industries, most notably chemicals, paper, and plastic and rubber products. In contrast, the contribution of domestic intermediates appears to have decelerated for all but one of the nondurable industries. Thus, unlike durable goods industries, where both domestic and foreign outsourcing appears to have accelerated, foreign outsourcing appears to have accelerated for nondurables while domestic outsourcing has slowed.

7. Outsourcing, Productivity, and Employment

Up until this point, we have solely focused on the contributions from domestic and foreign outsourcing to output growth. Provided that we have manufactured a dataset that contains TFP growth, employment growth, and several outsourcing measures, it would be insightful to test for a basic relationship between the growth rates of: outsourcing and productivity and outsourcing and employment. Although there are multiple reasons to offshore segments of a production process such as cost saving, insulation against demand fluctuations, and specialization, the possible employment effects and productivity gains have captured the attention of the literature.[20]

For productivity and outsourcing, we utilize the following basic specification:

$$\widehat{MFP}_{it} = \alpha + \beta Outsourcing_{it} + \delta X_{it} + \varepsilon_{it}, \tag{7.1}$$

where $\widehat{MFP}_{it}$ is our growth rate in total factor productivity, $Outsourcing_{it}$ is one of two measures of foreign outsourcing growth, and X_{it} is a matrix of controls, including time and/or industry. The data are pooled together over each year t and for each industry i. The two measures we use for $Outsourcing_{it}$ are the real growth in outsourcing and the change in the share of imported intermediates of total intermediates. We perform the analysis for other and own-industry foreign outsourcing for the 19 manufacturing industries listed in table 6.

[20] See Abraham and Taylor (1996) for an analysis concerning the reasons for outsourcing. Amiti and Wang (2006) work provides evidence that outsourcing, primarily service outsourcing, has a significant effect on producivity. On the labor side, Feenstra and Hanson (1999) find that foreign outsourcing has played an important role in the increase of the skill premium.

For employment, a similar specification is utilized, except we replace the growth in MFP with the growth in our real employment index.

$$\widehat{L}_{it} = \alpha + \beta Outsourcing_{it} + \delta X_{it} + \varepsilon_{it}, \tag{7.2}$$

where $\widehat{L}_{it}$ is our real growth rate of employment.

The results of specifications 7.1 and 7.2 can be found in tables 7 and 8. The results in table 7, i.e., the estimates of the relationship between productivity growth and the change in foreign outsourcing, reflect positive and barely significant results for foreign other outsourcing, with and without industry controls. In the case of own-foreign outsourcing, we also cannot uncover a relationship between MFP growth and the share of own-industry outsourcing and the growth in real own-industry outsourcing.

Table 8 tackles the relationship between employment and outsourcing. We find a surprising correlation, significant in many cases at the one percent level, that both the growth in real-foreign intermediates and the change in the share of intermediates are positively related to employment growth, holding industry constant.

Although we remain agnostic at this point about causality and what the underlying model or framework may be that relates outsourcing to productivity and employment, the aforementioned results contain several interesting findings. First, as the pace of foreign outsourcing accelerates, either in real terms or in the fraction of intermediates, we see that the growth rate of MFP does not necessarily change while employment growth does.[21] The faster employment growth may be related to a more efficient allocation of resources in manufacturing, essentially supporting outsourcing as a means of further specializing the factors of production.[22]

8. Conclusion

In this paper we decomposed intermediate inputs into foreign and domestic components in order to separately identify their contribution to growth. We further decomposed intermedi-

[21] Since our work entails the contribution to growth, our specifications are working with second derivatives. The analysis of levels changes will be saved for future work.

[22] One possibility for the lack of productivity gains seen could lie in pricing issues, such as the mismeasurement of the value and prices of foreign intermediates. For a discussion of foreign outsourcing biasing MFP results, see Houseman (2006). Basically, to the extent our detailed import price measures correctly account for the value of imported intermediates, the measurement bias in MFP will be attenuated. Conversely, the large MFP residual for computers and electronics products in Table 6 may be indicative of this bias.

ate intputs into categories based on own- and other-industry usage. We then introduced these four types of intermediates and their prices into a growth accounting framework through the use of detailed industry-by-commodity BEA data, which was first concorded and aggregated to the industry level. We find that foreign intermediate inputs explain roughly 15 percent of the growth of U.S. private industry over the 1997-2005 period, and that their contribution accelerated in the latter half of our sample. The pickup in the contribution of imported intermediates was predominantly a manufacturing phenomenon. Numerous durable goods industries increased their reliance on both foreign and domestic intermediates, while non-durable goods industries appear to have substituted away from domestic intermediates towards foreign intermediates. Outside of the contribution to growth, we also find that the increase in imported intermediates, both own-industry and other, is positively related to employment gains in manufacturing.

References

[1] Amiti, Mary & Wei, Shang-Jin (2006). "Service Offshoring, Productivity and Employment: Evidence from the US." CEPR Discussion Papers 5475.

[2] Abraham, K.G., Taylor S.K. (1996). "Firms' Use of Outside Contractors: Theory and Evidence." Journal of Labor Economics 14(3), 394-424.

[3] Bosworth, Barry P.and Jack E. Triplett (2007). "The Early 21st Century U.S. Productivity Expansion is Still in Services." International Productivity Monitor (14) pp 3-19.

[4] Campa, Jose and Linda S. Goldberg (1997). "The Evolving External Orientation of Manufacturing: A Profile of Four Countries." FRBNY Economic Policy Review (July), 53-81.

[5] Corrado, Carol, Paul Lengermann, Eric Bartelsman, and Joe Beaulieu (2006). "Modeling Aggregate Productivity at a Disaggregate Level" draft presented at NBER/CRIW Summer Institute, July 2006.

[6] Corrado, Carol, Paul Lengermann, Eric Bartelsman, and Joe Beaulieu (2007) "Sectoral Productivity in the United States: Recent Developments and the Role of IT" German Economic Review 8(May).

[7] Domar, Evsey D. (1961). "On the Measurement of Technological Change." Economic Journal 71: 709-29.

[8] Feenstra, Robert C. (1998). "Integration of Trade and Disintegration of Production in the Global Economy" Journal of Economic Perspectives 12 (April): 31-50.

[9] Feenstra, Robert C. and Gordon Hanson (1996). "Globalization, Outsourcing, and Wage Inequality." Papers and Proceedings of the 108th Annual Meeting of the American Economic Review, 240-245.

[10] Feenstra, R.C. and G. Hanson (1999). "The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the U.S. 1972-1990." Quarterly Journal of Economics 114: 907-940.

[11] Feenstra, R. C. and G. Hanson (2002). "Global Production and Inequality: A Survey of Trade and Wages," in: E.K. Choi and J. Harrigan (Eds.), Handbook of International Trade, Blackwell, Ames.

[12] Gollop, Frank M. (1979). "Accounting for Intermediate Input: The Link between Sectoral and Aggregate Measures of Productivity Growth." In The Meaning and Interpretation of Productivity, Albert Rees and John Kendrick, eds., 318-33. Washington: National Academy of Sciences.

[13] Gollop, Frank M. (1983). "Growth Accounting in an Open Economy." In Developments in Econometric Analyses of Productivity, A. Dogramaci, ed., 35-62. Boston: Kluwer-Nijhoff Publishing.

[14] Houseman, S. (2006). "Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing." Upjohn Institute Staff Working Paper No. 06-130 (June).

[15] Hulten, Charles R. (1978). "Growth Accounting with Intermediate Inputs." Review of Economic Studies 45 (October): 511-518.

[16] Hummels, David, Jun Ishii, and Kei-Mu Yi (2001). "The Nature and Growth of Vertical Specialization in World Trade." Journal of International Economics 54 (June): 75-86.

[17] Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni (1987). Productivity and U.S. Economic Growth. Cambridge, Mass: Harvard University Press.

[18] Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh (2005a). "Information Technology, Education, and the Sources of Economic Growth across U.S. Industries." In Measuring Capital in the New Economy, C. Corrado, J. Haltiwanger, and D. Sichel, eds. Chicago: The University of Chicago Press.

[19] Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh (2005b). Productivity, Volume 3: Information Technology and the American Growth Resurgence. Cambridge, Mass: The MIT Press.

[20] Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh (2008). "A Retrospective Look at the U.S. Productivity Growth Resurgence," Journal of Economic Perspectives, Vol. 22, No. 1, pp. 3-24.

[21] Krugman, Paul (1995). "Growing World Trade: Causes and Consequences." Brooking Paper on Economic Activity 1: 327-362.

[22] Kurz, Christopher J. (2006). "Outstanding Outsourcers: A Firm and Plant-Level Analysis of Production Sharing," Finance and Economics Discussion Series 4.

[23] Oliner, S., D. Sichel, and Kevin J. Stiroh (2007) "Explaining a Productive Decade," Brookings Papers on Economic Activity, vol. 1 pp. 81-137.

[24] Olsen, K. (2006), "Productivity Impacts of Offshoring and Outsourcing: A Review." OECD-STI Working Paper 2006/1.

[25] Triplett, Jack E. and Barry P. Bosworth (2004). Productivity in the U.S. Services Sector. Washington, D.C.: Brookings Institution Press.

[26] Yeats, A.J. (2001). "Just How Big Is Global Production Sharing?" in: Arndt, S. and H.Kierzkowski (Eds.), Fragmentation: New Production Patterns in the World Economy. Oxford University Press, Oxford, pp. 108-43.

[27] Yuskavage, R. Erich H. Strassner, and Gabriel W. Medeiros (2008) "Outsourcing and Imported Services in BEA's Industry Accounts." in Marshall Reinsdorf and Matthew Slaughter, (Eds), International Flows of Invisibles: Trade in Services and Intangibles in the Era of Globalization. University of Chicago Press, Chicago, forthcoming.

Table 1

The Importance of Intermediate Inputs: 1997-2005

	1997	1998	1999	2000	2001	2002	2003	2004	2005	97-05 Avg.
(1) Import share of GDP	12.3%	12.3%	13.0%	14.5%	13.3%	13.1%	13.5%	14.8%	15.7%	13.6%
(2) Goods trade share of total imports	85.2%	84.6%	84.8%	85.5%	84.8%	84.7%	85.0%	85.0%	85.6%	85.0%
(3) Manufacturing share of goods trade	85.1%	87.7%	87.2%	84.4%	85.0%	85.2%	83.5%	81.7%	79.0%	84.3%
(4) Intermediate imports share of imports	44.1%	43.2%	42.7%	43.5%	42.1%	40.5%	41.5%	43.3%	45.0%	42.9%
(5) Manufacturing intermediate import share of imports	43.0%	39.3%	38.6%	39.9%	36.7%	34.9%	36.0%	38.3%	41.1%	38.7%
(6) Own-industry imports share of total intermediate imports	32.6%	32.4%	31.7%	29.1%	27.4%	26.6%	25.2%	23.9%	22.4%	27.9%
(7) Manfg. own-industry imports share of total manfg. Inter. imports	44.5%	46.2%	45.7%	42.1%	41.3%	40.6%	38.3%	36.2%	33.2%	40.9%
(8) Imported share of total intermediates	7.1%	7.0%	7.3%	8.0%	7.4%	7.3%	7.6%	8.5%	9.2%	7.7%
(9) Imported share of manufacturing intermediates	12.7%	12.6%	13.2%	15.1%	13.9%	13.8%	14.6%	16.6%	18.2%	14.5%
(10) Own imported share of manufacturing intermediates	5.7%	5.8%	6.0%	6.4%	5.8%	5.6%	5.6%	6.0%	6.0%	5.9%

Note: Calculations based on published GDP-by-industry, imports, goods trade, GDP, and published and unpublished imported commodities and prices data from the BEA.

Table 2

Summary of Imported Commodities: 1997-2005

Commodity	Atoms	2005 Imported Value	2005 Share of imported value	% Δ Value	% Δ Price
Farms	13	8,983.4	1.1%	-1.8%	13.6%
Forestry, fishing, and related activities	3	11,379.1	1.3%	68.1%	-4.1%
Oil and gas extraction	1	222,260.3	26.2%	244.7%	194.4%
Mining, except oil and gas	7	5,294.8	0.6%	74.1%	75.4%
Wood products	1	1,581.3	0.2%	208.7%	161.5%
Nonmetallic mineral products	38	22,940.3	2.7%	61.7%	9.7%
Primary metals	7	11,040.0	1.3%	34.6%	-4.1%
Fabricated metal products	4	3,043.8	0.4%	-12.8%	4.4%
Machinery	9	23,852.3	2.8%	90.1%	16.6%
Computer and electronic products	4	21,068.4	2.5%	45.5%	5.3%
Elect. equipment, appliances, & components	4	1,714.6	0.2%	104.4%	7.7%
Motor vehicles, bodies and trailers, & parts	2	42,268.3	5.0%	495.9%	177.1%
Other transportation equipment	10	61,404.5	7.2%	71.5%	11.4%
Furniture and related products	5	22,550.3	2.7%	99.6%	6.7%
Miscellaneous manufacturing	20	16,730.0	2.0%	102.8%	10.7%
Food and beverage and tobacco products	10	62,900.4	7.4%	82.2%	38.6%
Textile mills and textile product mills	25	32,055.5	3.8%	98.8%	5.2%
Apparel and leather and allied products	35	42,983.0	5.1%	102.7%	7.5%
Paper products	19	97,652.4	11.5%	8.0%	-33.0%
Printing and related support activities	16	29,735.3	3.5%	78.2%	-6.1%
Petroleum and coal products	6	65,336.0	7.7%	77.1%	3.2%
Chemical products	8	13,237.6	1.6%	25.3%	1.2%
Plastics and rubber products	7	2,810.5	0.3%	795.6%	2.6%
Utilities	8	14,487.6	1.7%	139.7%	-1.3%
Air transportation	1	7,739.6	0.9%	126.7%	19.7%
Truck transportation	1	2,375.4	0.3%	31.7%	39.5%
Publishing industries (includes software	5	827.3	0.1%	116.1%	4.0%
Motion picture & sound recording industries	1	1,389.6	0.2%	1009.0%	-28.3%
Information and data processing services	2	38.3	0.0%	192.4%	-40.4%

Note: The atoms are defined as the number of commodities aggregated up to the GDP-by-industry commodity level. The base for the price index is 2000 and all values are in millions of dollars. Calculations based on published GDP-by-industry, imports, goods trade, GDP, and published and unpublished imported commodities and prices data from the BEA.

Table 3

Intermediate Imports by Manufacturing Industry: 1997-2005

Industry	Total Imported Intermediates			Own-Industry Imported Intermediates			
	share of total intermediates	price change	value change	share of total intermediates	share of imported intermediates	price change	value change
Food and beverage and tobacco products	6.0%	9.6%	38.4%	2.5%	42.3%	11.3%	42.1%
Textile mills and textile product mills	13.4%	-3.2%	-2.3%	4.9%	36.6%	3.9%	-10.9%
Apparel and leather and allied products	13.6%	3.7%	-36.7%	1.2%	8.6%	1.8%	-70.6%
Wood products	14.3%	13.4%	40.7%	9.4%	65.5%	19.5%	21.0%
Paper products	12.5%	2.6%	12.8%	7.9%	62.8%	5.3%	13.2%
Printing and related support activities	11.1%	1.7%	-4.2%	0.2%	1.6%	38.3%	19.0%
Petroleum and coal products	54.2%	192.9%	220.3%	1.0%	1.9%	254.4%	323.5%
Chemical products	10.5%	39.0%	78.6%	4.9%	46.7%	13.8%	41.5%
Plastics and rubber products	13.0%	10.9%	67.3%	1.2%	9.2%	15.9%	37.4%
Nonmetallic mineral products	8.6%	12.0%	51.5%	3.7%	43.3%	10.4%	69.5%
Primary metals	19.3%	36.3%	54.5%	16.2%	83.7%	38.9%	64.9%
Fabricated metal products	11.8%	13.7%	49.8%	1.9%	16.0%	12.6%	49.6%
Machinery	15.9%	1.1%	54.5%	4.8%	30.3%	7.5%	74.4%
Computer and electronic products	18.0%	-29.8%	-12.2%	14.2%	78.9%	-34.4%	-21.1%
Elect. Equip., appliances, & components	14.6%	5.5%	22.9%	3.8%	26.3%	-4.5%	25.9%
Motor vehicles and parts	19.2%	0.4%	62.2%	11.5%	59.6%	3.2%	69.5%
Other transportation equipment	21.8%	-3.9%	64.6%	9.3%	42.7%	1.8%	18.3%
Furniture and related products	13.7%	10.7%	86.0%	0.1%	0.4%	2.4%	122.3%
Miscellaneous manufacturing	15.7%	14.9%	82.2%	4.2%	26.8%	6.2%	99.9%

Note: changes in prices and values are calculated from 1997 to 2005. Shares are calculated in 2005. Own-industry imports are defined at the GDP by industry level as imported intermediates from an industry by that same industry. Calculations based on published GDP-by-industry, imports, goods trade, GDP, and published and unpublished imported commodities and prices data from the BEA.

Table 4
Sources of growth in sectoral output
for U.S. private industry and major industry groups[1]

	Sectoral Output (1)	MFP (2)	IT Capital[2] (3)	Other Capital[3] (4)	Labor (5)	Purchased Domestic Inputs: (6)	Purchased Foreign Inputs: Other (7)	Purchased Foreign Inputs: Own (8)
A. 1997 to 2005								
1. Private industries	3.4	1.6	.6	.5	.3	-.1	.4	.1
2. Goods-producing industries	1.9	1.3	.2	.1	-.5	.2	.4	.1
3. Agriculture, forestry, fishing, and hunting	1.3	1.7	.0	.2	-.6	-.5	.3	.1
4. Mining	-.3	-1.5	.1	.3	-.4	.7	.4	.1
5. Construction	2.7	-.6	.1	.2	.8	1.9	.4	.0
6. Manufacturing	1.9	1.9	.2	.1	-.9	.1	.4	.2
7. Durable goods	2.8	2.9	.2	.1	-1.0	-.1	.5	.3
8. Nondurable goods	.3	.5	.1	.0	-.6	.1	.2	.0
9. Services-producing industries	3.5	1.2	.7	.6	.6	.1	.2	.0
10. Utilities	.5	1.3	.2	.5	-.3	-1.2	.1	.0
11. Wholesale trade	3.5	1.4	.5	.2	.3	1.1	.0	.0
12. Retail trade	4.7	2.1	.2	.2	.1	2.1	.1	.0
13. Transportation and warehousing	2.2	1.3	.5	.0	-.1	.2	.2	.0
14. Information	6.8	2.8	1.0	.2	.3	2.2	.3	.0
15. Finance, insurance, real estate, rental, and leasing	4.3	.9	.7	.9	.3	1.4	.2	.0
16. Professional and business services	4.4	.3	.9	.2	1.0	1.7	.2	.0
17. Educational services, healthcare, and social assistance	3.6	-.1	.2	.4	1.4	1.6	.1	.0
18. Arts, entertainment, recreation, accomodation, and food servic	2.7	.1	.1	.4	.7	1.3	.2	.0
19. Other services	2.2	-.1	.1	.1	-.1	1.7	.6	.0
B. 1997 to 2002								
1. Private industries	3.5	1.1	.8	.7	.4	.2	.3	.0
2. Goods-producing industries	1.8	1.2	.2	.2	-.6	.3	.3	.1
3. Agriculture, forestry, fishing, and hunting	.4	1.2	.0	.1	-.6	-.7	.1	.2
4. Mining	-1.2	-.7	.1	.0	-1.0	.4	.0	.0
5. Construction	2.3	-.7	.1	.2	.8	1.5	.3	.0
6. Manufacturing	1.9	1.7	.2	.2	-.9	.4	.3	.1
7. Durable goods	2.5	2.7	.3	.2	-1.1	-.1	.3	.1
8. Nondurable goods	.6	.2	.2	.1	-.5	.6	.2	.0
9. Services-producing industries	3.8	.7	.9	.8	.7	.5	.2	.0
10. Utilities	1.3	.7	.3	.5	-.3	.0	.2	.0
11. Wholesale trade	4.1	2.1	.6	.3	.3	.8	.0	.0
12. Retail trade	5.0	2.2	.2	.2	.2	2.1	.1	.0
13. Transportation and warehousing	1.4	1.0	.6	.1	-.4	-.1	.1	.0
14. Information	7.8	1.1	1.6	.4	1.0	3.2	.4	.0
15. Finance, insurance, real estate, rental, and leasing	4.3	.4	1.0	1.3	.3	1.2	.2	.0
16. Professional and business services	4.4	-.6	1.1	.3	1.1	2.4	.2	.0
17. Educational services, healthcare, and social assistance	3.7	-.4	.2	.4	1.5	1.9	.2	.0
18. Arts, entertainment, recreation, accomodation, and food servic	2.5	-.1	.1	.5	.7	1.2	.2	.0
19. Other services	2.8	-.6	.1	.1	.3	2.6	.4	.0
C. 2003 to 2005								
1. Private industries	3.2	2.4	.3	.2	.2	-.5	.5	.1
2. Goods-producing industries	2.1	1.5	.0	.0	-.4	-.1	.7	.2
3. Agriculture, forestry, fishing, and hunting	2.8	2.6	.0	.4	-.7	-.1	.6	.0
4. Mining	1.4	-2.7	.1	.9	.7	1.0	.9	.4
5. Construction	3.5	-.4	.1	.1	.7	2.4	.5	.0
6. Manufacturing	2.0	2.2	.0	-.1	-.8	-.2	.7	.3
7. Durable goods	3.4	3.1	.0	-.1	-.9	-.1	1.0	.4
8. Nondurable goods	-.2	1.0	.0	-.1	-.7	-.7	.3	.1
9. Services-producing industries	3.0	2.2	.4	.3	.5	-.5	.3	.0
10. Utilities	-.8	2.2	.1	.6	-.4	-3.3	.1	.0
11. Wholesale trade	2.6	.1	.2	.1	.3	1.7	.1	.0
12. Retail trade	4.2	1.8	.1	.2	.0	2.0	.1	.0
13. Transportation and warehousing	3.4	1.8	.2	-.2	.4	.7	.5	.0
14. Information	5.2	5.5	.0	.0	-1.0	.4	.2	.0
15. Finance, insurance, real estate, rental, and leasing	4.3	1.6	.3	.3	.4	1.7	.1	.0
16. Professional and business services	4.5	1.8	.8	.2	.9	.6	.2	.0
17. Educational services, healthcare, and social assistance	3.4	.5	.2	.4	1.2	1.0	.1	.0
18. Arts, entertainment, recreation, accomodation, and food servic	3.0	.3	.1	.2	.6	1.6	.2	.0
19. Other services	1.2	.8	.0	.0	-.7	.2	.8	.0
D. Difference in Annual Averages, (2003 to 2005) vs. (1997 to 2002)								
1. Private industries	-.3	1.3	-.5	-.5	-.1	-.7	.2	.0
2. Goods-producing industries	.3	.3	-.2	-.1	.2	-.4	.5	.1
3. Agriculture, forestry, fishing, and hunting	2.4	1.4	.0	.2	-.1	.6	.4	-.1
4. Mining	2.6	-2.0	-.1	.9	1.8	.6	.9	.5
5. Construction	1.2	.2	-.1	-.1	-.1	.9	.3	.0
6. Manufacturing	.1	.5	-.2	-.3	.1	-.5	.4	.2
7. Durable goods	.9	.3	-.3	-.3	.2	.0	.7	.3
8. Nondurable goods	-.8	.8	-.1	-.2	-.1	-1.3	.1	.0
9. Services-producing industries	-.7	1.5	-.6	-.5	-.3	-.9	.0	.0
10. Utilities	-2.1	1.5	-.2	.1	-.1	-3.4	-.1	.0
11. Wholesale trade	-1.5	-2.0	-.3	-.2	.0	.9	.1	.0
12. Retail trade	-.8	-.4	-.1	-.1	-.2	-.1	.0	.0
13. Transportation and warehousing	2.0	.7	-.5	-.3	.8	.7	.5	.0
14. Information	-2.6	4.4	-1.6	-.4	-2.0	-2.8	-.1	.0
15. Finance, insurance, real estate, rental, and leasing	.0	1.2	-.7	-1.1	.1	.5	-.1	.0
16. Professional and business services	.1	2.4	-.3	-.1	-.2	-1.8	.0	.0
17. Educational services, healthcare, and social assistance	-.3	.9	.0	.0	-.3	-.9	.0	.0
18. Arts, entertainment, recreation, accomodation, and food servic	.5	.4	.0	-.2	-.1	.4	.0	.0
19. Other services	-1.6	1.5	-.1	-.1	-1.0	-2.4	.4	.0

1. Average annual rate for period shown. Column (1) is percent change. Columns (2) through (6) are percentage points.
2. Computers and peripheral equipment, software, and communication equipment.
3. Non-IT equipment, structures, and inventories.

Note—For each row, column (1) equals the sum of columns (2) through (8).

Table 5

Decomposition of sources of growth for U.S. private industries[1]

	MFP (1)	IT Capital[2] (2)	Other Capital[3] (3)	Labor (4)	Purchased Foreign Inputs: Other (6)	Purchased Foreign Inputs: Own (7)	*Memo:* Domar Wght. (8)
A. 1997 to 2005							
1. Private industries	1.55	.64	.52	.30	.37	.06	----
2. Goods-producing industries	.53	.07	.05	-.21	.18	.06	40.02
3. Agriculture, forestry, fishing, and hunting	.04	.00	.01	-.01	.01	.00	2.31
4. Mining	-.04	.00	.01	.00	.01	.00	2.24
5. Construction	-.06	.01	.02	.08	.03	.00	9.72
6. Manufacturing	.58	.05	.02	-.26	.13	.05	31.20
7. Durable goods	.51	.03	.02	-.17	.10	.05	17.64
8. Nondurable goods	.07	.02	.00	-.09	.03	.01	15.14
9. Services-producing industries	1.02	.58	.47	.52	.19	.00	82.04
10. Utilities	.04	.01	.02	-.01	.01	.00	3.57
11. Wholesale trade	.12	.04	.02	.03	.00	.00	9.20
12. Retail trade	.23	.02	.02	.02	.01	.00	11.29
13. Transportation and warehousing	.07	.03	.00	.00	.01	.00	5.59
14. Information	.22	.08	.02	.02	.02	.00	8.12
15. Finance, insurance, real estate, rental, and leasing	.23	.18	.24	.08	.04	.00	26.22
16. Professional and business services	.06	.16	.04	.17	.03	.00	17.07
17. Educational services, healthcare, and social assistance	.00	.02	.05	.18	.02	.00	13.13
18. Arts, entertainment, rec., accomodation, and food services	.00	.01	.03	.05	.01	.00	6.98
19. Other services	.00	.00	.00	.00	.03	.00	4.72
B. Difference in Annual Averages, (2003 to 2005) vs. (1997 to 2002)							
1. Private industries	1.30	-.53	-.45	-.14	.20	.05	----
2. Goods-producing industries	.10	-.09	-.06	.07	.17	.05	-1.93
3. Agriculture, forestry, fishing, and hunting	.03	.00	.00	.00	.01	.00	-.03
4. Mining	-.06	.00	.03	.04	.02	.01	.78
5. Construction	.02	.00	-.01	.00	.03	.00	.43
6. Manufacturing	.10	-.08	-.08	.03	.10	.04	-2.81
7. Durable goods	-.03	-.06	-.06	.05	.09	.03	-2.73
8. Nondurable goods	.12	-.02	-.03	-.02	.01	.00	-.49
9. Services-producing industries	1.21	-.45	-.39	-.22	.03	.00	.47
10. Utilities	.06	-.01	.00	.00	.00	.00	-.01
11. Wholesale trade	-.18	-.03	-.02	.00	.01	.00	-.28
12. Retail trade	-.04	-.01	-.01	-.02	.00	.00	.18
13. Transportation and warehousing	.04	-.03	-.02	.04	.02	.00	-.30
14. Information	.35	-.13	-.03	-.16	-.01	.00	-.21
15. Finance, insurance, real estate, rental, and leasing	.32	-.17	-.27	.03	-.02	.00	1.07
16. Professional and business services	.41	-.05	-.01	-.02	.00	.00	.21
17. Educational services, healthcare, and social assistance	.12	.00	.01	-.03	.00	.00	1.09
18. Arts, entertainment, rec., accomodation, and food services	.03	.00	-.02	-.01	.00	.00	.09
19. Other services	.07	.00	.00	-.05	.02	.00	-.08

---- not applicable

1. Average annual rate for period shown. All entries (except memo item) are percentage point contributions to the growth of private nonfarm business sectoral output.
2. Computers and peripheral equipment, software, and communication equipment.
3. Non-IT equipment, structures, and inventories.

Note—In each panel, row (1) equals, alternatively, the sum of rows (9) and (9) or the sum of rows (3) through (9) and rows (10) through (19).

Table 6
Sources of growth for U.S. manufacturing industries[1]

	Gross Output (1)	MFP (2)	IT Capital[2] (3)	Other Capital[3] (4)	Labor (5)	*Purchased Domestic Inputs* Other (6)	*Purchased Domestic Inputs* Own (7)	*Purchased Foreign Inputs* Other (8)	*Purchased Foreign Inputs* Own (9)
A. 1997 to 2005									
Durable goods:									
1. Wood products	0.6	0.6	0.0	0.0	-0.2	0.4	-0.4	0.2	0.0
2. Nonmetallic mineral products	1.1	0.6	0.1	0.2	-0.3	0.4	0.0	0.2	0.1
3. Primary metals	-1.0	0.9	0.0	-0.1	-0.9	-0.8	-0.5	0.2	0.2
4. Fabricated metal products	-0.5	0.8	0.1	0.1	-0.6	-0.6	-0.3	0.2	0.0
5. Machinery	-0.1	0.7	0.3	0.2	-1.0	-0.7	-0.1	0.4	0.1
6. Computer and electronic products	7.7	7.9	0.1	0.1	-1.2	-0.3	0.5	0.3	0.2
7. Electrical equipment, appliances, and components	-1.0	1.2	0.0	-0.1	-1.1	-1.0	-0.3	0.2	0.1
8. Motor vehicles, bodies and trailers, and parts	2.0	0.5	0.1	0.1	-0.4	0.5	0.2	0.7	0.4
9. Other transportation equipment	0.7	0.5	0.2	0.1	-1.2	0.7	-0.6	0.8	0.1
10. Furniture and related products	2.2	1.2	0.1	0.2	-0.5	0.8	0.0	0.4	0.0
11. Miscellaneous manufacturing	3.3	2.6	0.1	0.0	-0.8	0.8	0.1	0.4	0.1
Nondurable goods:									
12. Food and beverage and tobacco products	0.7	0.0	0.1	-0.1	-0.1	0.8	-0.1	0.1	0.0
13. Textile mills and textile product mills	-3.4	1.5	0.0	-0.2	-1.8	-1.5	-1.4	0.0	-0.1
14. Apparel and leather and allied products	-9.7	1.3	0.0	-0.1	-3.2	-6.5	-0.7	-0.4	-0.1
15. Paper products	-1.4	0.4	0.0	-0.2	-0.8	-0.5	-0.5	0.1	0.0
16. Printing and related support activities	-2.1	0.6	0.2	0.1	-1.0	-1.5	-0.4	0.0	0.0
17. Petroleum and coal products	-0.2	-0.3	0.1	-0.1	-0.1	-0.4	-0.3	0.4	0.4
18. Chemical products	0.4	0.8	0.2	0.1	-0.2	-0.4	-0.3	0.2	0.1
19. Plastics and rubber products	0.8	0.7	0.1	0.2	-0.5	0.0	0.0	0.4	0.0
B. Difference in Annual Averages, (2003 to 2005) vs. (1997 to 2002)									
Durable goods:									
1. Wood products	0.5	0.6	0.0	-0.1	0.3	0.3	-0.3	0.1	-0.2
2. Nonmetallic mineral products	1.4	0.9	-0.2	-0.3	0.1	0.4	0.2	0.3	0.1
3. Primary metals	3.1	0.0	-0.1	-0.1	0.6	-0.1	1.1	1.0	0.7
4. Fabricated metal products	-0.4	2.4	-0.1	-0.2	0.8	-2.5	-0.8	0.0	0.0
5. Machinery	6.1	2.7	-0.4	-0.3	0.8	2.4	0.1	0.8	0.2
6. Computer and electronic products	-0.4	-1.1	-0.5	-0.3	-0.2	0.2	-0.1	0.9	0.7
7. Electrical equipment, appliances, and components	1.6	-0.1	-0.1	-0.3	-0.4	1.5	0.2	0.6	0.1
8. Motor vehicles, bodies and trailers, and parts	-1.6	-1.0	-0.1	-0.2	0.0	-0.8	-0.4	0.5	0.2
9. Other transportation equipment	2.1	-0.2	-0.3	-0.2	-0.7	2.5	0.1	0.9	0.0
10. Furniture and related products	0.5	3.3	-0.1	-0.3	-0.2	-2.0	-0.2	-0.1	0.0
11. Miscellaneous manufacturing	-1.1	2.2	-0.1	-0.1	0.7	-2.7	-0.5	-0.3	-0.2
Nondurable goods:									
12. Food and beverage and tobacco products	0.1	0.4	-0.1	-0.1	-0.2	-0.4	0.5	0.1	-0.1
13. Textile mills and textile product mills	-1.7	3.1	-0.1	-0.2	-0.1	-3.1	-1.3	0.1	-0.2
14. Apparel and leather and allied products	1.3	1.0	-0.1	-0.2	-1.3	1.5	0.4	0.0	0.1
15. Paper products	-0.7	3.3	-0.1	-0.1	-0.3	-3.3	-0.5	0.2	0.1
16. Printing and related support activities	-1.4	2.4	-0.2	-0.2	-0.3	-2.5	-0.5	-0.1	0.0
17. Petroleum and coal products	-3.1	-0.1	0.0	0.1	0.0	-0.3	-0.9	-1.3	-0.7
18. Chemical products	-0.8	0.4	-0.3	-0.2	-0.2	-1.6	0.5	0.4	0.2
19. Plastics and rubber products	-0.7	1.0	-0.1	-0.4	0.0	-1.4	-0.2	0.4	0.0

1. Average annual rate for period shown. Column (1) is percent change. Columns (2) through (9) are percentage points.
2. Computers and peripheral equipment, software, and communication equipment.
3. Non-IT equipment, structures, and inventories.

Note—For each row, column (1) equals the sum of columns (2) through (9).

Table 7

Productivity and Foreign Outsourcing Growth

Variable	Coefficient	Industry Controls	R^2
foreign-other outsourcing	0.040 *		0.059
	(0.0197)		
foreign-other outsourcing	0.0432 *	**X**	0.454
	(0.0229)		
own-foreign outsourcing	-0.001		0.036
	(0.0028)		
own-foreign outsourcing	-0.001	**X**	0.428
	(0.0035)		
share of foreign-other outsourcing	0.062 *		0.069
	(0.0334)		
share of foreign-other outsourcing	0.048	**X**	0.445
	(0.0288)		
share of own-foreign outsourcing	-0.002		0.036
	(0.0024)		
share of own-foreign outsourcing	-0.001	**X**	0.428
	(0.0033)		

Note: Each regression includes time controls, Huber-White consistent standard errors, and corrects for within-group dependence over time. ***, **, and * represent 1, 5, and 10% significance respectively. Each variable is log-differenced.

Table 8

Employment and Foreign Outsourcing Growth

Variable	Coefficient	Industry Controls	R^2
foreign-other outsourcing	0.176 ***		0.243
	(0.0559)		
foreign-other outsourcing	0.1463 ***	**X**	0.474
	(0.0505)		
own-foreign outsourcing	0.022 **		0.093
	(0.0098)		
own-foreign outsourcing	0.016 **	**X**	0.370
	(0.0065)		
share of foreign-other outsourcing	0.140 **		0.116
	(0.0501)		
share of foreign-other outsourcing	0.182 ***	**X**	0.455
	(0.0407)		
share of own-foreign outsourcing	0.015 ***		0.067
	(0.0033)		
share of own-foreign outsourcing	0.011 ***	**X**	0.360
	(0.0027)		

Note: Each regression includes time controls, Huber-White consistent standard errors, and corrects for within-group dependence over time. ***, **, and * represent 1, 5, and 10% significance respectively. Each variable is log-differenced.