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Carol Corrado, Federal Reserve Board
Paul Lengermann, Federal Reserve Board
Eric J. Bartelsman, Free University, Amsterdam and Tinbergen Institute
J. Joseph Beaulieu, Brevan Howard, Inc.

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ABSTRACT

This paper introduces new estimates of aggregate, sectoral, and industry productivity based on a solid framework for how industry and sectoral MFP feed into aggregate MFP. In addition, they are developed using industry data classified according to NAICS from 1987 on. Our sectoral approach confirms that the pick up in U.S. productivity in the late 1990s was not solely concentrated among producers of high-technology equipment and software, and that a surge in innovations in the retail and wholesale trade industries (the distribution sector) also contributed importantly to economic growth. More importantly, our work sheds light on the sources of the continued strong performance of U.S. productivity since 2000. We find that the major sectoral players in the late 1990s pickup were not contributors to the more recent surge in productivity. Rather, striking gains in MFP in the finance and business services sector, a resurgence in MFP growth in the industrial sector, and an end to drops elsewhere more than account for the acceleration in productivity growth in recent years.

KEYWORDS: Economic growth, multi-factor productivity, technical change, industry productivity.

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As the step-up in U.S. productivity growth in the mid-1990s became evident, research on productivity surged. Initially, the new work concentrated on estimating the contribution of information technology (IT) to the productivity pickup, with similar results obtained using industry-level or broad macroeconomic time-series data (Jorgenson and Stiroh 2000, Oliner and Sichel 2000, respectively). Later, studies exploited more detailed data and showed that, while multi-factor productivity (MFP) growth in the IT-producing industries was very high, many services industries also had substantial MFP growth in the late 1990s (Triplett and Bosworth 2004; Jorgenson, Ho, and Stiroh 2005a, 2005b).

It is not surprising that disaggregate data were needed to establish that the resurgence in U.S. productivity growth in the late 1990s went beyond the production of IT and was based, at least in part, in increases in MFP growth in some services industries.[1] Detailed analysis had previously documented that many services industries had flat or declining trends in labor productivity for twenty or more years before the pickup in the late 1990s became evident (Corrado and Slifman 1999). The discovery that the "use of IT" story was mostly a services phenomenon (Stiroh 1998, Triplett 1999) also required disaggregate data to determine which industries were investing in the newer technologies. In some sense, the well documented variability in the diffusion of new technology and innovation across ranges of products (Mansfield 1968, Gort and Klepper 1982) has long suggested that the available industry data should be studied to detect and identify changes in productivity.

Given the importance of prospects for productivity growth in the formulation of economic policy and forecasts, this paper addresses the following question: Can information on industry-level productivity be used to inform estimates of the current and prospective trend in aggregate MFP growth? Data hurdles—mainly the lag in the availability of data by industry—have long inhibited a detailed analysis of the latest

[1] This refers to the conventional representation of IT in the neoclassical growth accounting framework, which does not rule out the existence of externalities (or network effects) from IT. If such effects are present, the conventional framework will attribute them to MFP.

productivity developments, despite the potential importance of this information for macroeconomic policy analysis. In recent years, however, the Bureau of Economic Analysis (BEA) has expanded and sped up the issuance of its industry accounts, input-output information, and capital flow tables. Nonetheless, these key ingredients to productivity measurement and analysis still lag one or more years, and estimates for very recent years are subject to considerable revision (Anderson and Kliesen 2005).[2]

Moreover, the U.S. industry data have been undergoing a long transition to a profoundly new classification system (NAICS). As a result of the move to NAICS, substantial portions of the underlying source data used to estimate industry productivity (mostly in services) have a break in their time series or are available for a relatively short number of years. Although the BEA's GDP-by-industry accounts are now on a NAICS basis back to 1987, this is a rather short period for productivity analysis. Moreover, the effort to create BEA's historical NAICS data required many assumptions (Yuskavage and Pho 2004), and consistent industry employment and hours-worked data are not available for even this foreshortened period.

Despite these hurdles and caveats, we address the question of how to estimate the current trend in MFP from industry-level data because the prospects for MFP growth play such an important role in economic policy analysis and forecasting. We do this by creating estimates of industry-level productivity using all the available information, but then aggregating the results to six sectors that we believe both illuminate key trends and developments in productivity in the United States and traverse some of the most serious breaks and problems in the data. We show that the six sectors have highly divergent trends in MFP growth, a result that we believe, in itself, strongly suggests disaggregate data are extremely useful for determining the current trend in aggregate MFP.

We find that no matter how one looks at the late 1990s, the U.S. productivity resurgence was a sectoral story, with notable increases in the rate of change in MFP for some sectors partly offset by small step-downs in others. In terms of the sources of

[2] As of this writing, the most recent, comprehensive, consistent data on detailed industry output are available from the BEA and cover the years 1987 to 2004. These data, which include industry output, intermediate inputs, and factor shares for 66 industries, were updated on December 15, 2005 to include the results of the July 2005 NIPA revision through the year 2004. BEA's data on investment and net capital stocks by detailed industry also cover the years 1987 to 2004 and were updated on November 21, 2005 to include the results of the July 2005 NIPA revision through the year 2004.

economic growth since 2000, our results show that productivity (MFP) has been the major contributor. We also estimate that the rate of change in aggregate MFP picked up notably since 2000, driven primarily by striking results for finance and business services. Although the major players in the productivity pickup in late 1990s—the tech sector and retail and wholesale trade—were not players in the *acceleration* since then, we estimate that the rate of MFP growth in these sectors continued to be robust. All told, we find that by 2004 the resurgence in productivity growth that started in the mid-1990s was relatively broad-based by major producing sector.

That said, many inconsistencies and "holes" in the available data first had to be addressed before we could conduct our analysis, a task that was conducted using the tools of the FRB productivity system (Bartelsman and Beaulieu 2003). The most significant hurdles we faced were generating historical estimates of labor input by detailed NAICS industry and disaggregating selected BEA industry accounts in order to define appropriate sectors, especially a high-tech sector. As a consequence, one by-product of our work is a detailed SIC-to-NAICS concordance for non-manufacturing industries.[3]

The plan of this paper is as follows: The next section of this paper spells out our theoretical framework. That is followed by three sections that review the basic elements in our system: measures for industry-level growth accounting, measures of sectoral output and purchased inputs for aggregates of industries, and a structure for aggregating industries to sectors and to the total economy. We then present our results and suggest how measures of sectoral and industry productivity can be used to inform estimates of the trend in aggregate productivity.

1. MFP at the aggregate and industry level.

Productivity for the economy as a whole and productivity for industries are related using the framework of Domar (1961). This framework enables MFP growth at any level of aggregation to be decomposed into contributions from underlying sectors or industries. Hulten (1978) and Gollop (1979, 1983) further developed the framework, and it has been used in several prominent studies of U.S. productivity growth (e.g., Jorgenson, Gollop,

[3] For manufacturing, we incorporate the Bayard and Klimek (2004) concordances that were derived from Census Bureau microdata for "Census" years (1992, 1987, 1982, and so on) and used for the rebuilding of the Federal Reserve's industrial production (IP) index according to NAICS back to 1972.

Table 1. Notation and Definitions

A. *Notation:*

X_{ij}	**Generic element in an industry-by-industry input-output (I-O) system**	Each element in row *i* of the table shows shipments of producer *i* to purchaser *j*, where *j* is either in the set of domestic industries T, or a component of final demand, F ($j \in T \cup F$). Each element of column *j* of the table shows industry *j*'s purchases of producer *i*'s output, where *i* is in the set of domestic industries T, or in the 'import' industry, R ($i \in T \cup R$).
$X_{k\bullet}$	**Intra-industry shipments from/to *k*** ($k \in T$)	The shipments of producers in *k* to all other producers within *k*. Note that "*k*" can refer to a particular industry or to a collection of industries in the total set of domestic industries. The special subscript "•" indicates that $X_{k\bullet}$ is constructed from information from both rows and columns of the I-O table, and that aggregation takes place over both producing and purchasing industries.

(Table 1 continued on facing page.)

and Fraumeni 1987, and Gullickson and Harper 1999). The definitions and notation we employ in this paper are grounded in industry-by-industry input-output (I-O) relationships as laid out in table 1. Note that bolded letters denote growth rates in real terms and that the subscripts "*T*" and "*k*" refer to the total economy and its component domestic industries, respectively.

The items defined in table 1 are used to illustrate the basic Domar result that the rate of change in aggregate multi-factor productivity ($\boldsymbol{MFP}_T$) can be expressed as a weighted average of the rates of change in underlying industry-level multi-factor productivity ($\boldsymbol{MFP}_k$):

$$(1) \qquad \boldsymbol{MFP}_T = \sum_{k \in T} \frac{S_{k\bullet}}{S_T} \boldsymbol{MFP}_k .$$

Each industry-level productivity change in equation (1) is calculated residually from changes in Divisia quantity indexes for the industry's output ($\boldsymbol{S}_{k\bullet}$) and share-weighted inputs ($\boldsymbol{I}_{k\bullet}$):

$$(2) \qquad \boldsymbol{MFP}_k = \boldsymbol{S}_{k\bullet} - \boldsymbol{I}_{k\bullet} ,$$

and the "Domar" weights in equation (1) have the following property:

$$(3) \qquad \sum_{k \in T} \frac{S_{k\bullet}}{S_T} > 1 .$$

Table 1. Notation and Definitions (continued)

B. *Definitions:*

	Gross output	Production in industry *k* (which may be an aggregate of underlying industries or producers) equals shipments plus work-in-progress and finished inventories for goods producers; revenue for service providers. The cost of goods sold without further processing is excluded, which especially is relevant for the trade industries.
Q_k	$\sum_{j \in T \cup F} X_{k,j}$	
	Intermediate inputs	Inputs purchased by producers in industry *k* for use in production. Examples include electricity by retailers, steel by automakers, etc. Excludes imports. Equals:
M_k	$\sum_{i \in T} X_{i,k}$	
$X_{k\bullet}$	$\sum_{i \in k} X_{i,k}$ or $\sum_{j \in k} X_{k,j}$	Inputs purchased from, or sold to, producers *within* the own industry *k*, plus:
$N_{k\bullet}$	$\sum_{i \in T; i \notin k} X_{i,k}$	Inputs purchased by industry *k* from *other* domestic industries. (Note that when aggregating across industries, more purchasers and fewer suppliers are included, and that N_T=0), plus:
R_k	$\sum_{i \in R} X_{i,k}$	Imported inputs, that is, intermediates purchased by industry *k* from the import "industry."
	Sectoral output	Equals production in industry *k* that is shipped outside the industry, i.e. to *other* industries and to final demand. Equals the sum of the cost of labor, capital, inputs from *other* domestic industries, and inputs from the import industry.
$S_{k\bullet}$	$Q_k - X_{k\bullet} = \sum_{j \in T \cup F;\, j \notin k} X_{k,j}$	
	or	
	$L_k + K_k + N_{k\bullet} + R_k$	
	Value added	Gross output less intermediate inputs; equal to the sum of the the income paid to primary factors of production, or the cost of labor (L_k) and capital (K_k) inputs.
V_k	$Q_k - M_k$	
	or	
	$L_k + K_k$	
$\boldsymbol{I}^S_{k\bullet}$	**Sectoral inputs (real)**	Share-weighted growth of real inputs to production (labor, capital, and purchased inputs from other domestic industries/sectors and imports.
	$s^L_k \boldsymbol{L}_k + s^K_k \boldsymbol{K}_k + s^N_k \boldsymbol{N}_{k\bullet} + s^R_k \boldsymbol{R}_k$	
$\boldsymbol{I}^V_k$	**Value-added inputs (real)**	Share-weighted growth of real value-added inputs (labor and capital) for an industry or sector.
	$v^L_k \boldsymbol{L}_k + v^K_k \boldsymbol{K}_k$	
	Aggregate sectoral output	For the total economy, T, aggregate sectoral output is the sum of each domestic industry's deliveries to final demand, F. Equals GDP plus the value of imported inputs.
S_T	$\sum_{k \in T} X_{k,F}$	
	or	For major sectors, such as nonfarm business, sectoral output is the sum of each component industry's shipments to final demand and other domestic producers (in which case "F" denotes final users), and the value of sectoral output includes the value of purchased inputs *from* these producers (such as farms) as well as the value of labor, capital, and imported inputs. Thus, if the "total" economy aggregate "*T*" is a major sector, then $N_T \neq 0$.
	$L_T + K_T + R_T$	
	Aggregate value added	The sum of value added in all domestic industries is the sum of each industry's deliveries to final demand less the value of imported inputs used in production, which equals aggregate sectoral output less imported intermediates. T *must* represent the Total Economy for this identity to hold. $V_k = S_{k\bullet} - R_k - N_{k\bullet}$ holds for any *k*.
V_T	$\sum_{k \in T} (X_{k,F} - R_k) = S_T - R_T$	
	or	
	$L_T + K_T$	

Note—Plain upper case variables are nominal values; bolded variables are growth rates of Divisia quantity indexes; and plain lower case variables are factor cost shares.

The weights on the changes in industry-level MFP in equation (1) reveal the effect that a change in each industry's productivity has on the change in aggregate productivity. The weights sum to more than one because each industry contributes to aggregate productivity *directly* through its deliveries to final demand and *indirectly* through its deliveries to industries that purchase its output.

The sectoral output concept. The Domar framework uses the concept of sectoral output—defined as the gross output of an industry or sector less the amount produced and consumed within the industry or sector—to model production for an industry or a sector. This output concept has an interesting property: Although it is very close to gross output at the detailed industry level, as we move up an aggregation hierarchy of producing units, sectoral output strips out what each aggregate *collectively* uses up in production and moves closer and closer to value added.

Sectoral output for the total economy is thus the sum of each domestic industry's deliveries to final demand. This includes the value of intermediate inputs purchased from the rest-of-the-world (imports) and therefore differs from aggregate value added (GDP). Because the output of an industry, a collection of industries, or the whole economy is viewed, in effect, as production by a single vertically-integrated firm, the Domar or sectoral framework has come to be called the "deliveries-to-final demand" framework for studying industry productivity (Gollop 1979).

The framework—whatever it is called—has several useful properties for macro-productivity analysis. First, it yields the standard Solow-Jorgenson-Griliches decomposition of the sources of aggregate economic growth (Hulten 1978). Second, it allows for an explicit role for imports in aggregate production (Gollop 1983), a feature which is highly relevant given recent trends in outsourcing and offshoring. Third, the framework permits an assessment of the role of "intermediate" aggregates, or sectors, in the productivity performance of the overall economy.

If we were only interested in moving from results for individual industries to aggregate MFP, it would not be crucial to use sectoral output to calculate MFP.[4]

[4] MFP calculated using sectoral output is related to MFP calculated using gross output by a factor of proportionality equal to the ratio of gross output to sectoral output, and at a detailed industry level, gross output and sectoral output are quite close. If aggregate value added and aggregate sectoral output also are very close, then the relationship between industry and aggregate productivity can be studied by

Similarly, if we were only interested in results for aggregate MFP, it would not be necessary to include imported inputs along with labor and capital as primary factors of production.[5] However, we hope to show that the ability to model industry production appropriately, account for imported inputs, and exploit the vertical structure of the economy in aggregation is critical for understanding the factors that have driven recent productivity developments.

Growth accounting with sectoral output. Domar and Hulten showed that productivity calculated using disaggregate measures and equation (1) is identical to productivity obtained residually from appropriately aggregated measures of sectoral output and inputs:

$$(1') \qquad \boldsymbol{MFP}_T = \boldsymbol{S}_T - \boldsymbol{I}_T^S \ ,$$

where $\boldsymbol{S}_T$ is the aggregate real growth of each industry's deliveries to final demand and $\boldsymbol{I}_T^S$ is the share-weighted growth of real inputs to production for the total economy.

The results for MFP from (1′) and (1) are equivalent when the aggregate primary factor inputs—labor, capital, and imported inputs—are defined in the appropriate way. Aggregate primary factor inputs are usually defined as the share-weighted growth of industry factor inputs where the weights are the industry's share of the cost of the factor for the total economy (Schreyer 2001). This formulation can be readily shown to be equivalent to a Domar-weighted (that is, sectoral output-weighted) aggregate of the industry-level primary factor input contributions.[6]

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implementing (2) with industry-level productivity calculated using gross output and using gross output relative to aggregate value added as "Domar" weights. This general approach has been used in many productivity studies.

[5] This is the approach taken by the BLS. Although the BLS productivity statistics are grounded in the same framework we use in this paper (e.g., Gullickson 1995, Gullickson and Harper 1999, Harper and Dean 2000, and Fraumeni, Harper, Powers, and Yuskavage 2004), the BLS implementation uses aggregate value added, rather than sectoral output, to calculate MFP. According to the BLS, value added is used because the difference between value added and sectoral output is small, and value added is a more familiar concept.

[6] Using the notation in table 1, the usual aggregate formulation for labor input is $\boldsymbol{L}_T = \sum_k (L_k / L_T)\ \boldsymbol{L}_k$, and the contribution of labor input to aggregate output growth is $s_T^L\ \boldsymbol{L}_T$, or $s_T^L \sum_k (L_k / L_T)\ \boldsymbol{L}_k$. This expression is equal to the Domar-weighted aggregate of industry-level contributions, $\sum_k (S_k / S_T)\ s_k^L \boldsymbol{L}_k$: Substituting (L_k / S_k) for s_k^L in the latter and (L_T / S_T) for s_T^L in the former, the equivalence is readily established and can be similarly established for capital and imported intermediate inputs.

As indicated, aggregate MFP growth is often estimated using value added as the output concept and only labor and capital as primary factor inputs:

$$(4) \qquad \boldsymbol{MFP}_T^V = \boldsymbol{V}_T - \boldsymbol{I}_T^V \ .$$

But, as pointed out by Gollop (1983), in an open economy aggregate MFP calculated using the deliveries-to-final demand framework differs from aggregate MFP calculated using (4). The relation between the two results is obtained from the expressions and definitions in table 1 and is given as follows:[7]

$$(5) \qquad \boldsymbol{MFP}_T^V = \left(\frac{S_T}{V_T}\right) \boldsymbol{MFP}_T \, .$$

Because the value of aggregate sectoral output (S_T) exceeds the value of aggregate value added (V_T) in an open macro-economy, the use of equation (4) to calculate the growth of aggregate MFP has the effect of *overstating* the estimate of MFP growth relative to the result that would be generated using equation (1) or (1′). Equation (5) is used to compare our aggregate MFP results calculated using (1) to the official MFP estimates that are calculated using (4).

Because we use the deliveries-to-final demand model, our macro growth accounting must be augmented to specify the contribution of imported inputs. From table 1 and the above analysis, our total economy sources-of-growth decomposition is thus written as follows:

$$(6a) \qquad \boldsymbol{S}_T = \sum_k \frac{S_k}{S_T} \left[\boldsymbol{MFP}_k + s_k^L \boldsymbol{L}_k + s_k^K \boldsymbol{K}_k + s_k^R \boldsymbol{R}_k \right] \ .$$

The terms in the brackets are the industry-level MFP results ($\boldsymbol{MFP}_k$) calculated using equation (2) and the Domar-weighted industry-level contributions of labor, capital, and imported inputs used in those calculations.

The decomposition of growth in subaggregates of industries takes a similar form, but new sector-specific Domar weights are needed to reflect the less vertically-integrated

[7] The relation between the MFP result given by (1) or (1′) and the MFP result given by (5) is established by noting that $\boldsymbol{V}_T = (S_T / V_T)\ \boldsymbol{S}_T - (R_T / V_T)\ \boldsymbol{R}_T$ and that $v_T^L = s_T^L (S_T / V_T)$ and $v_T^K = s_T^K (S_T / V_T)$. Substituting these expressions in (1′) and rearranging terms gives equation (5).

structure of the subaggregate. In addition, account must be taken of purchased domestic inputs from outside the own sector:

$$(6b) \qquad \boldsymbol{S}_{A\bullet} = s_A^N \boldsymbol{N}_{A\bullet} + \sum_{k \in A} \frac{S_{k\bullet}}{S_{A\bullet}} [\boldsymbol{MFP}_k + s_k^L \boldsymbol{L}_k + s_k^K \boldsymbol{K}_k + s_k^R \boldsymbol{R}_k] \ .$$

The subscript *A* in (6b) denotes a sectoral subaggregate of industries, and the first term is the share-weighted growth of purchased domestically-produced inputs from outside the sector. As with the Domar weights, accounting for these purchases is specific to the subaggregate and is based on industry-by-industry I-O relationships. The terms in brackets—the estimates of industry-level MFP and labor, capital, and imported inputs contributions (for the included industries)—are the same as in equation (6a).

When the results for the terms inside the brackets in equation (6b) are scaled by $(S_{A\bullet} / S_T)$ and summed over all major producing sectors, we obtain the full vertical and horizontal decompositions of economic growth. That is, the result of:

$$(6c) \qquad \sum_{A \in T} \frac{S_{A\bullet}}{S_T} \sum_{k \in A} \frac{S_{k\bullet}}{S_{A\bullet}} [\boldsymbol{MFP}_k + s_k^L \boldsymbol{L}_k + s_k^K \boldsymbol{K}_k + s_k^R \boldsymbol{R}_k]$$

for each term in the brackets—MFP, and the labor, capital, and import contributions—yields the corresponding term in the aggregate decomposition, equation (6a).

In our work, we calculate industry-level MFP using equation (2) and aggregate MFP using equation (1). We then use the results in equations (6b) and (6c) to obtain sources-of-growth decompositions for major productivity aggregates and subaggregates.

2. Measures of output and inputs for individual industries.

The estimation of industry-level multifactor productivity using equation (2) requires the following empirical elements: growth rates of real sectoral output for each industry ($\boldsymbol{S}_{k\bullet}$), growth rates of the inputs to production (labor, capital, imported inputs, and inputs from other domestic industries) for each industry ($\boldsymbol{L}_k$, $\boldsymbol{K}_k$, $\boldsymbol{R}_k$, and $\boldsymbol{N}_{k\bullet}$), and income shares for each input for each industry (s_k^L, s_k^K, s_k^R, and s_k^N).

The nominal values of sectoral output for each industry were determined from input-output (I-O) relationships. We use BEA's annual I-O accounts for 1998 to 2004, which have been integrated with the industry accounts and the NIPAs for those years, to

derive annual values for $X_{k\bullet}$.[8] We did not incorporate information from benchmark I-O accounts for earlier years because the earlier accounts neither conform to the NIPAs nor the classification of industries according to NAICS. The 1998 relationships ($X_{k\bullet}$ relative to Q_k) are used to derive values of sectoral output ($S_{k\bullet}$) from data on gross output for all earlier years.[9] The data on gross output are from BEA's industry accounts dataset.

The creation of $S_{k\bullet}$ (from Q_k and an estimate of $X_{k\bullet}$ based on I-O relationships) also determines the value of purchased inputs from *other* industries ($N_{k\bullet} + R_k$), that is, the sum of purchased inputs from other domestic industries and from the "import" industry. This is because total intermediate inputs (M_k) equals the sum of inputs produced within the industry and those purchased from other industries (see table 1), and time series for M_k for each industry are available in BEA's industry accounts dataset. Thus, a time series for the value of $N_{k\bullet} + R_k$ is obtained by subtracting our estimates of $X_{k\bullet}$ from the BEA data for total intermediate inputs,

$$N_{k\bullet} + R_k \;=\; M_k - X_{k\bullet} \;\; .$$

Note that because we do not have the actual relationships between $S_{k\bullet}$ and Q_k prior to 1998, this method of computing $N_{k\bullet} + R_k$ implies that the true (but unobserved) variation in the relationship between $S_{k\bullet}$ and Q_k prior to 1998 is absorbed as variation in $N_{k\bullet} + R_k$.

From 1998 on, the value of imported inputs for each industry is estimated by, first, calculating the ratio of total imported intermediates implied by the 1998 import commodity flow table to the value of total intermediates (including imports) from the I-O table. Then, this ratio is applied to the BEA industry-level data on total intermediate inputs. Prior to 1998, detailed data on imports by commodity are used to extrapolate each cell in the import commodity flow table (see footnote 8) back to 1987. The results are then summed over commodities, and a ratio comparable to that used from 1998 on for estimating R_k from a time series on M_k is obtained.

Last, given estimates of R_k and of $N_{k\bullet} + R_k$ from 1987 on, the time series for purchased domestic inputs for each industry ($N_{k\bullet}$) is obtained by subtraction. The share

[8] Industry-by-industry I-O tables were created in which imports were treated as a separate industry. BEA's make and use tables were combined using the "industry" technology assumption, and an import commodity flow table was created assuming imported intermediates by industry are always net of own use.

[9] Although the published 1997 I-O table is on a NAICS basis, it is not consistent with the annual tables from 1998 on that have been integrated with the NIPAs. Our calculations for certain industries using the 1997 table revealed some discontinuities that we avoid by using 1998 relationships for 1997 and prior years.

weights for both types of purchased inputs in the growth accounting (s_k^N and s_k^R) are a straightforward computation, given complete time series for the values of $N_{k\bullet}$, R_k , and $S_{k\bullet}$ for each industry.

The growth of real industry-level sectoral output ($\boldsymbol{S_{k\bullet}}$) is determined from quantity indexes constructed by assuming the real value of inputs produced and consumed within the industry ($\boldsymbol{X_{k\bullet}}$) has the same price index as the industry's gross output.[10] The growth rate of imported intermediates purchased from the 'import industry ($\boldsymbol{R_k}$) is calculated from by deflating the estimated the value of imports for an industry with an industry-specific import deflator. The deflator is calculated by assuming that each cell in a row of the import commodity flow table has the same price as the domestic counterpart; the domestic commodity prices are then aggregated over import-types to generate a specific deflator for imported inputs by each using industry. Finally, the growth rate of intermediates purchased from other industries ($\boldsymbol{N_{k\bullet}}$) is calculated by chain stripping the real values of $X_{k\bullet}$ and R_k from the real value of $M_{k\bullet}$, for which value, price, and quantity measures are included in BEA's industry accounts dataset.

Changes in industry capital input measures ($\boldsymbol{K_k}$) were derived using BEA's detailed asset-by-industry net stocks. We follow the approach taken by the BLS and a long literature beginning with Jorgenson and Griliches (1967) and aggregate asset-by-industry capital stocks using *ex post* rental prices. The BEA's capital stocks differ from the "productive" stocks compiled by the BLS, however, because the two agencies use different models of capital depreciation (U.S. Department of Labor, 1983).[11] When we began this project, we were unable to calculate productive stocks because the BEA's publicly available data on investment by NAICS industry only began in 1987 and were insufficient for this purpose.[12] Although more historical NAICS investment data are now

[10] Because our estimates of purchased inputs for own use are a constant fraction of gross output prior to 1998, the growth of real sectoral output is the same as the growth in real gross output prior for those years.
[11] See also "Revisions to Capital Inputs for the BLS Multifactor Productivity Measures" on the BLS website (http://www.bls.gov/web/mprcaptl.htm).
[12] This is because the BLS's productive stocks are developed from an age-efficiency function that shows a slow decline in efficiency during the early years of an asset's life (a concave form), and the use of this function requires knowing the distribution of past investments to calculate stocks for a given year. Only in the case of geometric decay (a convex form) is the accrued efficiency loss for a year equal to a constant percentage of the stock in a prior year. Most of the BEA's stocks are generated under the assumption of geometric decay (Fraumeni 1997). This approach is generally supported by the literature (Hulten and

available, we are comfortable adopting the BEA model because the differences between the two approaches are very small (see U.S. Department of Labor, 1983, pp. 56-59). For further information on the estimation of user costs and capital input using the BLS model in the FRB productivity system, see Bartelsman and Beaulieu (2003, 2005).

Following numerous productivity studies, we aggregate the many detailed asset types into three aggregates for our sources-of-growth analysis: information technology (IT) capital, other equipment, and structures.[13] Although production theory would suggest that we also include inventories and land as capital assets (Diewert 1980), we do not now incorporate them in our analysis. Although these assets play a very small role in explaining trends in output and productivity growth during the period we study, inventories are generally important for modeling manufacturing productivity. Given our sectoral focus and emphasis on studying and interpreting recent developments, we plan to treat inventories as a capital asset in future work. On the other hand, data on land and its industry distribution are problematic (see Jorgenson, Ho, and Stiroh 2005b, p. 166-7), but we believe that the omission of land as a capital asset presents little drawback to the analytical value of the estimates reported in this paper.

Changes in industry labor input measures ($\boldsymbol{L}_k$) are changes in hours worked of all persons with no explicit differentiation by characteristics of workers. As indicated previously, the underlying source data on employment and hours contain serious breaks due to the introduction of NAICS, and it was necessary to use numerous basic data sources and the tools of the FRB productivity system to develop the industry-level labor input measures needed for equation (2). It was possible to develop these estimates (see discussion below) because the Census Bureau provided detailed SIC-to-NAICS concordances for data on industry employment, output, and payroll in 1997. Without similar information on changes in the occupational structure of the industry-level workforce, it is virtually impossible to update our earlier work (Bartelsman and Beaulieu

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Wycoff 1981a, 1981b), but important departures include computers and motor vehicles for which the BEA uses asset-specific models based on more recent research on capital depreciation.

[13] IT capital is defined as computers, communications equipment, and software.

2005) that used information on wages and occupations from BLS's Current Population Survey (CPS) to adjust for worker "quality" at the industry level.[14]

In order to exploit all available industry-level information, we differentiate hours worked implicitly by using the very detailed information on industry-level employment and payrolls from the *County Business Patterns* (CBP) series issued by the Census Bureau. The BEA industry accounts dataset contains several industry "atoms" that are at relatively high levels of industry aggregation (e.g., retail trade and construction). Using the full detail of the available establishment-level employment and payroll data thus enables us to better control for the effects of worker heterogeneity on labor input and productivity. It should be noted that because NAICS groups establishments according to similarity of production process, this implicit approach to the differentiation of workers by detailed industry of employment is more plausible than it was under the SIC.

The procedure used to develop the historical NAICS industry-level labor input data is detailed in Appendix A and summarized here as follows: (a) An earlier vintage of unpublished BEA data on hours worked by employees by detailed 1987 SIC industry was updated and controlled to be consistent with current published data (NIPA table 6.9B), which are available from 1987 to 2000 for more aggregated industries; (b) a concordance for employment between the 1987 SIC and the 1997 NAICS was developed at a highly detailed level using data from the Census Bureau;[15] (c) the concordance was applied to adjusted BEA/BLS hours and employment data in an overlap year;[16] and (d) data were created for changes in employment, hours worked of employees, and hours of all persons for use with the data on NAICS industries in BEA's industry accounts from 1987 to

[14] The BLS introduced NAICS industries and a new occupational structure with the publication of the March 2003 CPS. The results for the new NAICS industry, Management of Companies (NAICS 55), are implausible, however, in that only a minuscule number of workers were identified as working in the industry and the industry exhibited a highly unstable occupational structure in subsequent years (i.e., from 2003 to 2005). We believe that it is very difficult to use the currently available CPS data to estimate a time-series of consistent labor quality adjustments by NAICS industry.

[15] The basic source for this concordance is the establishment-based 4-digit SIC to 6-digit NAICS concordance from the 1997 Economic Census on the Census Bureau's website. Our final results blend in (1) information on auxiliaries from the 1997 Economic Census and (2) data from County Business Patterns and other sources on industries excluded from the Economic Census.

[16] The BEA's data for employment and hours are mostly derived from establishment-based surveys conducted by the BLS. Because of numerous differences in the way in which NAICS was implemented by the Census Bureau and the BLS, we found it was necessary to adjust the BEA/BLS data to conform more closely to the industry composition of Census data to develop historical NAICS data. For further details, see Appendix A.

2004.[17] The CBP employment and payroll data used for the implicit differentiation of workers was obtained by concording the CBP data on the 1987 SIC to the 1997 NAICS using the detailed Census-based concordance.

As previously indicated, the series for hours worked of all persons is the industry labor input measure that is used in our MFP estimates.[18] Data for hours of all employees are needed (in conjunction with data on hours of all persons) to impute the compensation of nonemployees and calculate the primary factor input shares for the growth accounting (s_k^L and s_k^K). Compensation of nonemployees is imputed using the usual assumption that the average compensation per hour of a self-employed person equals that of an employee, and the initial shares of labor and capital are adjusted accordingly (Schreyer 2001). Our final adjusted sectoral labor and capital shares are given by:

$$s_k^L = \left(\frac{L_k}{S_{k\bullet}}\right)\left(\frac{\text{Hours of all persons}_k}{\text{Hours of employees}_k}\right) \quad \text{and} \quad s_k^K = \left(\frac{V_k}{S_{k\bullet}}\right) - s_k^L \ .$$

All factor share weights are computed relative to the industry's income after excluding taxes on production and imports.

3. Measures of output and purchased inputs for aggregates of industries.

The deliveries-to-final-demand framework allows MFP growth for a sectoral subaggregate of industries ($\boldsymbol{MFP_A}$) to be obtained from the same industry-level empirical growth accounting elements described in the previous section. The only additional information that is needed is a Domar weight for the sector $(S_{A\bullet}/S_T)$. This is because the change in MFP for a sectoral subaggreate is readily shown to be equivalent to the weighted sum of the productivity change for each industry in the sector where the weights are each *industry's* Domar weight multiplied by the inverse of the *sector's* Domar weight, that is,

$$\boldsymbol{MFP_A} = \sum_{k\in A}(S_{k\bullet}/S_{A\bullet})\,\boldsymbol{MFP}_k = (S_T/S_{A\bullet})\sum_{k\in T}(S_{k\bullet}/S_T)\,\boldsymbol{MFP}_k \ .$$

[17] From 1998 on, our industry-level NAICS data on employment and hours are the extrapolated *changes* implied by the published BEA/BLS NAICS data. For further details, see Appendix A.

[18] The data for hours of all persons were created by assuming that self-employed persons in an industry work the same number of hours per week as the full-time equivalent employees in that same industry.

Likewise, the framework allows for computing and decomposing each industry's contribution to MFP growth for a major aggregate (e.g., the nonfarm business sector) whose scope is smaller than the total economy. The nominal values for major or sectoral subaggregates of industries, which are needed for the Domar weights, are computed from I-O relationships in the same fashion as for individual industries described in the previous section.

To obtain a full sources-of-growth decomposition for a major aggregate or a sectoral subaggregate of industries, the rates of growth of the aggregate's *real* sectoral output ($\boldsymbol{S_{A\bullet}}$) and its *real* purchased inputs from other domestic sectors ($\boldsymbol{N_{A\bullet}}$) also are needed. We compute the change in real sectoral output for aggregates of industries in essentially the same manner as we compute real industry-level sectoral output, namely, using data on industry-level gross output and purchased inputs. But we must recognize that the industry (commodity) composition of an aggregate's intra-sectoral inputs ($X_{A\bullet}$) is different from that of its gross output (Q_A), and further detail from the I-O system is needed. To ensure that all relevant prices and quantities are used to compute $\boldsymbol{S_{A\bullet}}$, we need information on *each* domestic industry's inter-sectoral flows for *each* possible higher-level aggregate or subaggregate of interest—information that is not necessary for just computing MFP for aggregates and subaggregates of industries.

By using such detailed I-O information, we achieve more accurate measures of $\boldsymbol{S_{A\bullet}}$ for each aggregate and subaggregate in our system. What does this additional information this buy us? With accurate estimates of the real change in sectoral output for all higher-level aggregates of industries, we calculate the contribution of purchased inputs from other domestic sectors, $\boldsymbol{N_{A\bullet}}$, *residually* via equation (6b). As indicated in section 1, the framework we use models production as a combination of labor, capital, and purchased domestic and imported inputs, and in this way we complete the accounting of the sources of growth—at any level of aggregation—according to our model.

4. Grouping industries into sectors for productivity analysis.

The final—and central—element of our system is a structure, or hierarchy, to traverse from the industry level to the sectoral level, and from the sectoral level to the total economy. In this section we explain the motivation and derivation of this hierarchy.

"*Total" economy aggregate.* Aggregate productivity analysis usually focuses on outcomes for businesses. Accordingly, our "total" economy aggregate is the private nonfarm business sector, the most commonly used aggregate for productivity analysis of the U.S. economy. In the NIPAs, output in the private nonfarm business sector is obtained by stripping four items—the output of farms, households, nonprofit institutions serving individuals, and the government—from total GDP. Three of these items—farms, households, and government—are (or can be represented as) "industries" in the BEA's GDP-by-industry system. Nonprofits, however, are not an industry.[19] Nonprofits are a legal form of organization (LFO) composed, in principle, of portions of each private industry in the economy. Thus, to decompose productivity for businesses by industry, the underlying industry data need to be further disaggregated by LFO.

In practice, the output of the nonprofit sector in the United States is only about 5 or 6 percent of GDP but accounts for more than 10 percent of all private nonagricultural employment. Although the inclusion (or exclusion) of the sector has only a small impact on aggregate productivity data, the sector's activities are concentrated in selected services industries (education, health, social services organizations), and they notably impact "intermediate" aggregates of services industries. Most work that relates productivity for individual industries to aggregate productivity does not address the fact that the nonprofit sector is blended in the data and that the behavior of these institutions may not conform to the model used to estimate productivity.[20]

We exploited the available information and estimated nonprofit segments for selected industries in the BEA dataset (mainly those in the medical care and other services industries; see Appendix B). Then, the nonbusiness segments of these industries plus the entirety of two other BEA industries (educational services and social assistance) were excluded (along with farms, government, etc.) in building the industry hierarchy that we use in our analysis.

[19] For ease of exposition, we will use "nonprofits" to refer to nonprofit institutions serving individuals, but the reader should remember that this does not refer to all nonprofit institutions. Nonprofit institutions serving businesses (e.g., trade associations) are included in the data for the business sector.

[20] The output of nonprofit institutions is valued at cost of production (Mead, McMcully, and Reinsdorf 2003). Although this is a meaningful measure for nonprofits, it is different from business output that is sold and valued at the amount that purchasers paid.

Table 2. Relation between GDP and our private nonfarm business aggregate, 2004.

	Value added (billions)	Employment[1] (thousands)	Hours[2]
GDP	11,734.3	134,951	249,094
Private industries	10,251.0	114,938	213,228
Nonfarm business	8,615.6	97,949	182,860
Other domestic producers	1,635.4	15,951	30,368
Farms	112.2	1,563	3,163
Private households	14.9	963	1,484
Housing[3]	933.1	528	672
Owner-occupied	730.0	0	0
Tenant-occupied	192.0	526	672
Nonprofits[4]	575.2	13,934	25,048
Memo: Private nonfarm business (BEA/BLS)	8,785.3	…	184,517

Source—Authors' calculations based on data from the Bureau of Economic Analysis.
1. Persons engaged in production (includes self-employed).
2. Hours of all persons (authors' calculations).
3. Includes value added in farm housing (not shown); housing value added figures are from NIPA table 7.4.5.
4. Selected industries (see text and details in Appendix B).
... Not available.

The relationship of our aggregate to GDP in 2004 in terms of value added, employment, and hours is shown above in table 2. Compared with BLS/BEA private nonfarm business output (shown as a memo item), our aggregate excludes the entire housing sector (rather than just owner-occupied housing) and uses our nonprofits aggregate (rather than the official aggregate). Because the tenant-occupied housing industry is the only holder of residential structures in the private nonfarm business sector, when the industry is excluded along with owner-occupied housing, residential structures is dropped as a capital asset. All told, nominal value added and hours in our private nonfarm business sector closely approximate the corresponding values used in official MFP statistics.

Sectoral aggregates. Even though our work is grounded in modeling production for individual industries, we do not group detailed industries into sectors according to similarity of production process using NAICS. We follow the deliveries-to-final demand model of section 1 and view aggregates of industries as vertically-integrated entities and group "upstream" industries with related "downstream" industries using I-O relationships. To the extent possible through aggregation to an "intermediate" level,

grouping industries according to this model/approach minimizes int*er*sectoral flows (the sum of the Domar weights) across a given number of groups.

The groups we work with were formed in two basic steps: First, we defined six sectors we thought important from a macro-productivity perspective and placed each BEA private industry in one of the groups based primarily on its two-digit 1997 NAICS classification.[21] Next, as described below, the initial industry assignments were evaluated using an algorithm based on input-output relationships. Other groupings would result if the initial BEA groupings of basic industries and/or the parameters of the algorithm were changed. See Appendix B for further discussion.

In view of the role of technology in the U.S. productivity resurgence in the late 1990s, we determined at the outset that one of our six sectors would be a "high-tech" sector that included both goods and services. By doing so, we continue to spotlight the contribution of productivity in the industries that produce and enable the adoption of IT-related technologies by both consumers and businesses in the United States. In addition to high-tech, the other sectors we identified were: construction, industrial, distribution, finance and business, and other (mostly personal) services. Although the construction sector is relatively small, we isolated it because the sector plays an important role in economic fluctuations and has been especially important in recent years. The other four sectors are much larger groupings of industries whose *primary* producing function is viewed as follows: producers of goods (industrial), merchandisers and transporters of goods (distribution), providers of services to businesses (finance and business), and providers of services to persons (personal services).

To group the key IT-producing industries (semiconductors, computers, communications equipment, computer software, telecommunications services, and internet services) in a single sector, it was necessary to cut across three major NAICS groupings and to further disaggregate three industries in BEA's industry hierarchy. This was largely accomplished using BEA's more disaggregate information on gross output and input-output relationships; but as indicated in the appendix, to isolate the information services industry (which includes internet services), it was necessary to go beyond the

[21] Examples of two-digit NAICS groupings are "Mining (NAICS 21) and "Finance and Insurance (NAICS 52)". The 1997, rather than the 2002, version of NAICS was used because the BEA's industry accounts are still classified according the 1997 version of NAICS.

official data and incorporate the results of recent research that measured quality-adjusted prices for internet services from 1993 to 1997 (Stranger and Greenstein 2003).

We did not map the entire new NAICS information sector to our high-tech sector because the NAICS information sector includes producers of cultural products (a NAICS term for newspapers, books, popular music, movies, TV programs, etc.) in addition to producers of IT products. Because cultural products are primarily consumed by persons, we assigned the industries that produced them to our personal services sector—and renamed it, "personal and cultural." The remaining initial assignments were based on two-digit NAICS groupings and are summarized in the first column of table 3.[22]

The evaluation of the initial placement of detailed industries outside of high-tech, entailed calculating the following: (1) the forward flow of each industry's output to other sectors and to final users and (2) the effect of excluding an industry from its sector on the sector's outward flow to other sectors. If an industry's forward flow went primarily to other sectors because the industry was an upstream supplier to an industry in another sector, the industry was moved to that sector provided the move did not increase the outward flow from the original sector. If an industry's forward flow went primarily to final demand, we reviewed its placement if its primary producing function was supplying services to persons and it was not already in the personal and cultural sector.

Given the basic design of the six sectors, we would expect certain industries to have large flows to other sectors. For example, we would expect large forward flows from wholesale trade, transportation, and warehousing (in distribution) to the industrial sector because these distributive industries are *general* service-providers to goods-producing industries. Similarly, we would expect the finance and business sector to appear as a collection of industries supplying services *generally* to all industries in the economy. Put differently, although we would expect large forward flows from distribution and from finance and business to other sectors, we would not expect those flows to be narrowly dedicated to another detailed industry. This consideration was built into the algorithm.

[22] As may be seen in the table, two "leftover" disaggregate industries, forestry, fishing, and other agriculture (NAICS 113-5) and data processing services (NAICS 5142), were included the industrial sector and the finance and business sector, respectively.

Table 3. Initial and final industry composition of sectors.

	Initial (based on NAICS)	Final (based on deliveries-to-final demand model) where different
High-tech	Computer and electronic product mfg. (NAICS 334) Software publishing (NAICS 5112) Telecommunications services (NAICS 5133) Information services (NAICS 5141) Computer systems design and related services (NAICS 5415)	
Construction	Construction (NAICS 23)	
Industrial	Manufacturing (NAICS 31, 32, 33, excl. 334) Mining (NAICS 21) Utilities (NAICS 22) Forestry, fishing and related (NAICS 113-5)	Pipeline transportion (NAICS 486) was added.
Distribution	Wholesale trade (NAICS 42) Retail trade (NAICS 44, 45) Transportation (NAICS 48) Warehousing (NAICS 49)	Transit and ground passenger transp. (NAICS 485) was moved. Pipeline transportation (NAICS 486) was moved.
Finance and business	Finance and insurance (NAICS 52) Real estate and rental and leasing (NAICS 53pt) Professional, scientific, and technical services (NAICS 54, excluding 5415) Management of companies (NAICS 55) Admin, waste and related (NAICS 56) Data processing services (NAICS 5142)	
Personal and cultural	Health care and social assistance (NAICS 62pt) Arts, entertainment, and recreation (NAICS 71) Accommodation and food services (NAICS 72) Other services (NAICS 81pt) Newspaper, book, etc. publishing (NAICS 5111) Motion pictures and sound recordings (NAICS 512) Radio/TV broadcasting (NAICS 5131-2)	Transit and ground passenger transp. (NAICS 485) was added.

The results of the input-output analysis suggested that only two detailed (BEA) industries be reassigned to other sectors: transit and ground passenger transportation from distribution to personal and cultural, and pipeline transportation from distribution to industrial. A data quality review was conducted from the perspective of our need to convert data to NAICS. As described in the appendix, the review both supported the move of the transit and ground passenger transportation industry and suggested that further disaggregation of two large BEA industries would conform better to our model. We did not implement these suggestions at this time, however.

Table 4. The Private Nonfarm Business Sectors and Relative Sizes, 2004

Billions of dollars	Sectoral Output: Total[1]	Deliveries to: Final Users[2]	Deliveries to: PNFB Sectors	Gross Output	Value Added	Empl.[3]
	(1)	(2)	(3)	(4)	(5)	(6)
Private nonfarm business	9,504.2	9,504.2	0.0	16,480.0	8,615.6	97,949
High-tech	994.7	714.9	279.8	1,186.9	562.0	3,713
Excluding high-tech	9,169.4	8,789.2	380.2	15,293.1	8,053.6	94,236
Construction	1,049.5	991.0	58.5	1,050.5	549.5	8,250
Industrial	3,298.7	2,435.6	863.1	4,686.9	1,734.7	14,579
Distribution	2,659.8	1,899.3	760.6	2,834.6	1,790.5	23,644
Finance and business	3,308.1	1,772.7	1,535.4	4,524.5	2,729.9	25,206
Personal and cultural	2,013.9	1,690.7	323.2	2,196.6	1,249.0	22,557
Shares (percent)						
High-tech	10.5	7.5	---	7.2	6.5	3.8
Construction	11.0	10.4	---	6.4	6.4	8.4
Industrial	34.7	25.6	---	28.4	20.1	14.9
Distribution	28.0	20.0	---	17.2	20.8	24.2
Finance and business	34.8	18.7	---	27.5	31.7	25.7
Personal and cultural	21.2	17.8	---	13.3	14.5	23.0
Sum of six sectors	140.2	100.0	---	100.0	100.0	100.0

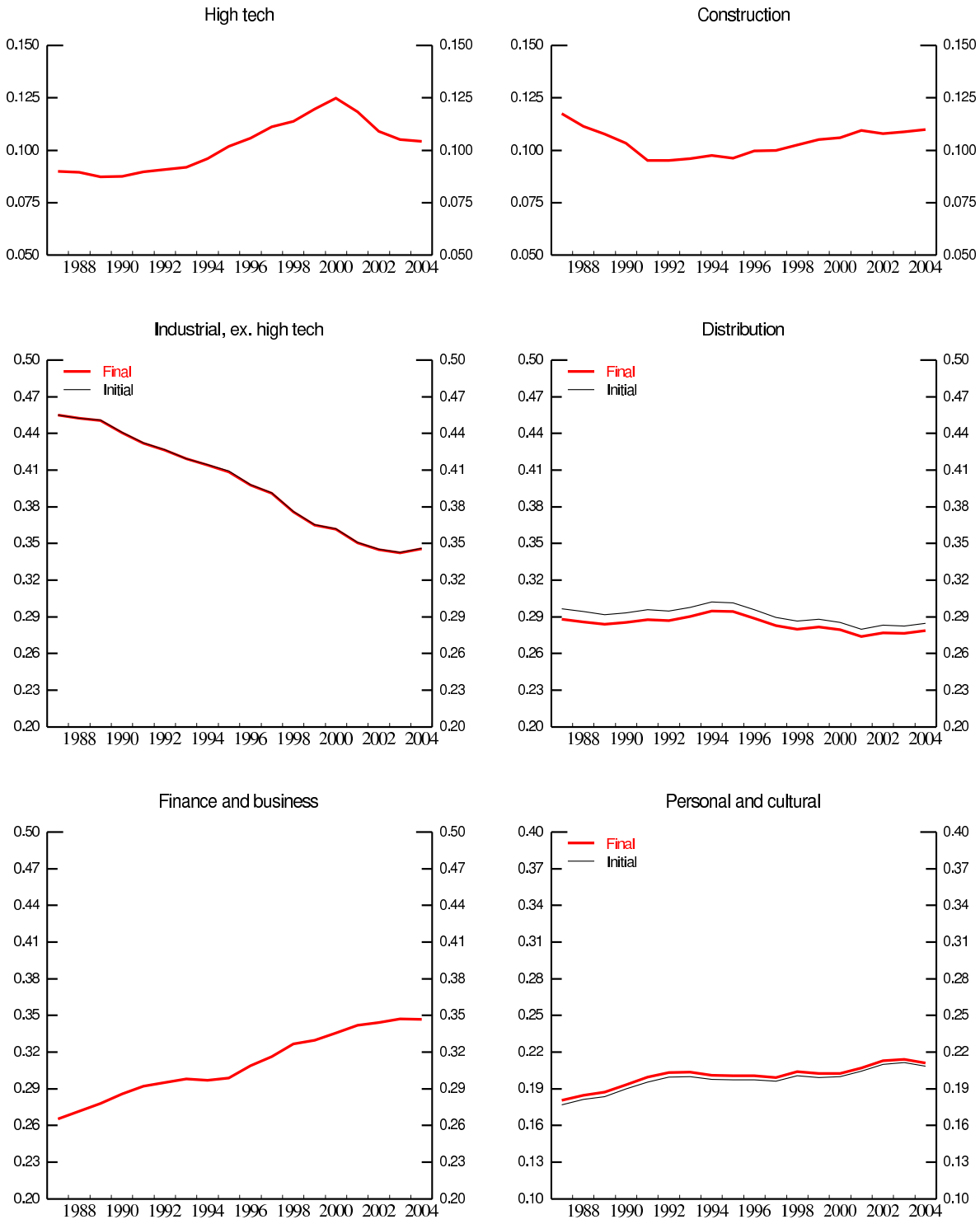
--- not applicable.
1. The shares in the lower half of column (1) are Domar weights.
2. Final users is final demand plus industries excluded from private nonfarm business (see table 2).
3. Thousands, persons engaged in production (full-time equivalent workers plus self-employed workers).
Note—The industry composition of each sector is reported in table 3.

The resulting six sectors and their relative sizes according to several metrics are illustrated in table 4. In terms of productivity, the Domar weights for each sector are shown in the bottom half of column 1. These are the weights you would use if you were aggregating MFP for each sector to obtain MFP for the total private nonfarm business sector using equation (1). As may be seen, the industrial and the finance and business sectors have relatively large Domar weights, and the sum of the Domar weights for all sectors exceeds one by 40 percent.

Chart 1 shows that the many of the Domar weights have shifted only slightly over time, although the weight for the industrial sector (which excludes high-tech manufacturing) has fallen whereas the weights for the high-tech and the finance and

Chart 1

Domar Weights
Major Producing Sectors



business sectors have risen. The chart also shows that the sectoral Domar weights changed little in moving from the initial to the final industry composition of sectors.

Table 4 also shows that in 2004, whether measured as sectoral output, deliveries-to-final demand, or value added, four sectors—industrial, distribution, finance and business, and personal and cultural—dominate U.S. business activity in their sheer size. The industrial sector is the largest in terms of gross output and shipments to final demand, but it is the smallest of the four—by a wide margin—in terms of employment share and does not dominate in terms of value added. The finance and business services sector is the largest in terms of value added; as previously mentioned, it and the industrial sector are the largest in terms of sectoral output, and, consequently, Domar weights.

5. Sectoral decomposition of output and productivity growth.

The empirical decomposition of output and productivity growth for the six sectors is shown in tables 5 and 6. Each table has five panels of rows, with the first (panel A) showing average results for the eighteen years in our dataset from 1987 to 2004 and the next three (panels B though D) showing results for three subperiods—1987 to 1995, 1995 to 2000, and 2000 to 2004. The final two panels show changes (in growth rates or contributions to growth) for the 1995 to 2000 period relative to 1987 to 1995 (panel E) and for the 2000 to 2004 period relative to the late 1990s (panel F).

Each **row** of table 5 is a sources-of-growth decomposition using equation (6b). The first row in each panel reports the decomposition for private nonfarm business; the subsequent rows in the panel show decompositions for major producing sectors. As may be seen in row 1 of panel A, we estimate that aggregate sectoral output growth for the private nonfarm business sector averaged about 3-1/2 percent from 1987 to 2004, with contributions from MFP, capital, labor, and purchased inputs all playing important roles. [At this point, we have not fully implemented the domestic/import split of purchased inputs in our empirical; as a result, the table shows the combined contribution these factors.] Because our "total" economy aggregate falls short of complete coverage of the U.S. economy, accounting for the growth in its purchased inputs from other domestic producers as well as the rest-of-world sector (imports) is important: During the late

Table 5
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
A. 1987-2004								
1. Private nonfarm business		**3.6**	1.2	0.6	0.3	0.3	0.6	0.5
2. Excl. high-tech	96.2	3.1	0.7	0.6	0.3	0.3	0.6	0.6
3. Industry	39.5	1.7	0.6	0.2	0.1	0.1	-0.3	1.1
4. Construction	10.3	1.8	-0.5	0.1	0.1	0.0	0.7	1.2
5. Distribution	28.4	4.2	2.0	0.4	0.1	0.1	0.4	1.2
6. Finance and business	31.3	4.2	0.0	1.0	0.5	0.4	0.9	1.3
7. Personal and cultural	20.2	2.9	-0.5	0.2	0.2	0.2	1.1	1.6
8. High-Tech	10.3	10.5	5.2	0.8	0.2	0.3	0.3	3.6
B. 1987 to 1995								
1. Private nonfarm business		3.0	0.8	0.5	0.3	0.3	0.8	0.4
2. Excl. high-tech	97.0	2.6	0.4	0.4	0.3	0.3	0.8	0.4
3. Industry	43.0	1.8	0.6	0.2	0.1	0.1	0.0	0.9
4. Construction	10.0	0.3	-0.3	0.1	0.0	0.0	0.5	0.0
5. Distribution	28.9	4.1	1.6	0.2	0.1	0.2	0.6	1.4
6. Finance and business	29.0	3.4	-0.5	0.8	0.5	0.6	0.9	1.1
7. Personal and cultural	19.7	2.8	-0.7	0.2	0.2	0.3	1.4	1.5
8. High-Tech	9.2	9.6	4.2	0.6	0.2	0.3	0.4	3.9
C. 1995 to 2000								
1. Private nonfarm business		5.4	1.1	1.0	0.5	0.3	1.5	1.0
2. Excl. high-tech	95.3	4.6	0.3	0.9	0.5	0.3	1.3	1.4
3. Industry	37.8	2.6	0.2	0.3	0.2	0.1	-0.1	1.9
4. Construction	10.3	4.8	-0.9	0.2	0.3	0.0	1.8	3.4
5. Distribution	28.3	5.3	2.3	0.6	0.3	0.2	0.8	1.1
6. Finance and business	32.3	6.6	-0.6	1.5	0.7	0.4	1.9	2.8
7. Personal and cultural	20.2	3.6	-0.6	0.3	0.2	0.3	1.1	2.3
8. High-Tech	11.5	17.6	6.8	1.5	0.3	0.3	2.4	6.4
D. 2000 to 2004								
1. Private nonfarm business		2.3	2.3	0.5	0.2	0.2	-0.8	0.0
2. Excl. high-tech	95.9	2.0	1.8	0.4	0.2	0.1	-0.5	0.0
3. Industry	34.6	0.6	1.1	0.1	0.0	0.1	-1.2	0.5
4. Construction	10.9	0.9	-0.2	0.1	0.1	0.0	-0.1	1.0
5. Distribution	27.6	3.1	2.5	0.3	0.1	0.1	-0.4	0.7
6. Finance and business	34.5	2.8	1.9	0.7	0.3	0.2	-0.3	0.1
7. Personal and cultural	21.1	2.1	0.2	0.2	0.2	0.1	0.6	0.8
8. High-Tech	10.9	3.2	5.3	0.4	0.0	0.2	-2.3	-0.3
E. Difference in Annual Averages, (1995 to 2000) vs. (1987 to 1995)								
1. Private nonfarm business		**2.4**	0.3	0.6	0.2	0.0	0.7	0.6
2. Excl. high-tech	-1.6	2.0	-0.1	0.5	0.2	0.0	0.5	0.9
3. Industry	-5.2	0.8	-0.4	0.1	0.1	0.0	0.0	1.0
4. Construction	0.2	4.6	-0.6	0.1	0.3	0.0	1.3	3.4
5. Distribution	-0.6	1.2	0.7	0.3	0.3	0.0	0.2	-0.2
6. Finance and business	3.4	3.2	-0.1	0.7	0.3	-0.2	0.9	1.7
7. Personal and cultural	0.5	0.8	0.1	0.1	0.0	0.0	-0.3	0.8
8. High-Tech	2.3	8.0	2.6	0.9	0.1	0.0	2.0	2.5
F. Difference in Annual Averages, (2000 to 2004) vs. (1995 to 2000)								
1. Private nonfarm business		**-3.1**	1.2	-0.6	-0.3	-0.1	-2.2	-1.0
2. Excl. high-tech	0.5	-2.6	1.5	-0.5	-0.3	-0.1	-1.8	-1.4
3. Industry	-3.2	-2.0	0.9	-0.2	-0.2	0.0	-1.1	-1.4
4. Construction	0.6	-3.9	0.7	-0.1	-0.2	0.0	-1.9	-2.3
5. Distribution	-0.6	-2.2	0.2	-0.3	-0.3	-0.1	-1.2	-0.5
6. Finance and business	2.2	-3.8	2.5	-0.8	-0.5	-0.2	-2.1	-2.7
7. Personal and cultural	1.0	-1.5	0.8	-0.1	0.1	-0.1	-0.5	-1.6
8. High-Tech	-0.6	-14.4	-1.5	-1.1	-0.3	-0.1	-4.7	-6.7

- For each row, column (2) equals the sum of columns (3) through (8).
- IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.

1990s (panel C), we estimate that nearly 20 percent of private nonfarm business sectoral output *growth* was accounted for by purchased inputs.

Although contributions from MFP, capital, labor, and purchased inputs are all important for understanding aggregate economic growth, the sectoral sources-of-growth results (panel A, rows 3 through 8) indicate that the importance of productivity and contributions of factor inputs varies notably by sector. For construction, measured productivity change is negative, and increases in the contribution of labor and purchased inputs more than account for the real output growth of this sector. By contrast, in the industrial sector, the contribution of labor input fell, on average, and increases in productivity and the contribution of purchased inputs account for much of its real output growth. Purchased inputs also contribute noticeably to output growth in the personal and cultural sector (mainly purchases by industries in the NAICS food and accommodation sector), whereas purchased inputs contribute much less to growth in the distribution and finance and business sectors.

Each **column** of table 6 shows the sectoral decomposition of the contribution of primary factors and MFP to aggregate growth using equation (6c). In this decomposition, the role of the high-tech sector in the late 1990s resurgence in productivity growth is seen by the substantial difference between MFP for the private nonfarm business sector and the contribution of MFP in the "excl. high-tech" subaggregate (panel C, column 2, compare rows 1 and 2). This is also seen in the decomposition for the late 1990s *pickup* in economic growth (panel E). Looking down column 2 of panel E, the aggregate pickup may be viewed as stemming from an increase in productivity in the high-tech sector (row 8), as well as the distribution sector (row 6), which is mainly gains in retail and wholesale trade. (Results for detailed industries in the format of table 5 are at the end of the paper.)

It would therefore appear that, no matter how one looks at this period, the late 1990s productivity pickup story is a sectoral story: Notable increases in the rates of change in MFP in the high-tech and distribution sectors drove the aggregate results, but their strong performance was partially offset by negative contributions from the industrial, construction, and finance and business sectors.

Table 6
Contribution to Sectoral Output Growth of Private Nonfarm Business
Average Contribution, Ex-Post Returns

	Domar Weight	MFP	Capital			Labor
			IT	EQX	STR	
	(1)	(2)	(3)	(4)	(5)	(6)
A. 1987 to 2004						
1. Private nonfarm business		1.2	0.6	0.3	0.3	0.6
2. Excl. high-tech	96.2	0.7	0.5	0.3	0.3	0.6
3. Industry	39.5	0.2	0.1	0.0	0.0	-0.1
4. Construction	10.3	0.0	0.0	0.0	0.0	0.1
5. Distribution	28.4	0.6	0.1	0.0	0.0	0.1
6. Finance and business	31.3	0.0	0.3	0.2	0.1	0.3
7. Personal and cultural	20.2	-0.1	0.0	0.0	0.0	0.2
8. High-Tech	10.3	0.5	0.1	0.0	0.0	0.0
B. 1987 to 1995						
1. Private nonfarm business		0.8	0.5	0.3	0.3	0.8
2. Excl. high-tech	97.0	0.4	0.4	0.2	0.3	0.7
3. Industry	43.0	0.3	0.1	0.1	0.0	0.0
4. Construction	10.0	0.0	0.0	0.0	0.0	0.1
5. Distribution	28.9	0.5	0.1	0.0	0.0	0.2
6. Finance and business	29.0	-0.1	0.2	0.1	0.2	0.3
7. Personal and cultural	19.7	-0.1	0.0	0.0	0.1	0.3
8. High-Tech	9.2	0.4	0.1	0.0	0.0	0.0
C. 1995 to 2000						
1. Private nonfarm business		1.1	1.0	0.5	0.3	1.5
2. Excl. high-tech	95.3	0.3	0.9	0.5	0.3	1.2
3. Industry	37.8	0.1	0.1	0.1	0.0	0.0
4. Construction	10.3	-0.1	0.0	0.0	0.0	0.2
5. Distribution	28.3	0.7	0.2	0.1	0.0	0.2
6. Finance and business	32.3	-0.2	0.5	0.2	0.1	0.6
7. Personal and cultural	20.2	-0.1	0.1	0.0	0.1	0.2
8. High-Tech	11.5	0.8	0.2	0.0	0.0	0.3
D. 2000 to 2004						
1. Private nonfarm business		2.3	0.5	0.2	0.2	-0.8
2. Excl. high-tech	95.9	1.7	0.4	0.2	0.1	-0.5
3. Industry	34.6	0.4	0.0	0.0	0.0	-0.4
4. Construction	10.9	0.0	0.0	0.0	0.0	0.0
5. Distribution	27.6	0.7	0.1	0.0	0.0	-0.1
6. Finance and business	34.5	0.6	0.2	0.1	0.1	-0.1
7. Personal and cultural	21.1	0.0	0.0	0.0	0.0	0.1
8. High-Tech	10.9	0.6	0.0	0.0	0.0	-0.3
E. Difference in Annual Averages, (1995 to 2000) vs. (1987 to 1995)						
1. Private nonfarm business		0.3	0.6	0.2	0.0	0.7
2. Excl. high-tech	-1.6	-0.1	0.4	0.2	0.0	0.4
3. Industry	-5.2	-0.2	0.0	0.0	0.0	0.0
4. Construction	0.2	-0.1	0.0	0.0	0.0	0.1
5. Distribution	-0.6	0.2	0.1	0.1	0.0	0.0
6. Finance and business	3.4	-0.1	0.3	0.1	-0.1	0.3
7. Personal and cultural	0.5	0.0	0.0	0.0	0.0	0.0
8. High-Tech	2.3	0.4	0.1	0.0	0.0	0.2
F. Difference in Annual Averages, (2000 to 2004) vs. (1995 to 2000)						
1. Private nonfarm business		1.2	-0.6	-0.3	-0.1	-2.2
2. Excl. high-tech	0.5	1.4	-0.4	-0.3	-0.1	-1.7
3. Industry	-3.2	0.3	-0.1	-0.1	0.0	-0.4
4. Construction	0.6	0.1	0.0	0.0	0.0	-0.2
5. Distribution	-0.6	0.0	-0.1	-0.1	0.0	-0.3
6. Finance and business	2.2	0.8	-0.2	-0.1	-0.1	-0.7
7. Personal and cultural	1.0	0.2	0.0	0.0	0.0	-0.1
8. High-Tech	-0.6	-0.2	-0.1	0.0	0.0	-0.5

• Up to rounding error, for each column, row (1) equals the sum of rows (3) through (8).

With regard to factor inputs, our results show that faster growth in IT capital services contributed importantly to the pickup in economic growth in the late 1990s (panel E, row 1, column 3), consistent with previous studies and the official macro productivity data.[23] As may be seen looking down column 3, the faster growth in IT capital services was concentrated primarily in industries in the distribution and finance and business sectors. All told, therefore, our results line up very well with the analysis and conclusions of many previous studies of the industries and factors that contributed to productivity growth in the United States in the late 1990s (Jorgenson and Stiroh 2000, Oliner and Sichel 2000, Triplett and Bosworth 2004).

Panel D reports our new results for the sources of the gains in output since 2000. As may be seen, productivity has been the major driver of recent economic growth (row 1), with most sectors contributing to the increase (rows 3 through 8). As shown in panel F, column 2, there is a notable sectoral variation in the results for the *pickup* in productivity since 2000, however. This faster growth in MFP in recent years is sizeable—more than 1 percent per year, on average—but the major sectoral players in the late 1990s (high-tech and distribution) are *not* contributors to the more recent pickup. Rather, very strong MFP gains in the finance and business sector, a resurgence in MFP growth in the industrial sector, and an end to the drops in MFP in the personal and cultural sector more than account for the continued strong pace of U.S. growth since 2000.

In terms of primary factor inputs, a notable result is that the post-2000 gains in output occurred as businesses pulled back on labor input (row 1 of panel D), leaving capital deepening (whose effect must be inferred from the results shown in row 1) and increasing MFP as the unambiguous sources of the post-2000 average gain in U.S. labor productivity. This result is pretty widespread by sector, although increases in hourly labor input in the personal and cultural sector continued to contribute to the economic growth of the post-2000 period.

[23] Appendix C provides a reconciliation of our aggregate MFP results with the macro-productivity statistics released by the BLS on March 23, 2006.

In addition to the changes in the rates of growth of sectoral MFP, changes in Domar weights (table 5, column 1) could also be contributing to the changes in aggregate productivity that we have just analyzed. As a result, a standard decomposition of the change in productivity growth was calculated as follows:

$$(7) \qquad \Delta \boldsymbol{MFP}_T = \sum_{A \in T} D_{A,t}\, \boldsymbol{MFP}_{A,t} - \sum_{A \in T} D_{A,t-1}\, \boldsymbol{MFP}_{A,t-1}$$

$$= \sum_{A \in T} .5\left(D_{A,t} + D_{A,t-1}\right)\left(\boldsymbol{MFP}_{A,t} - \boldsymbol{MFP}_{A,t-1}\right) +$$

$$\sum_{A \in T} .5\left(D_{A,t} - D_{A,t-1}\right)\left(\boldsymbol{MFP}_{A,t} + \boldsymbol{MFP}_{A,t-1}\right) .$$

where $D_{A,t}$ is a sectoral Domar weight, $\left(S_A / S_T\right)_t$, and the period of change (from t–1 to t) refers to the period averages analyzed in panels E and F of the tables. The first term in the second equation, the "within" effect, measures how much of the pickup in aggregate productivity growth can be attributed to faster productivity growth for individual sectors when their weights are held fixed at the average for the two periods. The second term, the reallocation or "between" effect, measures how much of the pickup can be attributed to rising weights for sectors with above-average productivity growth.

The results of this decomposition are reported in table 7. As may be seen, only a small portion of the increase in aggregate MFP growth in the late 1990s is the result of a "between" sectors effect; specifically, some of the pickup from 1995 to 2000 stems from an increase in the high-tech share. More generally, *at the sectoral level of aggregation*, the productivity step-ups in the late 1990s and early 2000s are almost entirely the result of "within" sector effects. This suggests that, except for high-tech, modeling the evolution of the relative sizes of our six sectors over relatively short periods is not very important relative to modeling the growth rates of sectoral productivity.

In summary, we have found that by 2004 the resurgence in productivity growth that started in the mid-1990s was relatively broad-based across major producing sectors. However, the timing of the increases in sectoral MFP growth rates varied notably within this period. More fundamentally, the underlying trends in sectoral productivity growth rates themselves are highly divergent. In the high tech sector, MFP growth averaged 6 percent per year between 1995 and 2004; elsewhere, the underlying trends ranged from –3/4 percent per year for construction to 2-1/2 percent per year for distribution. We

Table 7
Decomposing the Change in Aggregate Sectoral Output Growth

		Capital			
	MFP	IT	EQX	STR	Labor
	(1)	(3)	(3)	(4)	(5)
A. Avg. Contribution in (1995 to 2000) less Avg. Contribution in (1987 to 1995)					
Within Sector Effect					
1. Private nonfarm business	0.22	0.50	0.23	-0.06	0.61
2. Industry excl. high-tech	-0.17	0.05	0.03	0.01	-0.01
3. Construction	-0.06	0.01	0.03	0.00	0.13
4. Distribution	0.19	0.10	0.08	0.00	0.05
5. Finance and business	-0.04	0.22	0.08	-0.07	0.28
6. Personal and cultural	0.02	0.02	-0.01	0.00	-0.05
7. High-Tech	0.27	0.09	0.01	0.00	0.20
Between Sector Effect					
1. Private nonfarm business	0.07	0.05	0.02	0.02	0.09
2. Industry excl. high-tech	-0.02	-0.01	-0.01	0.00	0.00
3. Construction	0.00	0.00	0.00	0.00	0.00
4. Distribution	-0.01	0.00	0.00	0.00	0.00
5. Finance and business	-0.02	0.04	0.02	0.02	0.05
6. Personal and cultural	0.00	0.00	0.00	0.00	0.01
7. High-Tech	0.13	0.02	0.01	0.01	0.03
B. *Avg. Contribution in (2000 to 2004) less Avg. Contribution in (1995 to 2000)*					
Within Sector Effect					
1. Private nonfarm business	1.25	-0.58	-0.35	-0.15	-2.26
2. Industry excl. high-tech	0.32	-0.07	-0.07	0.00	-0.41
3. Construction	0.07	-0.01	-0.02	0.00	-0.20
4. Distribution	0.04	-0.09	-0.08	-0.03	-0.32
5. Finance and business	0.83	-0.26	-0.16	-0.08	-0.70
6. Personal and cultural	0.16	-0.03	0.01	-0.03	-0.09
7. High-Tech	-0.17	-0.12	-0.03	-0.01	-0.52
Between Sector Effect					
1. Private nonfarm business	-0.06	0.01	0.01	0.00	0.05
2. Industry excl. high-tech	-0.02	-0.01	0.00	0.00	0.02
3. Construction	0.00	0.00	0.00	0.00	0.01
4. Distribution	-0.01	0.00	0.00	0.00	0.00
5. Finance and business	0.01	0.02	0.01	0.01	0.02
6. Personal and cultural	0.00	0.00	0.00	0.00	0.01
7. High-Tech	-0.04	-0.01	0.00	0.00	0.00

- Within sector effect calculated as the change in the growth rate of the factor input times the average domar
- Between sector effect calculated as the change in the domar weights times the average growth rate in the
- Up to rounding error, for each column, row (1) equals the sum of rows (2) through (7).

believe these findings can be exploited for forecasting changes in the current/prospective trend in MFP growth.

6. What is the underlying trend in MFP growth and what is driving it?

In this section, we explore two simple examples of how our findings and our database can be used. The first example exploits only the *divergent pattern in sectoral MFP trends* just discussed and attempts to determine the current/prospective trend in aggregate MFP growth using a time-series approach.

The underlying variation in MFP growth across sectors and over time is displayed in chart 2. On the left, each panel displays the index level of actual MFP for a sector and an estimate of its trend based on the Hodrick-Prescott (HP) filter. The HP trends were generated using the smoothing parameter suggested by Ravn and Uhlig (2002) for annual data and have been calculated for three periods beyond the last observation on actual MFP.[24] The panel to the right shows percent changes in the actual and trend estimates of MFP, along with the period averages of MFP growth rates reported in table 5. Note that the changes in the estimated trends do not necessarily coincide with the averaged rates of actual productivity growth for the sub-periods analyzed in table 5.

We aggregate the HP-filtered sectoral trends shown in chart 2 using actual values of the Domar weights shown in chart 1. Because we determined via equation (7) that changes in these weights did not contribute significantly to recent productivity developments, we use a simple average of the two most recent actual values as Domar weights for the extension period, which in this example covers the years 2005 to 2007.[25] The results are shown in table 8. As may be seen, although the estimate of the trend in MFP growth from 2000 to 2004 in table 8 picks up less than the increase in its actual

[24] The projected trends were obtained by first extending the underlying data for five periods using forecasts from an ARIMA model and then applying the HP filter to the extended time series. This procedure minimizes the well-known end-of-sample problem with the HP filter. We thank our colleagues Charles Gilbert and Norman Morin for developing this routine.

[25] Of course, for additional precision in a practical forecasting setting, the sectoral weights could be developed from elements of macroeconomic data and/or a forecast in conjunction with the latest information on I-O relationships. Additionally, actual MFP at the sectoral level could be estimated for another year (in this case, 2005) using the methods described in Beaulieu and Bartelsman (2005) for estimating industry output using information on final demand components and adapting simplified methods for estimating capital input (e.g., Oliner and Sichel 2000, Meyer and Harper 2005) for use in a sectoral format.

Table 8. Sectoral-based estimates of trend MFP growth, private nonfarm business sector

	1987 to 1995	1995 to 2000	2000 to 2004	2005	2006	2007
Trend MFP	0.9	1.1	1.9	1.9	1.7	1.5
Memo: Actual MFP[1]	0.8	1.1	2.3	….	….	….

1. Estimates from table 5. See Appendix C for the relationship between the MFP results presented in this paper and the estimates published by the BLS.
… not applicable.

c

average rate in table 5 (also shown in the memo in table 8), the acceleration is still very notable—from 1.1 percent per year to 1.9 percent per year. The estimated current/prospective trends during 2005, 2006, and 2007—though at lower rates than during the preceding period—remain robust and average nearly 1-3/4 percent per year.

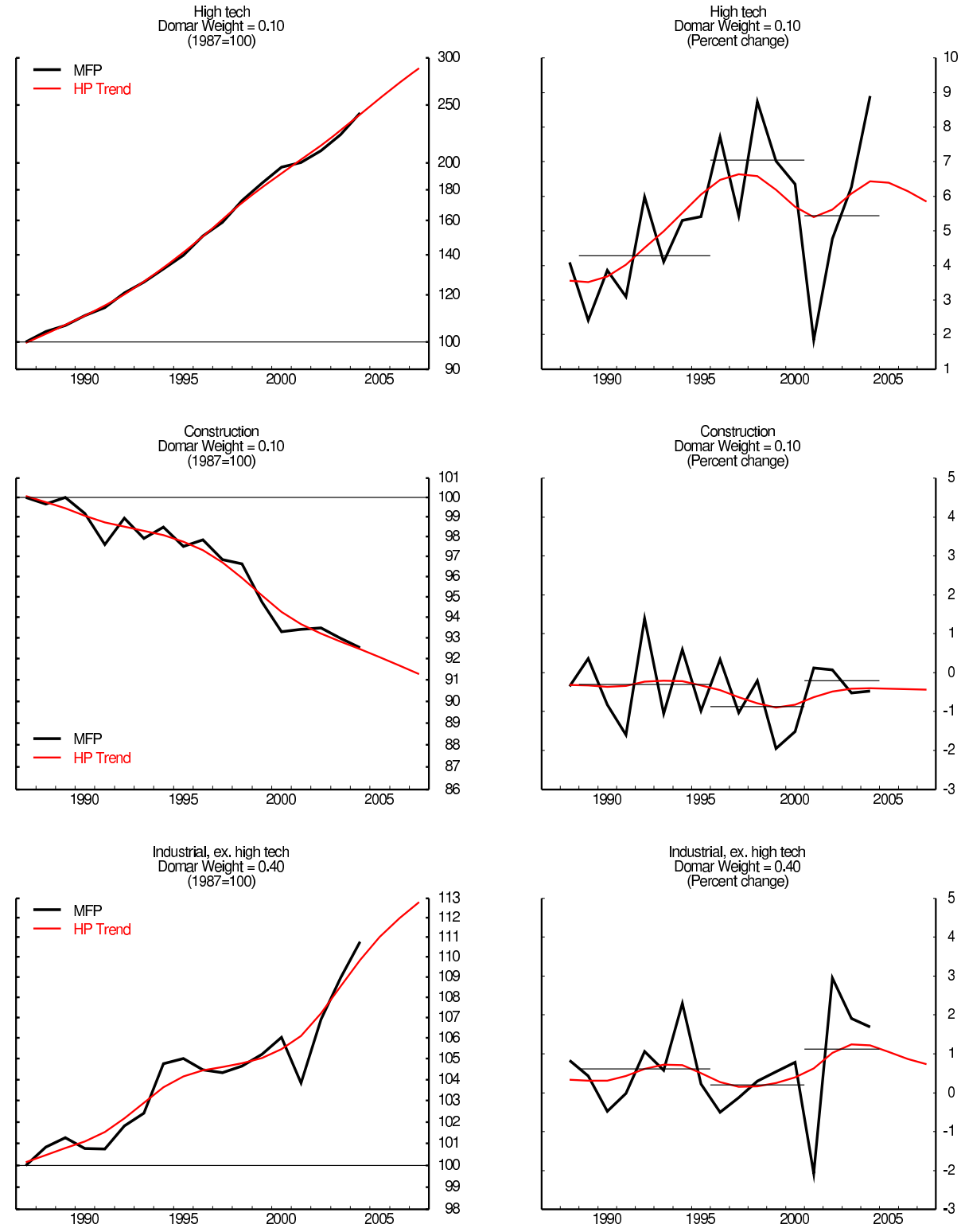
As seen in chart 2, the continued robust pace of aggregate productivity growth occurs primarily because most sectors are expected to continue to contribute to the overall gain. This is seen especially for the high-tech sector, in which the prospective trend in MFP growth continues to be relatively strong. Quality-adjusted price measures are important for gauging the pace of technological innovation in this sector. As a result, confidence in the estimated prospective MFP trend depends in large part on believing that the sector's price measures are capturing recent developments in technology. In future work we plan to further disaggregate this sector so that we may incorporate the results of more recent research on price measures for communications equipment that are not in BEA's figures but are included in the annual price indexes used to benchmark the Federal Reserve's industrial production index.[26] The Federal Reserve's measures attempt to capture the effects of relatively recent developments, such as fiber optics, wireless networking, and IP (internet protocol)-based telephony.

The prospective trends in MFP for the aggregate economy would be higher were it not for the projected step-down in trend MFP for finance and business and the persistently negative--almost implausible--change in actual MFP for the construction sector.

[26] These price indexes are based on research reported in Doms and Foreman (2005) and Doms (2005). Corrado (2001, 2003) and Bayard and Gilbert (2006) report on what has been developed, updated, and included in industrial production. The most recent annual price index for communications equipment is shown on page A48 of Bayard and Gilbert; it falls at an average annual rate of 8.2 percent from 1997 to 2004.

Chart 2

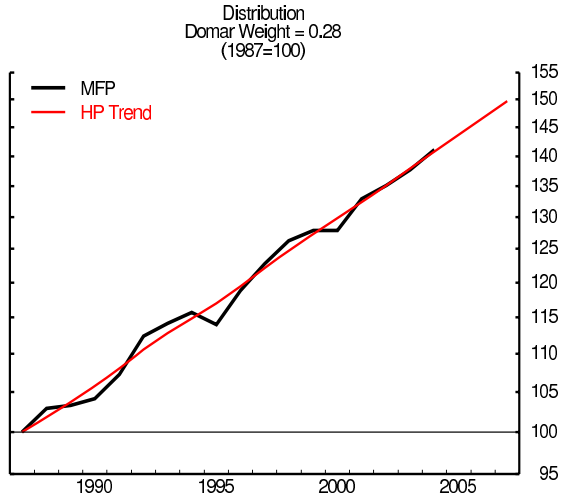
Multifactor Productivity
Major Producing Sectors

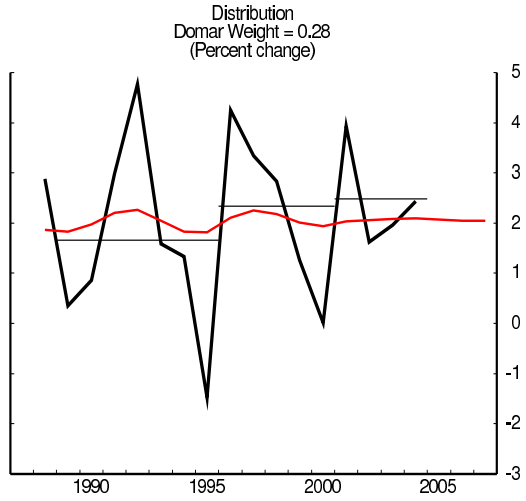


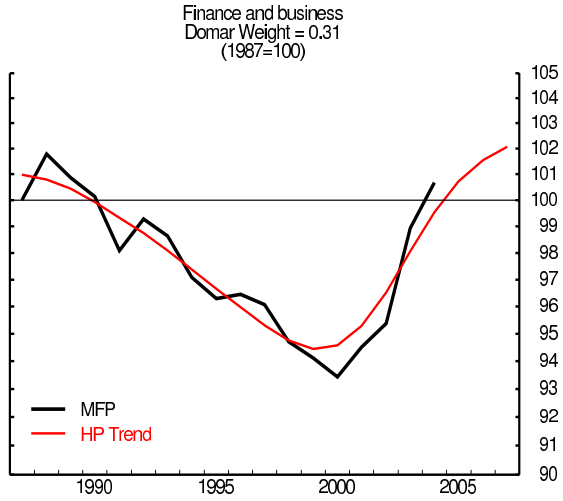
Note: Domar weights are 1987-2004 averages.

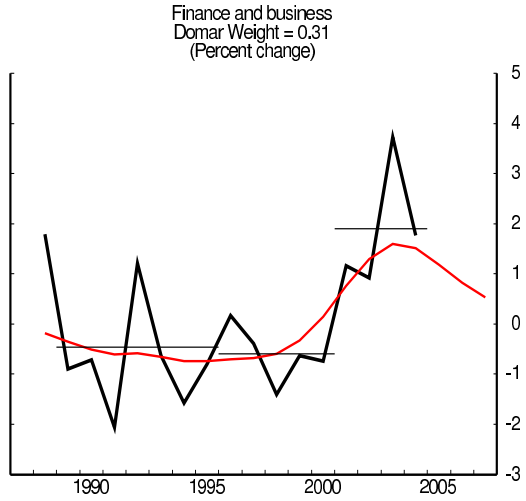
Chart 2 (continued)

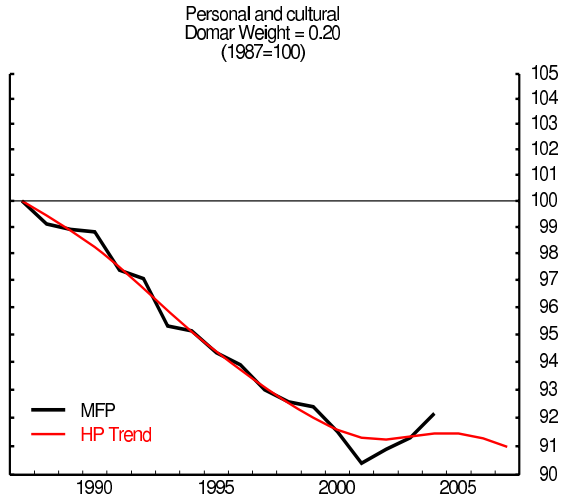
Multifactor Productivity
Major Producing Sectors

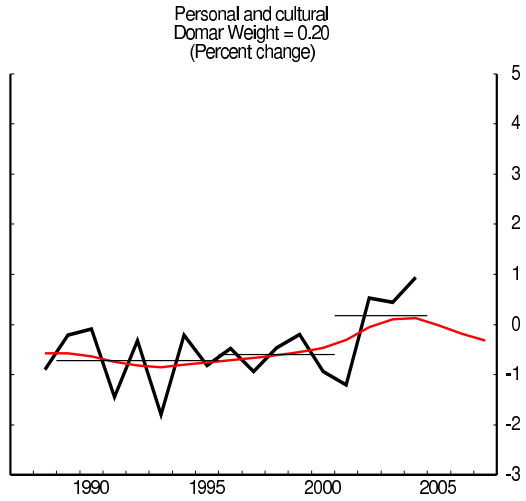












Note: Domar weights are 1987-2004 averages.

With regard to the finance and business sector, the large turnaround in post-2000 MFP growth is striking. Moreover, the result appears to be widespread by industry within the sector (see detailed tables at the end of the paper). The largest contributions are from the banking and commercial real estate industries; increases in MFP growth in these industries, along with an increase for the broad business services group, more than account for the step-up in the sector.27 Because the sector's demand drivers would appear to be relatively diverse and its measurement long a subject of debate, the specific productivity stories within this sector are deserving of much further scrutiny and study.

As for construction, recall that we isolated the sector because it is an important driver of aggregate demand. In addition, our input-output analysis did not strongly suggest that the sector should be integrated with industries in the BEA hierarchy that primarily produce its inputs. However, as noted in the discussion in Appendix B, given the materials-using nature of the sector's production (and the fact that real gross output grows substantially faster than real value added), a more detailed representation of supplying industries would be needed to create a more vertically-integrated construction sector. Another possibility would be to integrate the real estate industry with the construction sector. All told, therefore, the productivity of a more integrated construction (or construction and real estate) sector might look more plausible than the results for the construction industry alone.[28]

A second example uses only the *cross-sectional variation in MFP at the industry level* to analyze recent productivity developments.[29] Specifically, we ask whether the recent strong results for MFP are partly a reflection of earlier investments in IT. As noted in the introduction, the neoclassical growth accounting framework that we use may attribute part of what we think of "the use of" IT effects to MFP to the extent that

[27]Using SIC-based data, Triplett and Bosworth (2004) found that the securities industry posted a notable acceleration in productivity in the late 1990s. We estimate that MFP for this industry continued to expand post-2000, although the rate of growth was not nearly as rapid as in the late 1990s.

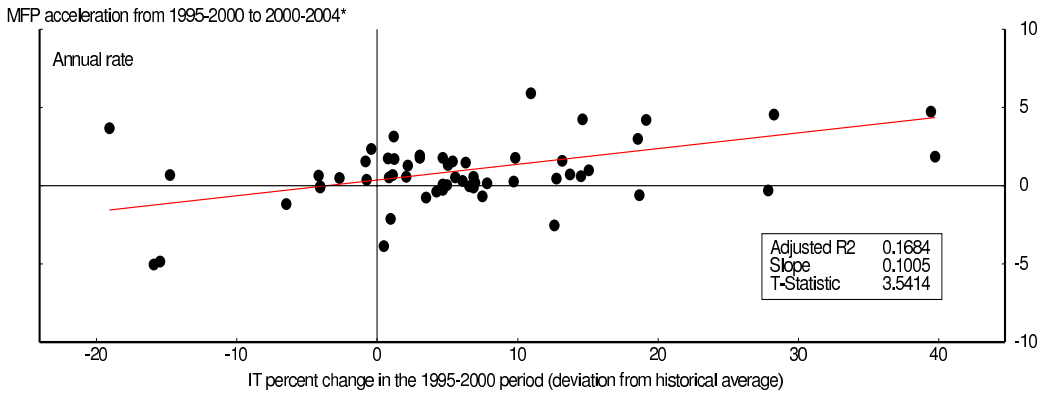
[28] Of course, the results for productivity of the aggregate economy would be different only if the output price of the construction sector was mismeasured. Construction prices received much attention as a possible "culprit" for mismeasurement during the 1970s and 1980s period of lackluster productivity growth (e.g., Baily and Gordon 1988). Bruce Grimm of the BEA recently revisited the measurement of construction prices, but his new results did not materially change the picture.

[29] We are grateful to Larry Slifman for suggesting this example to us.

network effects (and other externalities) are present. Furthermore, if firms experience adjustment costs (or must engage in learning) prior to factoring newly acquired IT technologies in production processes, the waning of those effects will have a temporary "accelerating" effect on MFP. Anecdotal and other information suggest that some of the recent productivity gains reflect firms making better use of existing capital and improving business processes, especially as they discover new and better methods for using IT (Gordon 2004, Bies 2006).

Chart 3

Investment and MFP by Industry



*Excludes High Tech industries. The acceleration in MFP is the percent change in MFP between 2000 and 2004 (annual rate) minus the percent change between 1995 and 2000 (annual rate).

If some of the recent productivity gains are a lagged realization of the large run-up in IT investment in earlier years, then we would expect to see a pattern in which MFP growth for industries that invested especially heavily in IT in the late 1990s accelerated more strongly than did MFP growth for industries whose IT investments were not especially strong. Chart 3 shows a simple scatter plot and regression relationship between the *acceleration* in MFP growth by industry in 2000 to 2004 (relative to 1995 to 2000) and the extent to which IT investment by industry was above trend in the late 1990s. As may be seen, the relationship is statistically significant. And, although the regression explains only a small portion of the cross-sectional variance in productivity

gains by industry in recent years, the period analyzed covers a recession and yet the effect shows through.

All told, the result shown in chart 3 suggests that the productivity-enhancing effects of installed IT capital (above and beyond the usual attribution in growth accounting) may still have been part of the story of the remarkable pace of U.S. economic growth since 2000. Because this "above and beyond" effect should only prove temporary, the result is consistent with the time-series analysis in suggesting that the underlying growth rate of aggregate productivity is likely to slow, albeit to a pace that would still be quite strong by historical standards.

7. Conclusion.

This paper introduces new estimates of aggregate, sectoral, and industry productivity. The estimates are based on a solid framework for how industry and sectoral MFP feed into aggregate MFP, and are developed using industry data classified according to NAICS from 1987 on. The six sectors we studied were designed to highlight differences among groups of industries in terms of their deliveries to final demand. Using this approach, we were able to provide new decompositions of economic growth and paint a rich picture of recent productivity developments in the United States. Our results indicate that the six sectors have had very different trends in multifactor productivity growth and made contributions to aggregate productivity that varied notably within the period from 1995 to the present. Nonetheless, by 2004 the resurgence in productivity growth that started in the mid-1990s was found to have been relatively broad-based and likely still driven by IT.

Given the macroeconomic importance of productivity, along with our finding that productivity has been the major source of the output gains since 2000, we believe it is especially important to understand the underlying drivers of productivity and to assess their implications for the period going forward. This paper has taken a modest step in this direction, but our work also raises questions, such as how the finance and business services sector experienced such a remarkable turnaround in productivity in recent years. The role of IT capital is often discussed in the context of productivity in financial services (e.g., Triplett and Bosworth), but it is important to remember that human capital

also is an important input in the financial and business services industries more broadly (Jorgenson, Ho, and Stiroh 2005). Our results, like the earlier SIC-based results of Triplett and Bosworth, do not include an explicit adjustment to account for the role of human capital in business sector productivity statistics. Furthermore, if the economy's aggregate production depends on uncounted intangible capital as in Corrado, Hulten, and Sichel (2005, 2006), the expanded view heightens the importance of this sector.[30] Uncounted investments in innovation (R&D, for example), organizational practices, and business strategies are not just inputs to production in the finance and business sector as in other sectors. Many of these intangibles are part of *the output* of this sector.

Stepping back, an inherent advantage of approaching productivity at an "intermediate" level of aggregation is that the effects of the underlying economic mechanisms may be discerned. In this paper, we chose to construct intermediate aggregates using demand drivers and product/service types as a grouping principle. But other aggregations of the same industry productivity estimates are possible. For example, one could combine industries into aggregates that reflect the cyclicality of final demand (i.e., industries that supply consumer durables, cyclical business equipment, exports, intermediates, and so on), the cyclical sensitivity of productivity, the level of innovative activity, the dependence on suppliers, purchases of IT capital, the competitiveness of markets, the average quality of labor input, the sensitivity to energy prices, and so on.

Ultimately, of course, the ability to create a flexible system to isolate the drivers of productivity depends crucially on the availability of high quality data at the detailed industry level. Undoubtedly, most readers, ourselves included, appreciate the richness and detail in the currently available data from the BEA, BLS, and Census Bureau. Nevertheless, it was necessary for us to undertake special efforts to develop many of the required NAICS time-series for our analysis. We hope that the agencies will actively work to achieve more permanent solutions to the data hurdles that we faced, especially the need to reconcile differences in industry classification in government surveys and the

[30] For further recent evidence on the importance of intangibles, see Abowd *et. al*. (2005) and Bloom and Van Reenan (2006), who provide micro data evidence for links between organizational and management practices and firm-level outcomes. Specifically, Abowd et. al. find that firm-level distributions of human capital are strongly related to revenue per worker and market valuation, and Bloom and Van Reenan find that an index of management effectiveness is strongly related to productivity, profitability, and market value.

need for better and more detailed productivity data for the dynamic high tech and finance and business services sectors of the U.S. economy.

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Appendix A

Conversion of BEA/BLS hours and employment data from SIC to NAICS

1. Background and approach.

As of this writing, the BEA's NAICS data for employment and for hours worked only begin in 1998 and 2000, respectively. Moreover, the BEA's hours worked data are only available for broad groupings of industries whereas we work with and need data at a more detailed level.

The Census Bureau provided much of the information required to develop a detailed concordance from 1987 SIC industries to 1997 NAICS industries based on data for the year 1997. Beyond the task of compiling this information for use in our system, we nonetheless faced several major obstacles in tailoring the results to be applicable to the BEA/BLS data.

Our work revealed that BLS and Census have many differences in industry classification. Although this has long been known by many users of industry data, the conversion to NAICS appears to have greatly exacerbated the problem. For example, in the newly created NAICS sector, Management of Companies (NAICS 55), the differences are gigantic: According to the BLS, 1.1 million workers were employed in NAICS 55 in 1997, whereas the Census Bureau tallied employment at 2.6 million for that year! In other industries, the differences, though not as large, still are dramatic: In the Oil and Gas Extraction industry (NAICS 211), the employment counts differ by more than 30 percent in 1997. In the Computer and Electronic Product Manufacturing industry (NAICS 334), the BLS and Census counts differ by more than 12 percent, and so on.

Many of the largest Census/BLS discrepancies appear to stem from differences in the treatment of auxiliaries in the conversion to NAICS. One of the primary changes introduced by NAICS was that auxiliaries are treated as establishments classified by their production process rather than by their using industry. This change presented implementation challenges, and in the event, Census and BLS did not implement the change in a similar fashion. Unfortunately, the inconsistency in the Census/BLS results is a problem because productivity analysis involves relating measures of output with measures of inputs. When the underlying industry output data (from the Census Bureau) are classified differently than the data on labor input (from the BLS), the measurement and analysis of productivity is affected adversely.

Less obviously, inconsistencies in the conversion to NAICS in surveys of households can also affect productivity analysis; see text footnote 13 on page 12. Because workers in auxiliaries are likely to have different characteristics than those of the workers in the establishments of the industry they serve, incomplete conversion to NAICS in household surveys also hampers productivity analysis if the available demographic information by industry is not consistent with the establishment-based industry output and input measures.

The table on the next page shows that Census Bureau has long collected separate information on employment in auxiliaries that can be used to develop consistent historical time series for the new industries. Furthermore, the shaded areas in the table suggest that an important dimension of the employment changes during the 1990/91 recession—cutbacks at headquarters associated with the corporate restructuring of that time—could be misallocated if care is not taken in treating auxiliaries when developing historical NAICS data. Bayard and Klimek (2004) previously demonstrated the importance of time-varying concordances in their work to reclassify the historical establishment-based microdata in the censuses of manufactures.

For 1997 the Census provided a SIC-to-NAICS concordance for auxiliary as well as for establishment-based industry activity (employment, payroll, shipments/receipts, and number of reporting units/establishments). This information on the industries that used auxiliaries was embedded in BEA's 1997 benchmark I-O table (Lawson, et. al. 2002), and the resulting relationships were exploited for the creation of the historical NAICS GDP-by-industry data (Yuskavage and Pho 2004; personal conversation with Robert Yuskavage, February 2006). Because the historical data for new NAICS industries created from SIC auxiliaries (mainly Management of Companies, Warehousing, and Office Administrative Services) were determined from the 1997 I-O pattern of using industries, the historical GDP-by-industry data reflect, at least in part, the 1997 Census information.

With the BEA's integration of the industry accounts with the NIPAs from 1998 on (Moyer et. al. 2004), the annual I-O and GDP-by-industry data fully inherited the BLS levels of compensation by industry (personal conversation with Sue Okubo and George Smith of BEA, April 2006). According to the BEA, the 1997 benchmark I-O table was updated in a way that left industry value added and gross output unchanged, but the Census-based industry compensation in the published table was replaced with BLS-based figures and gross operating surplus was adjusted so that value added in that year was unaffected.

This "updating" of the benchmark I-O table would be expected to introduce a discontinuity in the BEA's data for industries that were most affected by the changed treatment of auxiliaries in NAICS. This reasoning is borne out by the behavior of the compensation share in management of companies: After averaging about 82 percent from 1987 to 1997, the share drops markedly and averages below 75 percent in 2003 and 2004; we believe this drop to largely reflect an adjustment from the Census view of the level of employment in this industry to the BLS view of the level of employment in this industry. The reasoning is also borne out when considering the compensation share in manufacturing, which employs a notable fraction of its workforce in auxiliaries. Indeed, the BEA manufacturing compensation measure climbs about 15 percent between 1997 and 2002, whereas the Census Bureau reported establishment-based compensation as little changed, on balance, between those years.

Auxiliary Employment by SIC Division, 1988 to 1997.

Year	Total auxiliary employment	Auxiliary emp., share of total employment	Share of total auxiliary employment							
			Mining	Construction	Manufacturing	Transp.,Comm. & Utilities	Wholesale Trade	Retail Trade	Finance, Insur. & Real estate	Services
1988	3,300,643	0.038	0.040	0.007	0.363	0.092	0.093	0.246	0.058	0.100
1989	3,396,594	0.037	0.038	0.007	0.355	0.093	0.095	0.247	0.064	0.101
1990	3,532,710	0.038	0.037	0.006	0.355	0.092	0.095	0.243	0.071	0.100
1991	3,132,738	0.034	0.037	0.007	0.416	0.039	0.102	0.269	0.017	0.112
1992	3,111,640	0.034	0.035	0.005	0.386	0.055	0.110	0.264	0.020	0.124
1993	3,192,505	0.034	0.029	0.005	0.397	0.052	0.106	0.257	0.019	0.134
1994	3,241,080	0.034	0.026	0.005	0.396	0.053	0.101	0.254	0.023	0.140
1995	3,338,029	0.033	0.024	0.005	0.397	0.053	0.102	0.255	0.021	0.143
1996	3,405,410	0.033	0.022	0.005	0.398	0.054	0.099	0.255	0.020	0.147
1997	3,327,377	0.032	0.023	0.007	0.377	0.057	0.097	0.262	0.027	0.149

Source. Authors' calculations based on data from *County Business Patterns* (Census Bureau). Data are for the week including March 12.

Note. Results for SIC Division A, Agriculture, forestry and fishing, are included in the total but not shown separately. For some divisions, the economic census contains additional detail on employment in auxiliaries.

Because some of the Census/BLS differences are so substantial, we stopped short of following an approach that sought to obtain accurate time series levels for employment by detailed industry.[31] Although we view both the BLS allocation of auxiliary employment to NAICS industries and the shift in BEA's I-O and GDP-by-NAICS industry data to fully reflect the BLS industry distribution as problematic, correcting these problems is well beyond the scope of this paper.

So, what can we do? First, we ignore the problem with the level of BEA's compensation shares for industries. Second, we abandon working at a very detailed level for the purpose of obtaining precision in SIC-to-NAICS conversion, both because the aforementioned problems would likely swamp the potential gain and because ultimately we want data on hours worked of all persons at roughly the BEA GDP-by-industry level and the raw data on hours worked are not readily available at a very detailed level. As a result, we set as our goal to derive industry hourly labor input series from 1987 to present whose changes are both consistent over time and appropriate for calculating productivity.

In a nutshell, we adopt the Census NAICS industry composition in 1998 and treat the BEA/BLS NAICS data on employment and hours as *indicators* from then on. Given converted values for employment, we preserve the underlying time-series relationships between (1) employment and average hours worked (the average workweek) and (2) employment and full-time equivalent employment in the BEA/BLS SIC and NAICS source data. All in all, we concord SIC data on employment and hours for about 80 private industries to the "adjusted" BEA/BLS NAICS data on employment and hours for about 75 private industries.

The motivation for the specific industries we use is reviewed in Appendix B, and further detail on the data we use and the calculations we make are reviewed in remainder of this appendix.

2. Data and concepts.

The BEA income and employment by industry tables (the NIPA "Section 6" annual-only tables) are mainly developed from BLS source data. They include four basic concepts of interest: full-time and part-time employment (FTPT), full-time equivalent employment (FTE), persons engaged in production (PEP), and hours worked by employees (HWEA).

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[31] We do believe, however, that the combination of (1) the detailed Census concordances for 1997, (2) the Bayard-Klimek concordances for manufacturing for 1987 and 1992, and (3) the detailed time series on employment from County Business Patterns for all years, would yield highly accurate time series for the level of employment by detailed NAICS industry from 1987 to 1997.

Better yet, though well beyond the scope of this paper, the accuracy could be further improved by applying the Bayard-Klimek research strategy to the microdata from the 1987 and 1992 economic censuses for other (i.e., nonmanufacturing) SIC divisions. The 1987 Economic Census did not include Finance, Insurance and Real Estate, and it included only selected transportation industries within the Transportation, Communication, and Utilities sector. The addition of those components in 1992 boosted census coverage from about 76 percent of GDP in 1987 to about 98 percent in 1992; the coverage of service industries expanded in 1967, 1977, and 1987. (See "Scope of Economic Census Programs" at http://www.census.gov/epcd/www/g97work.htm#START.)

Three of the series—FTPT, FTE, and PEP—are provided at the GDP-by-industry level of detail on both a NAICS and SIC basis, with the NAICS data from 1998 on covering 60 private industries and the SIC data from 1987 to 2000 covering 61 private industries.

The data for HWEA are only published for higher level aggregates, specifically, 13 private SIC industries from 1987 to 2000 and 16 private NAICS industries from 2000 on (see NIPA tables 6.9B and 6.9C). However, we have a HWEA dataset on an SIC basis that covers all previously published BEA SIC industries (65 total domestic industries, including government). The source is an earlier vintage of *unpublished* HWEA data, which were previously provided by the BEA; the dataset was updated to be consistent with the current vintage of more aggregated, published data in NIPA 6.9B.

We created a detailed dataset for HWEA on a NAICS basis from 2000 on by disaggregating the data published in NIPA table 6.9C by the available data on FTE. This assumes that the full-time workweek in industries for which it was necessary to create disaggregated series is the same as the full-time workweek in the "parent" industry.

Before we describe exactly what we do with these four variables, we find it useful to illustrate the relationship among them and the basic source data as follows:

(A1.a) HWE = **HWEA**/52 = AWHP_FTPT * **FTPT** * (HW/HP)

(A1.b) = AWHW_FTPT * **FTPT**

(A1.c) = WW_FT * (FT+ PT*WW_PT/WW_FT)

(A1.d) = WW_FT * **FTE**

Employment (FTPT) and average weekly hours paid (AWHP_FTPT) are obtained from the BLS establishment survey. These data are adjusted to hours worked using information from other BLS sources, which we summarize in equation (A1.a) by the ratio of hours worked to hours paid (HW/HP).

The ratio (HW/HP) embodies information on paid holidays and sick leave, which converts the observed variable, average weekly hours paid (AWHP_FTPT) to the unobserved variable, average weekly hours worked (AWHW_FTPT), as shown in equation (A1.b) Information on the relationship between hours worked and hours paid typically has been available only annually by broad industry groups.

However, as seen in (A1.c), HWE can also be expressed in terms for the full-time/part-time mix of employment (FT versus PT) and the differential between the actual workweek of full-time and part-time employees (WW_FT versus WW_PT). Information on these concepts is available in the decennial census and can be extrapolated annually from the BLS Current Population Survey at a more detailed industry level (although the industry classification relies on the respondent identification, which likely has been a problem with the advent of NAICS; see our earlier comment on page 43).

Nonetheless, as seen in equation (A1.d), the BEA series for FTE embodies important information on hourly labor input, especially to the extent that the actual workweek of full-time equivalent employees varies less than the workweek (actual or paid) averaged over all employees. We thus preserve the information on the *relationship* between hours and employment by preserving the relationship between FTE and FTPT for each BEA industry.

Finally, as indicated in the text, we compute hours of all persons (HWA) by assuming the workweek of the self-employed (SE = PEP – FTE) is the same as that of full-time equivalent employees:

(A1.e) $\quad HWA = (\mathbf{FTE} + SE) * WW\_FT$

(A1.f) $\quad = \mathbf{PEP} * WW\_FT$

To summarize, prior to concording the SIC data to NAICS, we transform the BEA/BLS NAICS data as follows:

1. We adjust the *levels* of the NAICS employment data (FTPT) in 1998 so that they conform to the industry composition of the Census *County Business Patterns* (CBP) data.
2. We compute an *adjusted* FTE for each industry in 1998 by multiplying the adjusted FTPT data by the relationship between FTE and FTPT in the original BEA/BLS data.
3. We recalculate the HWEA data from 2000 so that they embody the *adjusted* FTE but such that the implied values of WW_FT in the current published series are preserved (that is, HWE for each industry is *adjusted* FTE * *original* WW_FT)
4. Finally, all adjusted NAICS data from 1998 on (as well as all new estimates for 1987 to 1997) are controlled so that the published BEA/BLS aggregates for employment and hours worked in total private industries are preserved.

The Census-based concordance is then applied to the adjusted FTE data and "RASed" using bi-proportional balancing techniques so that the SIC-based FTE data line up with the adjusted FTE data in 1998. The "RASed" FTE concordance is applied to the HWEA data, with little need for further balancing. Further details are available from the authors.

Appendix B

Creation of the "Sectors" PNFB Industry Hierarchy

1. Summary and numbers of industries.

We start with 65 total domestic industries in BEA's industry accounts, 61 of which are *private* industries. After disaggregating selected services industries and segmenting nonprofits, we have 68 private industry components. After disaggregating BEA's real estate industry into housing and all other real estate activities, we have 69 components. After stripping out the farm sector (1), nonbusinesses (6) and households/housing (2), we are left with 60 private industry nonfarm business components.

To carve out the high-tech sector, we disaggregated three BEA industries using BEA's more disaggregated information on gross output and I-O relationships and other available information. This created three additional new industries, and we ended with a total of 63 private industry nonfarm business components. We would prefer to use the 2002 NAICS to define our high-tech sector because it greatly improved the classification of internet activity, but the BEA gross output industry and I-O data still use the 1997 version of NAICS.

All in all, to create our sectors, we needed to create 18 new NAICS industries from 7 original BEA NAICS industries. A list of the 76 total domestic industries in our system, 72 of which are private industries and 63 are the private nonfarm business industries, are shown in first column of table B1. The original components of the BEA's industry accounts dataset, where different, are shown in the two far right columns.

The I-O analysis evaluated the initial placements of industries in sectors as shown in text table 3; in effect, the algorithm does not pertain to the 5 industries in the high-tech, nor does it reconsider the placement of the construction industry in the construction sector or the retail trade industry in the distribution sector because these industries are anchored by the definitions of the sectors. As a result, the work was to evaluate the placement of 56 industries in the four large sectors, industrial, distribution, finance and business, and personal and cultural. The conclusion was to move two detailed industries.

A "data quality" review was conducted from the perspective of the need to convert historical SIC data to NAICS. The review suggested that further disaggregation of selected BEA industries would notably improve both our grouping of industries into sectors and our ability to create reliable historical estimates of hours (and thus productivity) by NAICS industry, especially the motion picture industry.

Because of other data limitations, this further disaggregation was not implemented, but, in view of the data quality analysis and our desire to carve out the high-tech sector, we used a more disaggregated list of SIC industries as the starting point in our work to concord historical SIC employment and hours data to NAICS. The industry list that was used for the mapping of SIC data to NAICS consists of 79 SIC industries and is shown in table B2.

Table B1. Components of the sectors PNFB heirarchy and relation to BEA industries.

Number in Total	Number in NFB	Code	Description	Code	BEA industry, if different	Number in BEA
1		N111T2	Farms			1
2	1	N113T5	Forestry, fishing, and related activities			2
3	2	N211	Oil and gas extraction			3
4	3	N212	Mining, except oil and gas			4
5	4	N213	Support activities for mining			5
6	5	N22	Utilities			6
7	6	N23	Construction			7
8	7	N321	Wood products			8
9	8	N327	Nonmetallic mineral products			9
10	9	N331	Primary metals			10
11	10	N332	Fabricated metal products			11
12	11	N333	Machinery			12
13	12	N334	Computer and electronic products			13
14	13	N335	Electrical equipment, appliances, and components			14
15	14	N3361T3	Motor vehicles, bodies and trailers, and parts			15
16	15	N3364T6A9	Other transportation equipment			16
17	16	N337	Furniture and related products			17
18	17	N339	Miscellaneous manufacturing			18
19	18	N311T2	Food and beverage and tobacco products			19
20	19	N313T4	Textile mills and textile product mills			20
21	20	N315T6	Apparel and leather and allied products			21
22	21	N322	Paper products			22
23	22	N323	Printing and related support activities			23
24	23	N324	Petroleum and coal products			24
25	24	N325	Chemical products			25
26	25	N326	Plastics and rubber products			26
27	26	N42	Wholesale trade			27
28	27	N44T5	Retail trade			28
29	28	N481	Air transportation			29
30	29	N482	Rail transportation			30
31	30	N483	Water transportation			31
32	31	N484	Truck transportation			32
33	32	N485	Transit and ground passenger transportation			33
34	33	N486	Pipeline transportation			34
35	34	N487T8A492	Other transportation and support activities			35
36	35	N493	Warehousing and storage			36
37	36	**N5111**	**Publishing industries (exc. Software)**	N511	Publishing industries	**37**
38	37	**N5112**	**Software publishers**	N511	Publishing industries	**37**
39	38	N512	Motion picture and sound recording industries			38
40	39	**N5131A2**	**Radio/TV and cable broadcasting**	N513	Broadcasting	**39**
41	40	**N5133**	**Telecommunications**	N513	Broadcasting	**39**
42	41	**N5141**	**Information services**	N514	Information and data processing services	**40**
43	42	**N5142**	**Data processing services**	N514	Information and data processing services	**40**
44	43	N521T2	Federal Reserve banks, credit intermediation, and related activities			41
45	44	N523	Securities, commodity contracts, and investments			42
46	45	N524	Insurance carriers and related activities			43
47	46	N525	Funds, trusts, and other financial vehicles			44
48		**N531h**	**Housing (owner- and tenant-occupied)**	N531	Real estate	**45**
49	47	**N531re**	**Real estate, excluding housing**	N531	Real estate	**45**
50	48	N532T3	Rental and leasing services and lessors of in tangible assets			46
51	49	N5411	Legal services			47
52	50	N5415	Computer systems design and related services			48
53	51	N54MISC	Miscellaneous professional, scientific, and technical services			49
54	52	N55	Management of companies and enterprises			50
55	53	N561	Administrative and support services			51
56	54	N562	Waste management and remediation services			52
57		N61	Educational services			53
58	55	**N621A**	**Offices of physicians, dentists, and other h.c. practioners**	N621	Ambulatory health care services	**54**
59	56	**N621XB**	**Home and other ambulatory health care services, busines**	N621	Ambulatory health care services	**54**
60		**N621XN**	**Home and other ambulatory health care services, nonprofi**	N621	Ambulatory health care services	**54**
61	57	**N622B**	**Hospitals, business**	N622A3	Hospitals and nursing and residential care fa	**55**
62		**N622N**	**Hospitals, nonprofit**	N622A3	Hospitals and nursing and residential care fa	**55**
63	58	**N623B**	**Nursing and residential care facilities, business**	N622A3	Hospitals and nursing and residential care fa	**55**
64		**N623N**	**Nursing and residential care facilities, nonprofit**	N622A3	Hospitals and nursing and residential care fa	**55**
65		N624	Social assistance			56
66	59	N711T2	Performing arts, spectator sports, museums, and related activities			57
67	60	N713	Amusements, gambling, and recreation industries			58
68	61	N721	Accommodation			59
69	62	N722	Food services and drinking places			60
70	63	**N811A2**	**Repair and other personal services**	N81	Other services, except government	**61**
71		**N813**	**Religious, grantmaking, civic etc. organizations**	N81	Other services, except government	**61**
72		**N814**	**Private households**	N81	Other services, except government	**61**
73		N92FGG	Federal General government			62
74		N92FGE	Federal Government enterprises			63
75		N92SLGG	State and local General government			64
76		N92SLGE	State and local Government enterprises			65

Note--Bolded industries were estimated. Shaded industries are excluded from the analysis of the private nonfarm business sector.

Table B2. Components of heirarchy used for concording SIC BEA hours and employment data to NAICS

Number	Code	Definition (SIC87)	Code	BEA industry, if different	Number
1	E01A2	Farms			1
2	E07T9	Agricultural services, forestry, and fishing	*****		2
3	E10	Metal mining			3
4	E12	Coal mining			4
5	E13	Oil and gas extraction			5
6	E14	Nonmetallic minerals, except fuels			6
7	E15T7	Construction			7
8	E24	Lumber and wood products			8
9	E25	Furniture and fixtures			9
10	E32	Stone, clay, and glass products			10
11	E33	Primary metal industries			11
12	E34	Fabricated metal products			12
13	E35	Industrial machinery			13
14	E36	Electrical machinery			14
15	E371	Motor vehicles and equipment			15
16	E372T9	Other transportation equipment			16
17	E38	Instruments and related products			17
18	E39	Miscellaneous manufacturing industries			18
19	E20	Food and kindred products			19
20	E21	Tobacco products			20
21	E22	Textile mill products			21
22	E23	Apparel and other textile products			22
23	E26	Paper and allied products			23
24	**E271T4**	**Newpapers, books, periodicals, and misc. publishing**	E27	Printing and publishing	24
25	**E275T9**	**Commercial printing and related products**	E27	Printing and publishing	
26	E28	Chemicals and allied products			25
27	E29	Petroleum and coal products			26
28	E30	Rubber and miscellaneous plastics products			27
29	E31	Leather and leather products			28
30	E49	Electric, gas, and sanitary services			29
31	E40	Railroad transportation			30
32	E41	Local and interurban passenger transit			31
33	E42	Trucking and warehousing			32
34	E44	Water transportation			33
35	E45	Transportation by air			34
36	E46	Pipelines, except natural gas			35
37	**E472**	**Arrangement of passenger transportation**	E47	Transportation services	36
38	**E473A4A8**	**Transportation services, excl passenger arr.**	E47	Transportation services	
39	E481A2A9	Telephone and telegraph			37
40	E483A4	Radio and television			38
41	E50A1	Wholesale trade			39
42	**E52T7A9**	**Retail trade, excl. eating and drinking pl.**	E52T9	Retail trade	40
43	**E58**	**Eating and drinking places**	E52T9	Retail trade	
44	E60	Depository institutions			41
45	E61	Nondepository institutions			42
46	E62	Security and commodity brokers			43
47	E63	Insurance carriers			44
48	E64	Insurance agents, brokers, and service			45
49	**E65h**	**Housing**	E65	Real estate	46
50	**E65re**	**Real estate, excluding housing**	E65	Real estate	
51	E67	Holding and other investment offices			47
52	E70	Hotels and other lodging places			48
53	E72	Personal services	*****		49
54	**E731T6A8**	**Business services, excl software**	E73	Business services	50
55	**E7371**	**Computer programming services**	E73	Business services	
56	**E7372**	**Software publishers**	E73	Business services	
57	**E7374**	**Data processing services**	E73	Business services	
58	**E7375**	**Online information services**	E73	Business services	
59	**E7376**	**Computer facilities mgt. services**	E73	Business services	
60	**E7373A7T9**	**Computer systems integrators, rent/lsg, main/rpr, & nec.**	E73	Business services	
61	E75	Auto repair, services, and parking			51
62	E76	Miscellaneous repair services			52
63	E78	Motion pictures	*****		53
64	E79	Amusement and recreation services			54
65	**E801**	**Offices and clinics of doctors**	E80	Health services	55
66	**E802**	**Offices and clinics of dentists**	E80	Health services	
67	**E805**	**Nursing and personal care facilities**	E80	Health services	
68	**E806**	**Hospitals**	E80	Health services	
69	**E807**	**Medical and dental laboratories**	E80	Health services	
70	**E808**	**Home health centers**	E80	Health services	
71	**E803A4A9**	**Offices of other health care pract. & misc. health and allied servi**	E80	Health services	
72	E81	Legal services			56
73	E82	Educational services			57
74	E83	Social services			58
75	E86	Membership organizations			59
76	E84A7A9	Other services			60
77	E88	Private households			61
78	E91a	Federal general government			62
79	E91b	Federal government enterprises			63
80	E92a	State and local general government			64
81	E92b	State and local government enterprises			65

***** Industries "severely" split across sectoral lines (see text for discussion).

Note--Data for bolded industries were disaggregated based on source data from the BLS.

2. Estimation of nonprofits.

Nonprofit institutions serving individuals (hereafter nonprofits) appear in the BEA industries shown in the table below.

BEA Industries with nonprofit activity, 1998.

NAICS Code	Description	Gross Output (billions)	Nonprofit share (percent)
611	Educational services	120,555	83.1
621	Ambulatory health care services	406,560	11.1
622,3	Hospitals and nursing and residential care facilities	385,191	73.1
624	Social assistance	72,047	64.4
711,2	Performing arts, spectator sports, museums, and related activities	58,463	16.3
713	Amusements, gambling, and recreation industries	71,335	11.1
81	Other services, except government	379,246	26.6

Source—Mead, McCully, and Reinsdorf (2003) and authors' calculations.
Note. Industries whose nonprofit share of gross output is less than 2 percent are omitted).

According to data from the BEA and the Census Bureau, the nonprofit shares and growth of the underlying industries in the BEA industry, ambulatory health care (NAICS 621), vary notably. Accordingly, the industry was split into offices of physicians, dentists, and other health care professionals (NAICS 6211-3) and home and other ambulatory health care services (NAICS 6214-9). For the same reason, the BEA industry, hospitals and nursing and residential care facilities (NAICS 622-3), was split into hospitals (NAICS 622) and nursing and residential care facilities (NAICS 623). The new industries were estimated using BEA's more disaggregated information on gross output and I-O relationships. Within other services (NAICS 81), nonprofit activity is concentrated in the industry, religious, grantmaking, civic, professional, and similar organizations (NAICS 813). We estimated an account for this industry using the same sources.

We estimated nonprofit and business segments for three industries based mainly on data from the Census Bureau: home and other ambulatory health care services (NAICS 6214-9), hospitals (NAICS 622), and nursing and residential care facilities (NAICS 623). We did not segment the new disaggregate industry, offices of physicians, dentists, and other health care professionals (NAICS 6211-3), or the BEA industries, performing arts, spectator sports, museums and related activities (NAICS 711-2) and amusements, gambling, and recreation activities (NAICS 713), because their nonprofit shares are very small. Similarly, we did not segment educational services (NAICS 61), social assistance services (NAICS 624), and religious, grantmaking, civic, professional, and similar organizations (NAICS 813) because their business shares are very small.

We erred against segmenting all affected industries because of the spottiness of the available price and output data and the difficulty of obtaining accurate measures of capital input for business vs. nonbusiness segments. We did not even attempt to bring more information to bear on the latter issue; instead, we allowed the index of capital input for each segment to change at the same rate as the index for the total industry. The BLS

uses information on investment by businesses in affected industries to create its capital input measures for business activity. Although the available source data are limited and highly imprecise (BLS 1983), we may consider using their results in future work.

3. High-tech sector definition/estimation.

To group the key IT-producing industries in a single sector, we assigned the computer and electronic product manufacturing NAICS subsector (NAICS 334), the software publishing industry (NAICS 5112), the information services industry (NAICS 5141), the telecommunications services industry (NAICS 5133), and the computer systems design and related services industry (NAICS 5415) to high-tech.

BEA includes accounts for NAICS 334 and 5415 in its GDP-by-industry dataset. To obtain an account for NAICS 5112, we split the BEA publishing industry (NAICS 511) into separate accounts for software publishing (NAICS 5112) and other publishing (mainly newspapers, books, and periodicals, NAICS 5111). Gross output and price indexes for these industries were obtained from the historical BEA and Census SIC data and BEA's own historical price index for prepackaged software. The BEA broadcasting industry (NAICS 513) was split into separate accounts for radio/TV/cable broadcasting (NAICS 5131,2) and telecommunications (NAICS 5133) based entirely on previously published GDP by SIC industry data.

The BEA information and data processing services industry (NAICS 514) was split into information services (NAICS 5141) and data processing services (NAICS 5142) using historical BEA and Census SIC data. NAICS 5141 includes internet service providers, and we use the price index from 1993 to 1997 developed by Granger and Greenstein (2003, table 12; see also Greenstein 2002) to capture the early development of this industry. As a result of incorporating this research price index, our real output measure for NAICS 514 is slightly different than the published data for this industry.

We did not further disaggregate NAICS 334 because the appropriate information on I-O relationships between different types of equipment (computers vs. communications equipment) and different types of semiconductors, as well as prices for the different types of semiconductors, is not available (see Triplett and Bosworth 2004, chapter 10, for a discussion of the importance of this kind of detailed information on high-tech manufacturing). In future work, we plan to work to further disaggregate the high-tech sector and highlight the need for more detailed price measures for IT (see discussion on page 26).

4. Input-output analysis.

The algorithm for evaluating the assignment of industries to the six sectors begins with an industry-by-sector "use" table that summarizes the distribution an industry's gross output to other sectors and final users. It evaluates the initial placement of each industry based on its int*ra*sectoral flows and then evaluates alternative placements based on the impact on the move on the system's int*er*sectoral flows.

As suggested by earlier discussion, we begin with "industries" that are at very different degrees of aggregation (e.g., wholesale trade is itself a large NAICS sector; the miscellaneous professional, scientific, and technical services industry is a very diverse grouping of activities, etc.). If the underlying I-O relationships of the detailed components of these NAICS sectors/industries are highly heterogeneous, our algorithm will have problems uncovering the distinctions we are trying make about the uses of the products and services produced by each sector.

Our industry "atoms" are also at different degrees of vertical aggregation. This is most easily seen in the first column table B3, which shows an industry-by-sector use table. It is based on the initial assignment of industries to sectors and reported in terms of percent of industry gross output. We are not trying to uncover *multiple* stages of process beyond the basic definitional relationships among the sectors, however. As a result, the high degree of initial vertical aggregation of some of the industries that we work with is not necessarily a problem for our algorithm (see Gaddie and Zoller 1988 for a discussion of the more complicated problem of assigning industries to multiple stages of process).

The algorithm takes the definitions of the six sectors as described above and in the text as given, which, in effect, involves evaluating the placement of 56 industries in the four large sectors, industrial, distribution, finance and business, and personal and cultural. We first check the assignment of the final demand vector, which concerns the classification of industries in the personal and cultural sector. We then review the assignments of industries whose output is primarily for intermediate use. These reviews utilize the statistics in table B4, which shows an industry-by-sector use table in terms of industry sectoral output. (In this table the shares of intermediate use going to other sectors are normalized to sum to one.)

Steps in the algorithm:

Step 1. Check assignment of final demand vector.

List industries that produce *services* and are (1) not already classified in the personal and cultural sector AND have (2) a final users' share of sectoral output greater than 50 percent AND (3) a PCE share of total final use greater than 80 percent:

22	Utilities
485	Transit and ground passenger transportation
524	Insurance carriers
525	Funds, trusts, and other financial vehicles

Proposed destination: Personal and cultural

Step 2. Check assignment of industries with share of sectoral output to intermediate use of 25 percent or greater (and PCE share is less than 80 percent).

Table B3. Industry by sector use table (percent of gross output), 1998.

Sector[1]	Industry		Own Use[2]	Other Intermediate Use[2]	Private Non Farm Business Sectors (Components of Intermediate Use)						Total Final Use[2]	XNFB[2]	Final Demand[2]	Components of Final Demand	
					HITCH	CON	INDX	DIST	FIB	SVCX				PCE	Other
HITCH	N334	Computer and electronic prod	0.158	0.194	0.030	0.007	0.101	0.015	0.020	0.022	0.647	0.006	0.642	0.075	0.566
HITCH	N5112	Software publishers	0.038	0.145	0.137	0.001	0.004	0.000	0.002	0.001	0.817	0.001	0.816	0.101	0.715
HITCH	N5133	Telecommunications	0.184	0.352	0.027	0.028	0.044	0.057	0.129	0.066	0.464	0.028	0.435	0.376	0.059
HITCH	N5141	Information servives	0.002	0.532	0.031	0.023	0.048	0.080	0.166	0.184	0.466	0.036	0.431	0.422	0.009
HITCH	N5415	Computer systems design and related	0.009	0.256	0.034	0.004	0.037	0.062	0.091	0.028	0.735	0.017	0.718	0.008	0.710
CON	N23	Construction	0.001	0.062	0.003	0.000	0.013	0.008	0.027	0.011	0.937	0.031	0.906	0.000	0.906
INDX	N113T5	Forestry, fishing, and related activ	0.262	0.430	0.000	0.000	0.360	0.000	0.011	0.059	0.308	0.182	0.126	0.069	0.057
INDX	N211	Oil and gas extraction	0.064	0.863	0.000	0.004	0.838	0.018	0.002	0.001	0.073	0.031	0.042	0.016	0.026
INDX	N212	Mining, except oil and gas	0.096	0.711	0.002	0.096	0.603	0.002	0.006	0.002	0.193	0.057	0.136	0.011	0.125
INDX	N213	Support activities for mining	0.010	0.091	0.000	0.000	0.090	0.000	0.000	0.000	0.899	0.000	0.899	0.000	0.899
INDX	N22	Utilities	0.002	0.442	0.015	0.009	0.168	0.060	0.116	0.073	0.556	0.057	0.500	0.497	0.002
INDX	N311T2	Food and beverage and tobacco prod	0.149	0.153	0.000	0.000	0.009	0.002	0.001	0.142	0.698	0.044	0.654	0.587	0.067
INDX	N313T4	Textile mills and textile product	0.198	0.426	0.001	0.014	0.374	0.010	0.007	0.019	0.376	0.018	0.358	0.249	0.109
INDX	N315T6	Apparel and leather and allied pro	0.047	0.040	0.000	0.000	0.026	0.005	0.003	0.004	0.913	0.004	0.910	0.770	0.140
INDX	N321	Wood products	0.201	0.577	0.010	0.321	0.152	0.046	0.028	0.019	0.223	0.051	0.171	0.019	0.153
INDX	N322	Paper products	0.197	0.574	0.018	0.016	0.352	0.048	0.054	0.086	0.229	0.037	0.192	0.108	0.083
INDX	N323	Printing and related support activ	0.060	0.721	0.061	0.022	0.096	0.106	0.245	0.191	0.219	0.125	0.095	0.059	0.036
INDX	N324	Petroleum and coal products	0.082	0.442	0.004	0.089	0.137	0.158	0.037	0.017	0.475	0.070	0.406	0.345	0.061
INDX	N325	Chemical products	0.200	0.316	0.012	0.017	0.220	0.008	0.025	0.035	0.484	0.073	0.411	0.242	0.169
INDX	N326	Plastics and rubber products	0.055	0.686	0.034	0.089	0.366	0.071	0.036	0.090	0.259	0.065	0.194	0.101	0.093
INDX	N327	Nonmetallic mineral products	0.095	0.717	0.016	0.389	0.218	0.013	0.039	0.042	0.188	0.064	0.125	0.062	0.063
INDX	N331	Primary metals	0.218	0.682	0.024	0.030	0.613	0.006	0.002	0.007	0.100	0.007	0.093	0.027	0.066
INDX	N332	Fabricated metal products	0.096	0.705	0.054	0.167	0.399	0.031	0.020	0.035	0.198	0.034	0.164	0.059	0.105
INDX	N333	Machinery	0.057	0.203	0.007	0.050	0.104	0.011	0.006	0.024	0.740	0.018	0.723	0.030	0.692
INDX	N335	Electrical equipment, appliances	0.056	0.443	0.064	0.144	0.179	0.011	0.013	0.032	0.501	0.025	0.476	0.169	0.307
INDX	N3361T3	Motor vehicles, bodies and trailer	0.213	0.091	0.002	0.006	0.015	0.019	0.008	0.041	0.696	0.005	0.691	0.267	0.424
INDX	N3364T6A9	Other transportation equipment	0.162	0.051	0.001	0.002	0.004	0.034	0.004	0.005	0.788	0.002	0.786	0.058	0.728
INDX	N337	Furniture and related products	0.013	0.159	0.007	0.123	0.013	0.003	0.008	0.004	0.829	0.017	0.812	0.409	0.403
INDX	N339	Miscellaneous manufacturing	0.043	0.173	0.008	0.009	0.033	0.010	0.024	0.089	0.785	0.043	0.741	0.417	0.324
DIST	N42	Wholesale trade	0.023	0.427	0.049	0.032	0.259	0.023	0.018	0.047	0.550	0.034	0.515	0.316	0.200
DIST	N44T5	Retail trade	0.004	0.098	0.001	0.052	0.014	0.005	0.013	0.013	0.898	0.009	0.889	0.843	0.046
DIST	N481	Air transportation	0.001	0.320	0.030	0.008	0.084	0.038	0.118	0.040	0.679	0.036	0.643	0.422	0.221
DIST	N482	Rail transportation	0.002	0.699	0.006	0.038	0.552	0.057	0.017	0.030	0.299	0.077	0.221	0.129	0.092
DIST	N483	Water transportation	0.001	0.307	0.003	0.030	0.218	0.035	0.012	0.010	0.692	0.028	0.665	0.400	0.265
DIST	N484	Truck transportation	0.124	0.542	0.010	0.061	0.390	0.020	0.021	0.041	0.333	0.048	0.286	0.223	0.063
DIST	N485	Transit and ground passenger trans	0.053	0.281	0.036	0.002	0.029	0.030	0.136	0.047	0.666	0.046	0.621	0.620	0.000
DIST	N486	Pipeline transportation	0.008	0.880	0.000	0.002	0.865	0.010	0.002	0.001	0.112	0.067	0.044	0.025	0.020
DIST	N487T8A492	Other transportation and support a	0.050	0.752	0.025	0.021	0.087	0.414	0.152	0.052	0.198	0.033	0.165	0.086	0.079
DIST	N493	Warehousing and storage	0.000	0.891	0.060	0.001	0.368	0.321	0.104	0.038	0.109	0.066	0.043	0.018	0.025
FIB	N5142	Data processing services	0.015	0.902	0.093	0.011	0.199	0.152	0.343	0.105	0.083	0.052	0.031	0.005	0.027
FIB	N521T2	Federal Reserve banks, credit inte	0.075	0.433	0.035	0.020	0.098	0.080	0.143	0.058	0.491	0.067	0.424	0.384	0.040
FIB	N523	Securities, commodity contracts, a	0.160	0.451	0.010	0.011	0.039	0.018	0.350	0.023	0.389	0.042	0.347	0.305	0.042
FIB	N524	Insurance carriers and related act	0.350	0.125	0.010	0.004	0.030	0.021	0.045	0.015	0.525	0.046	0.480	0.468	0.012
FIB	N525	Funds, trusts, and other financial	0.000	0.047	0.000	0.000	0.000	0.000	0.047	0.000	0.953	0.000	0.953	0.953	0.000
FIB	N531re	Real Estate - excl Housing	0.087	0.362	0.017	0.007	0.022	0.090	0.121	0.105	0.551	0.139	0.412	0.328	0.084
FIB	N532T3	Rental and leasing services and le	0.024	0.530	0.049	0.046	0.160	0.083	0.119	0.072	0.447	0.029	0.418	0.261	0.157
FIB	N5411	Legal services	0.035	0.481	0.034	0.015	0.074	0.054	0.238	0.067	0.484	0.096	0.388	0.367	0.021
FIB	N54MISC	Miscellaneous professional, scienti	0.072	0.753	0.081	0.078	0.161	0.137	0.199	0.097	0.175	0.056	0.120	0.057	0.063
FIB	N55	Management of companies and enterp	0.000	0.885	0.063	0.005	0.419	0.239	0.093	0.065	0.115	0.024	0.091	0.000	0.091
FIB	N561	Administrative and support services	0.049	0.713	0.077	0.031	0.049	0.170	0.276	0.111	0.238	0.161	0.076	0.072	0.005
FIB	N562	Waste management and remediation se	0.133	0.628	0.028	0.022	0.292	0.052	0.158	0.075	0.239	0.062	0.177	0.725	-0.547
SVCX	N5111	Publishing (exc Software	0.082	0.448	0.040	0.034	0.076	0.069	0.163	0.065	0.470	0.054	0.416	0.384	0.033
SVCX	N512	Motion picture and sound recording	0.286	0.302	0.002	0.001	0.014	0.001	0.050	0.233	0.412	0.026	0.386	0.291	0.095
SVCX	N5131A2	Radio/TV and cable broadcasting	0.202	0.374	0.037	0.004	0.048	0.083	0.121	0.082	0.424	0.027	0.397	0.386	0.011
SVCX	N621A	Offices of physicians, dentists, an	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	1.000	1.000	0.000
SVCX	N621XB	Home and other ambulatory health ca	0.016	0.019	0.000	0.000	0.000	0.001	0.002	0.017	0.965	0.020	0.945	0.945	0.000
SVCX	N623B	Nursing and residential care facili	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	1.000	1.000	0.000
SVCX	N711T2	Performing arts, spectator sports	0.160	0.392	0.014	0.008	0.036	0.020	0.118	0.195	0.448	0.021	0.427	0.425	0.002
SVCX	N713	Amusements, gambling, and recreatio	0.001	0.047	0.004	0.001	0.014	0.006	0.015	0.007	0.952	0.003	0.949	0.949	0.000
SVCX	N721	Accommodation	0.002	0.313	0.028	0.007	0.066	0.035	0.143	0.034	0.685	0.018	0.668	0.667	0.001
SVCX	N722	Food services and drinking places	0.008	0.138	0.009	0.002	0.028	0.025	0.052	0.022	0.854	0.018	0.836	0.837	-0.001
SVCX	N811A2	Repair and other personal services	0.014	0.328	0.027	0.023	0.121	0.052	0.076	0.030	0.658	0.025	0.633	0.632	0.000

[1] The primary sectors are HITCH = High Tech; CON = Construction; FIB = Finance and Business; SVCX = Personal and Cultural; INDX = Industry excluding High Tech; DIST = Distribution; XNFB = Other Intermediates; PCE = Personal Consumption

[2] Share of gross output

Table B4. Use Table (percent of sectoral output), 1998

Sector[1]	Industry		Other Intermediate Use[2]	Private Nonfarm Business Sectors (Normalized to 1)							Total Final Use[2]	XNFB[2]	Final Demand[2]	PCE[3]
				HITCH	CON	INDX	DIST	FIB	SVCX	CV				
HITCH	N334	Computer and electronic prod	0.231	0.153	0.034	0.520	0.078	0.103	0.112	1.063	0.769	0.007	0.762	0.116
HITCH	N5112	Software publishers	0.151	0.945	0.008	0.027	0.003	0.010	0.007	2.282	0.849	0.001	0.848	0.123
HITCH	N5133	Telecommunications	0.431	0.078	0.079	0.125	0.162	0.368	0.188	0.646	0.569	0.035	0.534	0.811
HITCH	N5141	Information servives	0.533	0.058	0.043	0.089	0.150	0.313	0.346	0.790	0.467	0.036	0.432	0.904
HITCH	N5415	Computer systems design and related	0.258	0.133	0.017	0.143	0.243	0.354	0.110	0.699	0.742	0.017	0.724	0.010
CON	N23	Construction	0.062	0.052	0.000	0.211	0.123	0.439	0.175	0.924	0.938	0.031	0.907	0.000
INDX	N113T5	Forestry, fishing, and related activ	0.582	0.000	0.000	0.837	0.000	0.027	0.136	1.991	0.418	0.247	0.170	0.224
INDX	N211	Oil and gas extraction	0.922	0.000	0.005	0.970	0.021	0.002	0.001	2.358	0.078	0.033	0.045	0.221
INDX	N212	Mining, except oil and gas	0.786	0.003	0.134	0.849	0.003	0.008	0.003	2.026	0.214	0.063	0.151	0.056
INDX	N213	Support activities for mining	0.092	0.000	0.001	0.996	0.002	0.000	0.000	2.433	0.908	0.000	0.908	0.000
INDX	N22	Utilities	0.443	0.035	0.021	0.381	0.135	0.262	0.166	0.824	0.557	0.057	0.500	0.894
INDX	N311T2	Food and beverage and tobacco prod	0.180	0.000	0.000	0.056	0.013	0.007	0.924	2.225	0.820	0.052	0.768	0.841
INDX	N313T4	Textile mills and textile product	0.531	0.002	0.033	0.878	0.024	0.017	0.045	2.089	0.469	0.022	0.447	0.662
INDX	N315T6	Apparel and leather and allied pro	0.042	0.012	0.005	0.668	0.129	0.084	0.102	1.500	0.958	0.004	0.955	0.843
INDX	N321	Wood products	0.721	0.017	0.556	0.264	0.080	0.049	0.033	1.264	0.279	0.064	0.214	0.084
INDX	N322	Paper products	0.715	0.031	0.027	0.614	0.084	0.094	0.149	1.339	0.285	0.046	0.239	0.473
INDX	N323	Printing and related support activ	0.767	0.085	0.030	0.134	0.147	0.340	0.265	0.690	0.233	0.133	0.101	0.269
INDX	N324	Petroleum and coal products	0.482	0.009	0.202	0.310	0.357	0.083	0.039	0.872	0.518	0.076	0.442	0.725
INDX	N325	Chemical products	0.394	0.038	0.052	0.696	0.024	0.079	0.111	1.562	0.606	0.092	0.514	0.500
INDX	N326	Plastics and rubber products	0.726	0.049	0.130	0.534	0.103	0.053	0.131	1.099	0.274	0.069	0.205	0.390
INDX	N327	Nonmetallic mineral products	0.792	0.023	0.542	0.304	0.017	0.054	0.059	1.277	0.208	0.070	0.138	0.327
INDX	N331	Primary metals	0.872	0.036	0.044	0.898	0.009	0.003	0.011	2.149	0.128	0.009	0.119	0.272
INDX	N332	Fabricated metal products	0.781	0.077	0.237	0.566	0.044	0.028	0.049	1.258	0.219	0.038	0.182	0.298
INDX	N333	Machinery	0.215	0.036	0.247	0.514	0.054	0.031	0.118	1.129	0.785	0.019	0.766	0.041
INDX	N335	Electrical equipment, appliances	0.469	0.144	0.325	0.404	0.025	0.030	0.072	0.964	0.531	0.027	0.504	0.337
INDX	N3361T3	Motor vehicles, bodies and trailer	0.116	0.018	0.066	0.169	0.211	0.090	0.446	0.921	0.884	0.006	0.878	0.384
INDX	N3364T6A9	Other transportation equipment	0.061	0.027	0.031	0.084	0.671	0.088	0.099	1.490	0.939	0.002	0.937	0.074
INDX	N337	Furniture and related products	0.161	0.047	0.774	0.085	0.020	0.052	0.022	1.787	0.839	0.017	0.822	0.493
INDX	N339	Miscellaneous manufacturing	0.180	0.045	0.050	0.193	0.058	0.137	0.518	1.088	0.820	0.045	0.775	0.532
DIST	N42	Wholesale trade	0.437	0.115	0.074	0.605	0.053	0.042	0.110	1.299	0.563	0.035	0.528	0.575
DIST	N44T5	Retail trade	0.098	0.011	0.534	0.139	0.051	0.136	0.129	1.124	0.902	0.009	0.892	0.939
DIST	N481	Air transportation	0.320	0.095	0.026	0.263	0.119	0.370	0.126	0.755	0.680	0.036	0.644	0.621
DIST	N482	Rail transportation	0.701	0.008	0.054	0.789	0.081	0.025	0.043	1.831	0.299	0.078	0.222	0.432
DIST	N483	Water transportation	0.307	0.008	0.097	0.709	0.114	0.039	0.032	1.610	0.693	0.028	0.665	0.577
DIST	N484	Truck transportation	0.619	0.018	0.112	0.719	0.036	0.039	0.075	1.634	0.381	0.054	0.326	0.669
DIST	N485	Transit and ground passenger trans	0.296	0.127	0.009	0.104	0.106	0.486	0.167	0.988	0.704	0.048	0.655	0.931
DIST	N486	Pipeline transportation	0.887	0.000	0.003	0.983	0.012	0.002	0.001	2.395	0.113	0.068	0.045	0.222
DIST	N487T8A492	Other transportation and support a	0.792	0.034	0.028	0.116	0.551	0.202	0.070	1.192	0.208	0.034	0.174	0.435
DIST	N493	Warehousing and storage	0.891	0.067	0.001	0.413	0.360	0.116	0.043	1.048	0.109	0.066	0.043	0.165
FIB	N5142	Data processing services	0.916	0.103	0.012	0.221	0.168	0.380	0.117	0.753	0.084	0.052	0.032	0.055
FIB	N521T2	Federal Reserve banks, credit inte	0.469	0.081	0.046	0.226	0.184	0.329	0.134	0.618	0.531	0.073	0.459	0.781
FIB	N523	Securities, commodity contracts, a	0.537	0.023	0.024	0.086	0.040	0.776	0.050	1.794	0.463	0.050	0.413	0.784
FIB	N524	Insurance carriers and related act	0.192	0.077	0.033	0.242	0.169	0.360	0.119	0.714	0.808	0.071	0.738	0.890
FIB	N525	Funds, trusts, and other financial	0.047	0.000	0.000	0.000	0.000	1.000	0.000	2.445	0.953	0.000	0.953	1.000
FIB	N531re	Real Estate - excl Housing	0.396	0.047	0.018	0.060	0.250	0.336	0.289	0.839	0.604	0.153	0.451	0.595
FIB	N532T3	Rental and leasing services and le	0.543	0.093	0.087	0.303	0.157	0.225	0.136	0.499	0.457	0.029	0.428	0.584
FIB	N5411	Legal services	0.499	0.070	0.032	0.154	0.112	0.494	0.139	0.997	0.501	0.100	0.402	0.759
FIB	N54MISC	Miscellaneous professional, scienti	0.811	0.107	0.103	0.214	0.182	0.264	0.129	0.388	0.189	0.060	0.129	0.325
FIB	N55	Management of companies and enterp	0.885	0.071	0.006	0.474	0.270	0.105	0.074	1.046	0.115	0.024	0.091	0.000
FIB	N561	Administrative and support services	0.750	0.107	0.043	0.069	0.238	0.387	0.156	0.766	0.250	0.170	0.080	0.301
FIB	N562	Waste management and remediation se	0.724	0.045	0.035	0.465	0.083	0.252	0.119	0.994	0.276	0.072	0.204	3.028
SVCX	N5111	Publishing (exc Software	0.488	0.088	0.077	0.170	0.155	0.364	0.146	0.622	0.512	0.059	0.453	0.815
SVCX	N512	Motion picture and sound recording	0.423	0.008	0.004	0.047	0.003	0.165	0.772	1.814	0.577	0.036	0.541	0.707
SVCX	N5131A2	Radio/TV and cable broadcasting	0.469	0.098	0.010	0.128	0.221	0.323	0.220	0.660	0.531	0.034	0.497	0.910
SVCX	N621A	Offices of physicians, dentists, an	0.000	0.002	0.000	0.000	0.049	0.090	0.860	2.045	1.000	0.000	1.000	1.000
SVCX	N621XB	Home and other ambulatory health ca	0.020	0.002	0.000	0.000	0.050	0.092	0.855	2.033	0.980	0.020	0.960	0.979
SVCX	N623B	Nursing and residential care facili	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	1.000	1.000
SVCX	N711T2	Performing arts, spectator sports	0.466	0.037	0.021	0.093	0.050	0.302	0.498	1.151	0.534	0.025	0.509	0.948
SVCX	N713	Amusements, gambling, and recreatio	0.047	0.092	0.021	0.306	0.120	0.311	0.149	0.706	0.953	0.003	0.950	0.997
SVCX	N721	Accommodation	0.314	0.090	0.022	0.209	0.113	0.457	0.109	0.926	0.686	0.018	0.669	0.973
SVCX	N722	Food services and drinking places	0.139	0.063	0.013	0.204	0.183	0.379	0.158	0.763	0.861	0.018	0.843	0.980
SVCX	N811A2	Repair and other personal services	0.333	0.081	0.071	0.367	0.158	0.231	0.091	0.692	0.667	0.025	0.642	0.961

[1] The primary sectors are HITCH = High Tech; CON = Construction; FIB = Finance and Business; SVCX = Personal and Cultural; INDX = Industry excluding High Tech; DIST = Distribution; XNFB = Other Intermediates; PCE = Personal Consumption; CV=coefficient of variation

[2] Share of sectoral output

[3] Share of total final use

A. List industries whose largest intermediate use is NOT other industries within the sector where it is initially classified and where the difference between the two most dominant (normalized) shares is more than 2 percentage points:

321	Wood products
324	Petroleum and coal products
327	Nonmetallic mineral products
42	Wholesale trade
481	Air transportation
482	Rail transportation
484	Truck transportation
486	Pipeline transportation
493	Warehousing and storage
532T3	Rental and leasing services
5111	Publishing (excl. software)
54MISC	Miscellaneous professional, scientific, and technical services
55	Management of companies
562	Waste management and remediation services

B. Check variance of normalized *sectoral* use shares for industries whose initial classification is in the distribution and the finance and business sectors.

List after excluding industries that supply intermediates generally to all sectors measured by a coefficient of variation of sectoral use shares less than 1.1 (approximately the median of our sample).

42	Wholesale trade
482	Rail transportation
483	Water transportation
484	Truck transportation
486	Pipeline transportation

C. Check variance of normalized *industry* use shares within the dominant sector (for all affected industries, the dominant sector is the industrial sector).

List after excluding industries that supply services *generally* to all industries within the industrial sector:

486	Pipeline transportation

D. Summary list for evaluation using intersectoral flows:

321	Wood products
327	Nonmetallic mineral products

Proposed destination: Construction

324 Petroleum and coal products
Proposed destination: Distribution

486 Pipeline transportation
Proposed destination: Industrial

Step 3. Collect industry lists from step 1 and step 2D and evaluate alternate assignment by calculating the impact of the move on (1) the outflow of the sector where excluded, (2) the outflow of the sector where added. Calculate SUM = (1) + (2).

List of industries to be moved after excluding industries for which the reassignment increased total int*er*sectoral flows (that is, after excluding moves for which SUM *not* less than zero, ± 5 percent of sectoral output):

485 Transit and ground passenger transportation
Final destination: Personal and cultural

486 Pipeline transportation
Final destination: Industrial

Although our final results are sensitive to the initial placements and parameters of the algorithm, the placement of only one proved highly sensitive in this regard: the newspaper, book, and other publishing industry (NAICS 5111, or newspapers for short). Although the original BEA commodity-by-industry use table shows newspapers as primarily delivered to consumers, the industry-by-commodity make table views the newspaper industry as producing two commodities, newspapers and advertising services where the latter is treated as intermediate, rather than final consumption. As a result, when we apply our algorithm to industry-by-industry I-O relationships, the newspaper industry could be in one of three sectors (industrial, finance and business, and personal and cultural) depending on its initial assignment and small tweaks to the algorithm.

The insurance industry (NAICS 524) and inputs to construction were the other industries we found to be sensitive to initial conditions and parameters of the algorithm. All in all, we erred toward keeping industries where they were initially assigned, and these industries were all on the borderline and thus were not moved.

With regard to construction, we would need to work at a much more disaggregate level to obtain an appropriate vertically-integrated aggregate for construction. In our dataset, only two industries (nonmetallic mineral products manufacturing, NAICS 327, and wood products manufacturing, NAICS 321), are shown as delivering primarily to construction but these industries supply just 17 percent of all purchased inputs in construction. To obtain a complete picture, we would need to integrate many detailed industries in the industrial sector (e.g., stone, sand, and gravel in mining, except oil and gas, NAICS 212; structural steel in primary metals, NAICS 331; unitary air-conditioners in machinery,

NAICS 333; electric lighting fixtures in electrical equipment, NAICS 335; and so on), a task beyond the scope of this paper.

6. Data quality analysis.

The initial placement of each industry was also evaluated from the perspective of the need to convert SIC data to NAICS. We do not work at an especially detailed level to develop our NAICS-based labor input data prior to 1998, and we wished to minimize the potential for distortions of our sectoral results owing to SIC-to-NAICS conversion issues.

We produced an employment concordance between BEA's 61 SIC-based private industries and the BEA components of our NAICS-based sectors. We then examined instances in which the share of employment in each of BEA's SIC-based industry was severely split along sectoral lines. A "severe" split was defined as one where a given SIC industry is funneled to two or more of our sectors and where the share of the non-dominant sector(s) is larger than 20 percent.

We concentrate on "severe" splits because, as previously indicated, one of the largest differences introduced by NAICS was that auxiliaries are treated as establishments classified by their production process, and new industries, such as Management of Companies, Warehousing, and Office Administrative Services were created by grouping auxiliaries across former SIC industry lines. As a result, the conversion of SIC data to NAICS entails allocating portions of most SIC industries to new NAICS industries in our finance and business sector (and, to a lesser extent, our distribution sector) and we ignored these effects in this analysis.

Excluding the splits of SIC industries that are necessary to form the high-tech sector and the effects of the new treatment of auxiliaries in NAICS, we found that most SIC industries were primarily routed to just one of our sectors. Relative to our *initial* sectors, the analysis revealed severe splits of only seven BEA private SIC industries:

BEA SIC industries with "severe" splits across NAICS-based sectors.

SIC code	Description	NAICS-based Sectors
07-9	Agricultural services, forestry, and fishing	Finance and business, Industrial
27	Printing and publishing	Industrial, Personal and cultural
41	Local and interurban passenger transit	Distribution, Personal and cultural
47	Transportation services	Distribution, Finance and business
52-9	Retail trade	Distribution, Personal and cultural
72	Personal services	Finance and business, Personal and cultural
78	Motion pictures	Finance and business, Personal and cultural

Note. Results are relative to the initial composition of the sectors as reported in text table 3 and exclude the splits that are necessary to form high-tech and the effects of the new treatment of auxiliaries in NAICS.

Relative to the *final* industry composition for the sectors, industry SIC 41 is *not* split across NAICS-based sectors (see results of the I-O analysis). Also, a decision to split the BEA Publishing industry (NAICS 511), which includes software publishing, was already

made so that the high-tech sector could be defined appropriately. Last, two other cases on this list, the split of the BEA SIC retail trade industry and the BEA SIC transportation services industry, entail resulting NAICS industries that are firmly placed according to the I-O relationships. Specifically,

- The large BEA SIC retail trade industry was split to create the "food" part of the new Accommodation and food sector (NAICS 72) that we include in our personal and cultural sector because the industry delivers services primarily to PCE.
- The BEA SIC transportation services industry was split to create the new Travel arrangement and reservation services industry (NAICS 5615) that we include in our finance and business sector because it is part of the BEA industry Administrative and support services (NAICS 561). Inspection of the I-O relationships for NAICS 5615 indicates that the industry deliveries primarily to other industries and serves industries generally.

The remaining three cases all suggest that further disaggregation of the basic atoms we work with (BEA's NAICS-based industry groupings) may be needed. The BEA industry grouping, Miscellaneous scientific, technical, and professional services (NAICS 5412-5414, 5416-5419), collects industries in which human capital is important in production processes. This grouping is too aggregated for the deliveries-to-final demand model of production. Specifically,

- The grouping includes Veterinary services (NAICS 54194), previously in agricultural services (SIC 074), and input-output relationships indicate that the industry delivers primarily (more than 80 percent of final use) to PCE.
- The grouping includes Photographic studios, portrait (NAICS 541921), previously in personal services (SIC 7221), and input-output relationships indicate the industry delivers primarily (more than 80 percent of final use) to PCE.

Similarly, the BEA industry, Rental and leasing services and lessors of intangible assets (NAICS 532-3), is too aggregated for the deliveries-to-final demand model of production. Specifically,

- The grouping includes Video tape and disc rental (NAICS 53223), previously in motion pictures (SIC 7841), and input-output relationships indicate the industry delivers primarily (more than 80 percent of final use) to PCE.

These results therefore suggest that further disaggregating the BEA hierarchy to break out these three industries would both improve our model and minimize distortions to *sectoral* results owing to conversion of BEA industry data from SIC to NAICS.

Finally, the review revealed that our model and sectoral results would be improved if further detail were to be added to NAICS. Talent payment agencies—previously part of SIC 7819 and who employ nearly one-half of all workers previously classified as engaged in motion picture production—were subsumed in Payroll services (NAICS 5412) along with establishments who provide general bookkeeping and billing services. Better and timelier information on the industries that consume the services of the establishments grouped together in NAICS 5412 is needed. (Are the services of NAICS 5412 purchases of hours of work for an "extra", a principal acting role, a spot in a

commercial? Or, are the purchases payments for data processing/billing services?) With the appropriate information, we could improve the modeling of motion picture production and the aggregation of its associated industries into a vertically-integrated entity.

More broadly, better information on using industries of certain NAICS services industries is needed for the approach to productivity analysis taken in this paper. In particular, information on the major using industries of industries such as management of companies is desirable (i.e., we need data similar to what were previously collected separately for auxiliaries in the SIC world). With the appropriate information, we could both model industry-level production according to similarity of production process and group industries into vertically-integrated sectors for macro-productivity analysis.

Appendix C

Comparison of our Aggregate MFP Results with BLS Estimates

The BEA's industry, input-output, and capital flow accounts also are key ingredients to the capital services measures used to compile the *aggregate* MFP statistics issued by the Bureau of Labor Statistics (BLS). In March 2006, the BLS updated its aggregate MFP estimates to incorporate the BEA data used in this paper.

Lines 1 through 3 of the table below report our aggregate MFP estimate, the BLS estimate, and the BLS estimate less ours, respectively. Subsequent lines report estimates of the effects of the key differences in modeling and in measuring real output and inputs that have been discussed in the paper. The effect of "output" differences shown on lines 4 and 5 are reported as BLS less ours. The effect of "input" differences is reported as ours less BLS. The difference between line 3 and the sum of lines 4, 5, and 6 is then the "unaccounted" difference shown on line 8.

Multifactor productivity, annual percent change, 1987 to 2004.

	1987 to 2004	1987 to 1995	1995 to 2000	2000 to 2004
1. MFP, this paper	1.25	.80	1.10	2.33
2. MFP, BLS	1.05	.55	1.19	1.87
		--percentage points--		
3. Line 2 less line 1	-.20	-.24	.00	-.46
Contribution of differences owing to:				
4. Modeling production	.14	.08	.13	.25
5. Output measurement	-.11	-.02	-.19	-.07
6. Input measurement[1]	-.36	- .49	.05	-.65
of which:				
6a. Labor	-.46	-.57	-.14	-.64
6b. Capital	.08	.03	.24	-.05
Memos:				
7. Contribution of assets excluded in this paper[2]	-.16	-.13	-.27	-.09
8. Unaccounted	.03	.08	-.08	.11

Notes. All figures are for the private nonfarm business sector (see table 2).
1. Input measurement differences are calculated as measured in this paper (adjusted to a value added basis) less as measured by BLS.
2. Calculated as the difference between the total published BLS capital contribution and the estimated contribution of equipment, software, and nonresidential structures alone.

Although the BLS productivity statistics are grounded in the model and framework laid out in section 1, the BLS implementation departs from this approach in that equation (4), not (1′), is used to calculate multifactor productivity. Line 4 reports an estimate of the effect of differences in the modeling production, calculated as the effect of changes in the

ratio shown in equation (5) of this paper. Line 4 shows how much you would have to add (in percentage points) to our estimate of the rate of change in MFP to obtain, all else equal, the estimate compiled by the BLS. As may be seen, the size of this wedge is initially very small, but, owing to increased use of imported intermediates, the wedge becomes notably larger toward the end of the period.[32]

The rate of change in *real* value added for our nonfarm business output measure differs from the rate of change in the BEA/BLS measure, in part because of differences in coverage (text table 2), but also because of an aggregation residual (see notes to tables in Smith and Lum 2005). Line 5 shows the combined effect of these differences (reported as the difference, in percentage points, between the average rates of growth of BEA/BLS real value added and real value added calculated using the BEA industry data in our hierarchy. This difference is small, on balance, but in the late 1990s, the aggregation residual (not separately shown) averages -1/4 percentage point per year. However, our implicit value added deflator for nonprofit institutions serving individuals increases more rapidly than the deflator used in the NIPAs, and the slower growth of our nonprofit aggregate partially offsets the relatively large aggregation residual (the nonprofits discrepancy and the aggregation residual are not shown separately).

Differences in input measures account for most of the discrepancy between our MFP estimates and those of the BLS (line 6). The large discrepancy in the labor input measures (line 6a) reflects the fact that the BLS uses an explicit modeling approach to capture the effects of changes in labor composition on productivity whereas our measure of labor input will only capture implicit effects though industry differentiation. This difference in the contribution labor inputs is large. Furthermore, the countercyclical nature of the BLS labor composition adjustment results in large MFP differences in recession years (see chart on the following page).[33]

As previously indicated, the BLS calculates aggregate capital input from industry-level data and uses methods and an approach that are consistent with the framework we follow and as laid out in section 2. Although differences in capital measurement do not contribute materially, on average, to differences between our MFP estimates and those of the BLS, the difference in the 1995 to 2000 period is notable. To a first approximation, this large difference does *not* stem for the underlying differences in the modeling of capital depreciation, however. As indicated in the memo item, if the assets that we exclude in our analysis were to be dropped from the BLS measure, the BLS would also show a stronger contribution of capital input growth to output and productivity change during 1995 to 2000.[34]

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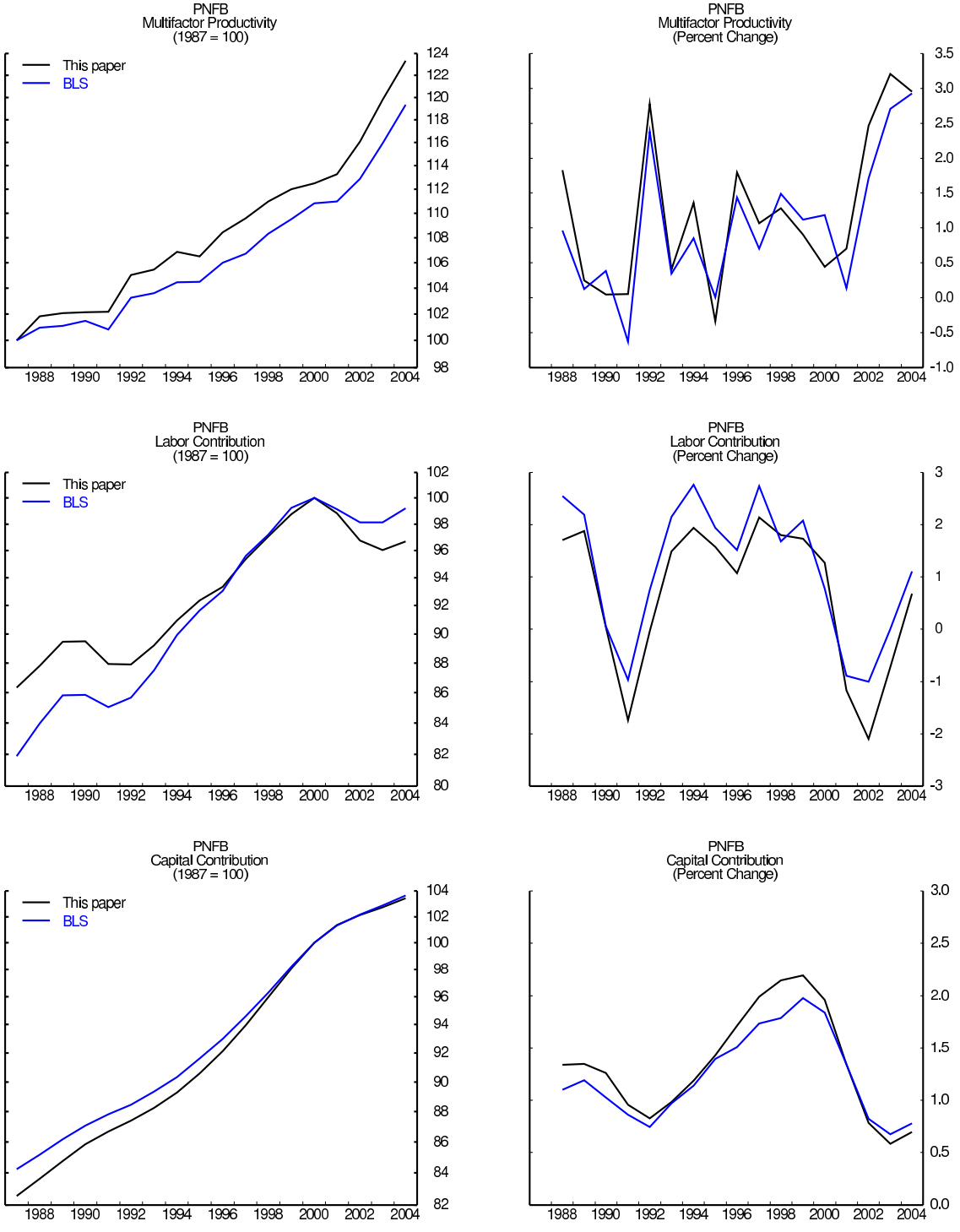
[32] Of course, intermediates purchased from other domestic producers are also included in the wedge in equation (5). For the nonfarm business sector, these purchases are nontrivial in that they include domestically-produced farm products purchased by restaurants and manufactures for further processing. In 2000, we estimate that slightly less than one-fourth of the *nominal* wedge between sectoral output and value added for private nonfarm businesses was accounted for by purchased inputs from other domestic producers.

[33] See http://www.bls.gov/web/mprlabor.pdfis for a description of the BLS labor composition adjustment.

[34] As previously indicated, we do not include inventories, land, and residential rental structures as capital assets in our system. Residential rental structures are held solely by the tenant-occupied housing industry,

Comparison of Multifactor Productivity Estimates



which we exclude from our analysis. The exclusion of this industry also limits the effects of excluding land as a capital asset: The BLS estimates that the residential real estate industry held nearly 20 percent of the value of land in 2000, whereas the industry's share of employment was less than 0.5 percent in that year. [Reader: although do not include inventories, that will be changed shortly. It will not change this analysis, but about half of the gap will close].

Detailed Table 1
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital			Labor (7)	Intmd. (8)
				IT (4)	EQX (5)	STR (6)		
1987-2004								
High-technology industries	10.3	10.5	5.2	0.8	0.2	0.3	0.3	3.6
Computer and electronic prod	4.7	11.0	7.6	0.3	0.2	0.1	-0.7	3.4
Telecommunications and information services	3.8	7.9	2.3	1.3	0.2	0.6	0.3	3.2
Telecommunications	3.6	6.8	2.1	1.3	0.2	0.6	0.2	2.4
Information services	0.2	18.2	6.1	1.2	0.2	0.2	2.7	7.8
Software	2.2	13.8	4.2	1.0	0.0	0.1	2.9	5.6
Software publishers	0.8	21.5	8.9	0.7	0.0	0.1	0.9	10.9
Computer systems design and related	1.4	9.7	1.6	1.2	0.1	0.1	4.0	2.7
1987-1995								
High-technology industries	9.2	9.6	4.2	0.6	0.2	0.3	0.4	3.9
Computer and electronic prod	4.7	10.4	5.6	0.3	0.2	0.1	-0.2	4.4
Telecommunications and information services	3.3	5.3	1.4	0.9	0.3	0.7	0.1	1.8
Telecommunications	3.2	4.6	1.4	0.9	0.3	0.8	0.0	1.2
Information services	0.1	9.2	1.2	0.6	0.3	0.3	2.4	4.5
Software	1.4	16.2	4.9	0.8	0.1	0.1	3.4	7.0
Software publishers	0.5	28.8	11.9	0.8	0.2	0.1	0.8	15.0
Computer systems design and related	0.9	9.7	1.2	0.8	0.1	0.0	4.7	2.9
1995-2000								
High-technology industries	11.5	17.6	6.8	1.5	0.3	0.3	2.4	6.4
Computer and electronic prod	5.2	19.5	11.8	0.6	0.5	0.1	0.5	5.9
Telecommunications and information services	4.0	14.5	2.3	2.4	0.1	0.6	1.8	7.4
Telecommunications	3.8	12.1	1.8	2.4	0.1	0.6	1.4	5.9
Information services	0.3	42.4	14.2	2.0	0.1	0.1	8.3	17.7
Software	2.7	18.6	2.7	1.7	0.0	0.1	6.4	7.6
Software publishers	1.0	20.5	6.9	0.7	-0.2	0.2	2.9	10.0
Computer systems design and related	1.7	17.3	0.1	2.4	0.1	0.1	8.5	6.2
2000-2004								
High-technology industries	10.9	3.2	5.3	0.4	0.0	0.2	-2.3	-0.3
Computer and electronic prod	3.8	1.6	6.2	0.0	0.0	0.0	-3.1	-1.7
Telecommunications and information services	4.5	4.7	4.2	0.7	0.0	0.4	-1.2	0.8
Telecommunications	4.1	4.6	4.0	0.6	0.0	0.4	-1.0	0.6
Information services	0.5	5.9	5.9	1.3	0.1	0.1	-3.5	2.1
Software	3.0	3.1	4.9	0.5	0.0	0.0	-2.5	0.2
Software publishers	1.1	8.3	5.5	0.4	-0.1	0.0	-1.4	3.8
Computer systems design and related	1.9	0.1	4.5	0.6	0.0	0.1	-3.1	-1.9
(1995 to 2000) vs (1987 to 1995)								
High-technology industries	2.3	8.0	2.6	0.9	0.1	0.0	2.0	2.5
Computer and electronic prod	0.5	9.1	6.2	0.3	0.3	0.1	0.7	1.5
Telecommunications and information services	0.7	9.3	0.8	1.4	-0.1	-0.2	1.7	5.6
Telecommunications	0.6	7.5	0.3	1.4	-0.1	-0.2	1.3	4.7
Information services	0.2	33.3	13.1	1.5	-0.2	-0.1	5.9	13.2
Software	1.4	2.4	-2.1	0.9	-0.1	0.1	3.0	0.7
Software publishers	0.5	-8.3	-5.0	-0.1	-0.3	0.0	2.1	-5.0
Computer systems design and related	0.8	7.6	-1.1	1.6	0.0	0.1	3.8	3.3
(2000 to 2004) vs (1995 to 2000)								
High-technology industries	-0.6	-14.4	-1.5	-1.1	-0.3	-0.1	-4.7	-6.7
Computer and electronic prod	-1.4	-17.9	-5.6	-0.6	-0.5	-0.1	-3.5	-7.6
Telecommunications and information services	0.5	-9.8	1.9	-1.7	-0.1	-0.2	-3.1	-6.6
Telecommunications	0.3	-7.5	2.2	-1.8	-0.1	-0.2	-2.3	-5.3
Information services	0.2	-36.5	-8.4	-0.7	0.0	-0.1	-11.8	-15.6
Software	0.3	-15.5	2.2	-1.2	0.0	-0.1	-8.9	-7.5
Software publishers	0.1	-12.2	-1.4	-0.3	0.1	-0.2	-4.2	-6.2
Computer systems design and related	0.2	-17.2	4.4	-1.8	-0.1	0.0	-11.7	-8.1

For each row, column (2) equals the sum of columns (3) through (8).

IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.

Detailed Table 2
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
1987-2004								
Industrial x hitech	39.5	1.7	0.6	0.2	0.1	0.1	-0.3	1.1
Forestry, fishing, and related activ	0.6	0.8	-1.2	0.0	-0.2	0.2	1.3	0.6
Forestry, fishing, and related activ	0.6	0.6	-1.2	0.0	-0.2	0.2	1.3	0.4
Mining	2.5	0.5	0.2	0.1	-0.1	0.0	-0.3	0.6
Oil and gas extraction	1.4	-0.8	-0.5	0.1	-0.1	0.0	-0.2	0.0
Mining, except oil and gas	0.7	1.2	2.2	0.2	-0.1	-0.1	-0.3	-0.5
Support activities for mining	0.4	3.3	-0.9	0.2	-0.2	-0.1	-0.4	4.6
Utilities	4.5	1.4	1.0	0.2	0.1	0.4	-0.2	-0.1
Manufacturing x hitech	35.0	1.8	0.6	0.2	0.1	0.0	-0.3	1.2
Durable manufacturing x hitech	17.8	2.1	0.7	0.2	0.1	0.0	-0.4	1.4
Wood products	1.0	1.2	-0.1	0.1	0.0	0.0	-0.1	1.3
Nonmetallic mineral products	1.1	1.3	1.4	0.1	0.1	0.0	-0.2	-0.1
Primary metals	1.9	1.0	1.2	0.1	-0.1	0.0	-0.5	0.4
Fabricated metal products	3.1	1.5	0.6	0.1	0.1	0.0	-0.2	0.9
Machinery	3.4	1.9	0.0	0.3	0.2	0.1	-0.4	1.7
Electrical equipment, appliances	1.5	0.9	0.7	0.1	0.0	0.1	-0.5	0.5
Motor vehicles, bodies and trailer	4.6	3.4	0.8	0.1	0.1	0.0	0.0	2.3
Other transportation equipment	2.1	-0.3	-0.6	0.2	0.1	0.1	-1.1	1.0
Furniture and related products	0.9	1.9	0.1	0.1	0.2	0.1	-0.1	1.5
Miscellaneous manufacturing	1.5	3.5	2.6	0.2	0.0	0.0	-0.6	1.4
Non-durable manufacturing	19.1	1.3	0.4	0.2	0.1	0.1	-0.3	0.9
Food and beverage and tobacco prod	6.8	1.3	0.1	0.1	0.1	0.0	0.0	1.1
Textile mills and textile product	1.0	0.3	1.5	0.0	0.0	0.0	-1.3	0.1
Apparel and leather and allied pro	1.1	-3.4	0.8	0.0	0.1	0.0	-1.8	-2.5
Paper products	1.9	0.6	0.1	0.1	0.0	0.0	-0.4	0.7
Printing and related support activ	1.3	0.1	-0.1	0.2	0.1	0.1	-0.2	0.0
Petroleum and coal products	2.6	1.0	0.0	0.1	0.0	0.0	-0.1	1.1
Chemical products	4.8	2.0	0.3	0.3	0.2	0.2	-0.1	1.0
Plastics and rubber products	2.1	3.2	1.2	0.1	0.3	0.1	-0.1	1.6
1987-1995								
Industrial x hitech	43.0	1.8	0.6	0.2	0.1	0.1	0.0	0.9
Forestry, fishing, and related activ	0.7	-0.6	-3.5	0.1	0.1	0.2	1.3	1.2
Forestry, fishing, and related activ	0.7	-1.1	-3.5	0.1	0.1	0.2	1.3	0.8
Mining	2.6	0.4	1.5	0.1	-0.2	-0.2	-0.2	-0.5
Oil and gas extraction	1.4	-0.6	1.4	0.1	-0.2	-0.3	-0.3	-1.2
Mining, except oil and gas	0.9	2.2	1.9	0.1	-0.2	-0.1	0.1	0.3
Support activities for mining	0.3	0.0	0.9	0.2	-0.5	0.0	-0.7	0.1
Utilities	5.1	2.5	1.4	0.2	0.1	0.3	0.0	0.5
Manufacturing x hitech	37.9	1.9	0.5	0.2	0.1	0.1	0.0	1.1
Durable manufacturing x hitech	19.0	2.0	0.6	0.1	0.0	0.0	-0.2	1.3
Wood products	1.0	0.1	-0.8	0.1	0.0	0.0	0.1	0.8
Nonmetallic mineral products	1.2	0.7	1.7	0.1	-0.1	0.0	-0.1	-0.8
Primary metals	2.2	2.1	1.0	0.1	-0.1	0.0	-0.1	1.3
Fabricated metal products	3.3	2.2	0.8	0.1	0.1	0.0	0.2	1.1
Machinery	3.6	3.2	0.1	0.2	0.1	0.0	0.2	2.5
Electrical equipment, appliances	1.6	2.0	0.5	0.1	0.1	0.1	-0.2	1.4
Motor vehicles, bodies and trailer	4.7	3.5	0.6	0.1	0.1	0.0	0.4	2.4
Other transportation equipment	2.4	-3.3	-1.4	0.1	0.0	0.1	-1.8	-0.3
Furniture and related products	0.9	0.6	-0.2	0.1	0.1	0.1	0.1	0.6
Miscellaneous manufacturing	1.5	3.4	2.8	0.2	0.0	0.0	-0.9	1.3
Non-durable manufacturing	21.1	1.7	0.3	0.1	0.2	0.1	0.0	0.9
Food and beverage and tobacco prod	7.6	1.9	0.6	0.1	0.1	0.0	0.1	1.0
Textile mills and textile product	1.3	1.5	1.6	0.1	0.1	0.0	-0.5	0.3
Apparel and leather and allied pro	1.4	-0.1	0.8	0.0	0.1	0.0	-0.6	-0.4
Paper products	2.1	1.7	-0.4	0.1	0.3	0.1	0.1	1.6
Printing and related support activ	1.5	1.2	-0.2	0.1	0.1	0.1	0.5	0.6
Petroleum and coal products	2.8	0.7	-0.5	0.1	0.1	-0.1	-0.1	1.2
Chemical products	5.1	2.0	-0.1	0.3	0.4	0.2	0.1	1.2
Plastics and rubber products	2.2	4.1	1.1	0.1	0.3	0.1	0.4	2.2

Detailed Table 2
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
1995-2000								
Industrial x hitech	37.8	2.6	0.2	0.3	0.2	0.1	-0.1	1.9
Forestry, fishing, and related activ	0.5	0.6	0.9	0.0	-0.6	0.3	1.1	-1.2
Forestry, fishing, and related activ	0.5	0.6	0.9	0.0	-0.6	0.3	1.1	-1.1
Mining	2.1	1.0	-0.1	0.2	0.0	-0.1	-0.6	1.6
Oil and gas extraction	1.2	-0.9	-2.5	0.2	0.0	-0.2	-0.4	2.0
Mining, except oil and gas	0.6	1.3	4.6	0.2	0.0	-0.1	-0.9	-2.5
Support activities for mining	0.3	7.9	-0.7	0.4	0.2	-0.1	-0.7	8.8
Utilities	4.1	1.5	0.7	0.2	-0.1	0.3	-0.3	0.7
Manufacturing x hitech	33.8	2.8	0.1	0.3	0.2	0.1	0.0	2.0
Durable manufacturing x hitech	17.8	3.6	0.3	0.3	0.3	0.1	0.2	2.4
Wood products	1.0	2.9	-0.3	0.1	0.2	0.0	0.4	2.6
Nonmetallic mineral products	1.1	3.4	0.9	0.2	0.3	0.0	0.3	1.6
Primary metals	1.8	1.1	1.2	0.1	0.0	0.0	-0.2	0.0
Fabricated metal products	3.1	3.1	0.4	0.2	0.3	0.0	0.3	1.9
Machinery	3.5	2.5	-0.7	0.6	0.4	0.1	0.0	2.1
Electrical equipment, appliances	1.5	3.5	0.2	0.1	0.0	0.1	0.3	2.7
Motor vehicles, bodies and trailer	4.8	4.3	0.0	0.2	0.3	0.1	0.2	3.6
Other transportation equipment	1.9	3.6	0.5	0.5	0.2	0.1	0.1	2.2
Furniture and related products	0.9	4.6	0.3	0.1	0.4	0.1	0.6	3.0
Miscellaneous manufacturing	1.4	4.1	2.3	0.2	0.2	0.0	-0.2	1.7
Non-durable manufacturing	17.9	1.6	-0.1	0.2	0.1	0.1	-0.2	1.5
Food and beverage and tobacco prod	6.3	1.5	-1.0	0.1	0.1	0.0	0.0	2.4
Textile mills and textile product	1.0	0.3	1.1	0.1	0.0	0.0	-1.4	0.6
Apparel and leather and allied pro	1.0	-3.1	0.1	0.1	0.1	0.0	-2.1	-1.4
Paper products	1.7	-0.4	0.1	0.1	-0.1	0.0	-0.3	-0.2
Printing and related support activ	1.3	1.3	-0.2	0.3	0.2	0.1	-0.2	1.2
Petroleum and coal products	2.2	1.6	1.0	0.1	-0.1	0.0	-0.1	0.8
Chemical products	4.6	2.2	-0.1	0.5	0.3	0.2	0.0	1.2
Plastics and rubber products	2.1	3.7	1.1	0.1	0.5	0.1	0.1	1.7
2000-2004								
Industrial x hitech	34.6	0.6	1.1	0.1	0.0	0.1	-1.2	0.5
Forestry, fishing, and related activ	0.4	3.8	0.9	0.0	-0.2	0.1	1.5	1.4
Forestry, fishing, and related activ	0.4	3.8	0.9	0.0	-0.2	0.1	1.5	1.4
Mining	2.6	0.1	-2.1	0.0	-0.1	0.5	0.0	1.7
Oil and gas extraction	1.5	-1.0	-1.9	0.0	-0.1	1.0	0.1	-0.1
Mining, except oil and gas	0.5	-0.9	-0.3	0.1	-0.3	-0.1	-0.5	0.2
Support activities for mining	0.5	4.4	-4.7	0.1	0.1	-0.2	0.6	8.4
Utilities	4.0	-0.8	0.6	0.3	0.4	0.6	-0.4	-2.2
Manufacturing x hitech	30.5	0.5	1.3	0.1	0.0	0.0	-1.3	0.4
Durable manufacturing x hitech	15.4	0.4	1.6	0.1	0.0	0.0	-1.7	0.4
Wood products	0.9	1.1	1.4	0.0	-0.1	-0.1	-0.9	0.8
Nonmetallic mineral products	1.0	-0.2	1.6	0.1	0.2	0.0	-0.9	-1.1
Primary metals	1.3	-1.4	1.7	0.0	-0.2	0.0	-1.9	-1.0
Fabricated metal products	2.6	-1.9	0.4	0.1	0.0	0.0	-1.7	-0.7
Machinery	2.7	-1.3	0.8	0.1	0.1	0.0	-2.0	-0.3
Electrical equipment, appliances	1.1	-4.4	1.9	0.1	-0.2	0.1	-2.2	-4.1
Motor vehicles, bodies and trailer	4.3	2.0	2.3	0.0	0.0	0.0	-1.1	0.7
Other transportation equipment	1.7	1.0	-0.1	0.2	0.1	0.0	-1.3	2.2
Furniture and related products	0.8	0.9	0.5	0.1	0.2	0.0	-1.4	1.6
Miscellaneous manufacturing	1.4	3.0	2.5	0.1	0.0	-0.1	-0.8	1.2
Non-durable manufacturing	16.6	0.2	0.9	0.1	-0.1	0.0	-0.9	0.2
Food and beverage and tobacco prod	5.9	-0.2	0.3	0.1	0.0	-0.1	-0.3	-0.3
Textile mills and textile product	0.7	-2.1	1.8	0.0	-0.3	0.0	-2.7	-0.9
Apparel and leather and allied pro	0.5	-10.6	1.7	0.0	-0.1	-0.1	-4.0	-8.0
Paper products	1.4	-0.6	1.3	0.0	-0.3	0.0	-1.5	-0.1
Printing and related support activ	1.0	-3.7	0.2	0.1	0.0	0.0	-1.6	-2.5
Petroleum and coal products	2.6	1.0	-0.2	0.1	0.0	0.0	-0.2	1.3
Chemical products	4.4	1.5	1.7	0.1	-0.1	0.1	-0.6	0.4
Plastics and rubber products	1.9	0.7	1.6	0.0	0.1	0.0	-1.2	0.1

Detailed Table 2
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital			Labor (7)	Intmd. (8)
				IT (4)	EQX (5)	STR (6)		
(1995 to 2000) vs (1987 to 1995)								
Industrial x hitech	-5.2	0.8	-0.4	0.1	0.1	0.0	0.0	1.0
Forestry, fishing, and related activ	-0.1	1.2	4.5	0.0	-0.7	0.1	-0.2	-2.4
Forestry, fishing, and related activ	-0.1	1.7	4.5	0.0	-0.7	0.1	-0.2	-1.9
Mining	-0.5	0.6	-1.6	0.1	0.3	0.1	-0.4	2.1
Oil and gas extraction	-0.2	-0.3	-3.9	0.1	0.2	0.2	0.0	3.2
Mining, except oil and gas	-0.3	-0.9	2.7	0.1	0.2	0.0	-1.0	-2.8
Support activities for mining	0.0	7.9	-1.6	0.2	0.6	0.0	0.0	8.7
Utilities	-0.9	-1.0	-0.7	0.0	-0.3	0.0	-0.3	0.2
Manufacturing x hitech	-4.1	0.9	-0.3	0.1	0.1	0.0	0.0	0.9
Durable manufacturing x hitech	-1.2	1.6	-0.2	0.2	0.3	0.0	0.3	1.0
Wood products	0.0	2.8	0.4	0.0	0.2	0.0	0.2	1.9
Nonmetallic mineral products	-0.1	2.7	-0.7	0.2	0.4	0.0	0.4	2.4
Primary metals	-0.4	-1.0	0.3	0.0	0.0	0.0	-0.1	-1.2
Fabricated metal products	-0.2	0.9	-0.4	0.1	0.2	0.0	0.1	0.9
Machinery	-0.1	-0.7	-0.9	0.4	0.4	0.1	-0.2	-0.5
Electrical equipment, appliances	-0.1	1.5	-0.3	0.0	0.0	0.0	0.5	1.3
Motor vehicles, bodies and trailer	0.1	0.8	-0.7	0.1	0.3	0.1	-0.2	1.2
Other transportation equipment	-0.6	6.9	1.9	0.4	0.2	0.0	1.9	2.5
Furniture and related products	0.0	4.0	0.5	0.1	0.3	0.1	0.5	2.4
Miscellaneous manufacturing	-0.1	0.7	-0.6	0.0	0.2	0.0	0.7	0.4
Non-durable manufacturing	-3.2	-0.1	-0.4	0.1	-0.1	0.0	-0.3	0.5
Food and beverage and tobacco prod	-1.2	-0.4	-1.6	0.0	-0.1	-0.1	0.0	1.3
Textile mills and textile product	-0.3	-1.2	-0.5	0.0	-0.1	0.0	-0.9	0.3
Apparel and leather and allied pro	-0.4	-3.0	-0.6	0.0	0.0	0.0	-1.5	-1.0
Paper products	-0.4	-2.1	0.5	0.0	-0.4	-0.1	-0.4	-1.8
Printing and related support activ	-0.2	0.1	-0.1	0.2	0.1	0.0	-0.7	0.6
Petroleum and coal products	-0.5	0.9	1.5	0.0	-0.1	0.0	0.0	-0.4
Chemical products	-0.6	0.2	0.1	0.2	-0.1	0.0	-0.1	0.0
Plastics and rubber products	-0.1	-0.4	0.1	0.1	0.1	0.0	-0.2	-0.5
(2000 to 2004) vs (1995 to 2000)								
Industrial x hitech	-3.2	-2.0	0.9	-0.2	-0.2	0.0	-1.1	-1.4
Forestry, fishing, and related activ	-0.1	3.2	0.0	0.0	0.4	-0.2	0.4	2.6
Forestry, fishing, and related activ	-0.1	3.2	0.0	0.0	0.4	-0.2	0.4	2.6
Mining	0.4	-0.9	-2.0	-0.2	-0.1	0.7	0.6	0.1
Oil and gas extraction	0.3	-0.1	0.6	-0.2	-0.1	1.2	0.5	-2.1
Mining, except oil and gas	-0.1	-2.3	-4.9	-0.1	-0.2	0.0	0.4	2.7
Support activities for mining	0.2	-3.5	-4.0	-0.3	-0.1	-0.1	1.3	-0.4
Utilities	-0.1	-2.3	-0.1	0.0	0.5	0.3	-0.2	-2.9
Manufacturing x hitech	-3.3	-2.3	1.2	-0.2	-0.3	-0.1	-1.3	-1.6
Durable manufacturing x hitech	-2.5	-3.2	1.2	-0.2	-0.3	-0.1	-1.9	-2.0
Wood products	-0.1	-1.8	1.8	-0.1	-0.3	-0.1	-1.3	-1.9
Nonmetallic mineral products	-0.1	-3.6	0.7	-0.1	-0.2	0.0	-1.3	-2.7
Primary metals	-0.4	-2.5	0.5	-0.1	-0.2	0.0	-1.7	-1.1
Fabricated metal products	-0.5	-5.1	0.0	-0.1	-0.2	-0.1	-2.0	-2.7
Machinery	-0.8	-3.7	1.6	-0.4	-0.3	-0.1	-2.0	-2.4
Electrical equipment, appliances	-0.4	-7.9	1.7	-0.1	-0.2	0.0	-2.4	-6.8
Motor vehicles, bodies and trailer	-0.6	-2.4	2.3	-0.1	-0.3	0.0	-1.2	-2.9
Other transportation equipment	-0.2	-2.6	-0.6	-0.3	-0.2	-0.1	-1.4	-0.1
Furniture and related products	-0.1	-3.7	0.1	-0.1	-0.2	-0.1	-2.0	-1.4
Miscellaneous manufacturing	0.0	-1.2	0.3	-0.1	-0.1	-0.1	-0.7	-0.5
Non-durable manufacturing	-1.3	-1.4	1.0	-0.2	-0.2	-0.1	-0.7	-1.3
Food and beverage and tobacco prod	-0.4	-1.8	1.3	-0.1	-0.1	0.0	-0.3	-2.6
Textile mills and textile product	-0.3	-2.4	0.7	-0.1	-0.2	0.0	-1.3	-1.5
Apparel and leather and allied pro	-0.4	-7.5	1.5	-0.1	-0.2	-0.1	-2.0	-6.7
Paper products	-0.3	-0.2	1.3	-0.1	-0.2	0.0	-1.2	0.1
Printing and related support activ	-0.3	-5.0	0.5	-0.2	-0.2	0.0	-1.4	-3.8
Petroleum and coal products	0.3	-0.6	-1.2	0.0	0.1	0.1	-0.1	0.5
Chemical products	-0.2	-0.6	1.7	-0.4	-0.4	-0.1	-0.6	-0.8
Plastics and rubber products	-0.3	-3.1	0.5	-0.1	-0.4	-0.1	-1.3	-1.7

For each row, column (2) equals the sum of columns (3) through (8).
IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.

Detailed Table 3
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital			Labor (7)	Intmd. (8)
				IT (4)	EQX (5)	STR (6)		
1987-2004								
Distribution	28.4	4.2	2.0	0.4	0.1	0.1	0.4	1.2
Trade	23.2	4.4	2.1	0.3	0.2	0.2	0.4	1.3
Wholesale trade	10.7	4.3	1.9	0.5	0.2	0.1	0.4	1.2
Retail trade	12.6	4.5	2.3	0.2	0.1	0.2	0.3	1.3
Air transportation	1.5	3.8	1.3	0.9	0.2	0.1	1.0	0.4
Rail transportation	0.7	2.0	2.1	0.2	-0.2	-0.1	-0.9	0.9
Water transportation	0.4	2.0	0.4	0.4	-0.1	0.0	0.1	1.3
Truck transportation	2.1	3.8	1.4	0.1	0.1	0.1	0.1	2.0
Transit and ground passenger trans	0.3	0.8	-1.0	0.3	0.4	0.0	1.0	0.0
Pipeline transportation	0.4	0.9	0.7	0.5	0.0	0.1	-0.4	-0.1
Other transportation and support a	1.2	3.1	0.7	0.3	-0.2	0.0	1.6	0.7
Warehousing and storage	0.4	5.4	3.2	0.3	0.2	0.1	0.1	1.7
1987-1995								
Distribution	28.9	4.1	1.6	0.2	0.1	0.2	0.6	1.4
Trade	23.6	3.9	1.6	0.2	0.1	0.2	0.4	1.4
Wholesale trade	11.0	4.0	1.2	0.4	0.0	0.1	0.6	1.8
Retail trade	12.7	3.8	1.9	0.1	0.1	0.3	0.3	1.0
Air transportation	1.6	3.4	-0.5	0.3	0.1	0.0	2.8	0.6
Rail transportation	0.8	3.3	3.0	0.2	-0.1	-0.2	-0.9	1.3
Water transportation	0.4	3.0	2.2	0.1	-0.3	0.0	0.1	0.8
Truck transportation	2.1	5.7	3.1	0.1	0.1	0.1	-0.3	2.7
Transit and ground passenger trans	0.4	1.5	-0.8	0.1	0.1	0.1	0.9	1.1
Pipeline transportation	0.5	1.2	0.1	0.6	0.0	0.0	-0.1	0.5
Other transportation and support a	1.2	4.2	-0.6	0.2	-0.2	0.0	2.8	1.9
Warehousing and storage	0.4	6.4	4.7	0.2	0.2	0.0	-0.4	1.8
1995-2000								
Distribution	28.3	5.3	2.3	0.6	0.3	0.2	0.8	1.1
Trade	23.0	5.6	2.6	0.5	0.4	0.2	0.8	1.1
Wholesale trade	10.7	5.4	2.4	0.8	0.6	0.1	0.9	0.6
Retail trade	12.4	5.8	2.7	0.2	0.1	0.3	0.7	1.7
Air transportation	1.5	4.9	1.6	1.8	0.4	0.1	0.3	0.7
Rail transportation	0.6	0.1	1.0	0.3	-0.2	0.0	-1.0	0.0
Water transportation	0.4	3.1	-0.2	0.9	0.0	0.0	0.1	2.3
Truck transportation	2.2	4.8	-0.2	0.2	0.3	0.1	0.9	3.4
Transit and ground passenger trans	0.3	0.7	-1.0	0.6	0.9	-0.1	1.5	-1.3
Pipeline transportation	0.4	0.0	0.5	0.6	0.0	0.2	-0.4	-1.0
Other transportation and support a	1.2	3.8	1.6	0.7	-0.1	0.0	1.0	0.6
Warehousing and storage	0.4	5.3	4.0	0.3	0.1	0.2	0.1	0.5
2000-2004								
Distribution	27.6	3.1	2.5	0.3	0.1	0.1	-0.4	0.7
Trade	22.8	3.9	2.6	0.2	0.1	0.1	-0.3	1.2
Wholesale trade	10.1	3.3	2.6	0.3	0.2	0.0	-0.6	0.8
Retail trade	12.8	4.4	2.6	0.2	0.1	0.2	-0.1	1.5
Air transportation	1.3	3.4	4.6	0.9	0.1	0.1	-1.8	-0.6
Rail transportation	0.5	1.7	1.6	-0.1	-0.3	-0.1	-0.9	1.5
Water transportation	0.3	-1.4	-2.7	0.6	0.0	0.0	-0.1	0.8
Truck transportation	2.1	-1.4	0.3	0.1	-0.3	0.0	-0.2	-1.2
Transit and ground passenger trans	0.3	-0.5	-1.3	0.3	0.4	0.0	0.6	-0.4
Pipeline transportation	0.3	1.4	2.1	0.1	-0.1	0.4	-0.9	-0.3
Other transportation and support a	1.1	-0.1	2.0	0.0	-0.5	0.0	-0.1	-1.6
Warehousing and storage	0.4	3.5	-0.7	0.3	0.2	0.1	1.0	2.7

Detailed Table 3
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital			Labor (7)	Intmd. (8)
				IT (4)	EQX (5)	STR (6)		
(1995 to 2000) vs (1987 to 1995)								
Distribution	-0.6	1.2	0.7	0.3	0.3	0.0	0.2	-0.2
Trade	-0.6	1.6	1.0	0.3	0.3	0.0	0.3	-0.3
Wholesale trade	-0.3	1.3	1.2	0.5	0.6	0.0	0.3	-1.2
Retail trade	-0.3	2.0	0.7	0.1	0.0	0.0	0.4	0.7
Air transportation	-0.1	1.5	2.1	1.5	0.3	0.0	-2.5	0.0
Rail transportation	-0.2	-3.3	-2.0	0.1	0.0	0.2	-0.1	-1.4
Water transportation	0.0	0.1	-2.4	0.8	0.2	0.0	0.0	1.5
Truck transportation	0.1	-0.9	-3.3	0.1	0.3	0.1	1.3	0.7
Transit and ground passenger trans	0.0	-0.8	-0.1	0.5	0.8	-0.2	0.6	-2.4
Pipeline transportation	-0.1	-1.2	0.4	0.0	0.0	0.2	-0.3	-1.5
Other transportation and support a	0.0	-0.3	2.2	0.4	0.1	0.0	-1.8	-1.2
Warehousing and storage	0.0	-1.1	-0.6	0.1	-0.1	0.2	0.5	-1.3
(2000 to 2004) vs (1995 to 2000)								
Distribution	-0.6	-2.2	0.2	-0.3	-0.3	-0.1	-1.2	-0.5
Trade	-0.2	-1.6	0.1	-0.3	-0.2	-0.1	-1.1	0.1
Wholesale trade	-0.6	-2.1	0.2	-0.5	-0.4	-0.1	-1.5	0.2
Retail trade	0.4	-1.4	0.0	-0.1	-0.1	-0.1	-0.9	-0.2
Air transportation	-0.2	-1.5	3.1	-0.9	-0.3	0.1	-2.1	-1.3
Rail transportation	-0.1	1.7	0.6	-0.3	-0.2	0.0	0.0	1.5
Water transportation	0.0	-4.5	-2.6	-0.2	0.0	0.0	-0.2	-1.5
Truck transportation	-0.2	-6.2	0.5	-0.1	-0.7	-0.1	-1.2	-4.6
Transit and ground passenger trans	0.0	-1.1	-0.3	-0.3	-0.6	0.0	-0.9	0.9
Pipeline transportation	0.0	1.4	1.5	-0.5	-0.1	0.2	-0.5	0.7
Other transportation and support a	-0.1	-4.0	0.4	-0.6	-0.4	0.0	-1.0	-2.3
Warehousing and storage	0.0	-1.8	-4.8	0.0	0.1	-0.1	0.9	2.1

For each row, column (2) equals the sum of columns (3) through (8).

IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.

Detailed Table 4
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
1987-2004								
Finance and Business	31.3	4.2	0.0	1.0	0.5	0.4	0.9	1.3
Finance, insurance and real estate	16.6	4.0	0.7	0.8	0.3	0.7	0.4	1.1
Real Estate - excl Housing	6.2	4.2	1.2	0.1	0.0	1.0	0.3	1.6
Federal Reserve banks, credit inte	5.7	2.4	-1.5	1.5	0.6	0.5	0.2	1.1
Securities, commodity contracts, a	2.1	11.5	6.8	0.4	0.1	0.2	1.2	2.7
Insurance carriers and related act	3.5	2.3	-0.8	0.8	0.4	0.4	0.4	1.0
Funds, trusts, and other financial	0.8	3.0	-0.9	0.1	0.1	0.4	0.0	3.4
Business and professional services	17.8	4.4	-0.5	1.0	0.6	0.1	1.2	2.0
Rental and leasing services and le	2.1	5.4	-3.6	2.7	2.9	0.1	0.4	2.9
Data processing services	0.5	6.6	-1.8	1.1	0.3	0.2	1.6	5.2
Management of companies and enterp	3.5	2.2	-0.1	0.6	0.0	0.1	0.4	1.1
Legal services	2.3	2.0	-0.7	0.5	0.2	0.1	0.7	1.2
Miscellaneous professional, scienti	6.8	5.5	0.1	1.0	0.3	0.1	1.3	2.7
Administrative and support services	4.1	5.7	0.0	0.4	0.3	0.1	2.3	2.7
Waste management and remediation se	0.5	3.2	0.8	0.2	0.0	0.2	0.2	1.8
1987-1995								
Finance and Business	29.0	3.4	-0.5	0.8	0.5	0.6	0.9	1.1
Finance, insurance and real estate	15.6	2.7	-0.5	0.8	0.3	1.0	0.2	0.9
Real Estate - excl Housing	6.2	3.7	0.1	0.0	0.0	1.5	0.1	2.1
Federal Reserve banks, credit inte	5.2	1.0	-2.3	1.5	0.6	0.5	-0.3	0.9
Securities, commodity contracts, a	1.4	8.7	4.4	0.4	0.1	0.4	1.2	2.2
Insurance carriers and related act	3.6	2.4	-0.7	0.9	0.4	0.8	0.7	0.2
Funds, trusts, and other financial	0.8	0.1	-0.3	0.0	0.0	0.5	0.3	-0.4
Business and professional services	16.2	4.1	-0.3	0.7	0.5	0.2	1.4	1.6
Rental and leasing services and le	2.0	5.4	-1.5	1.7	2.3	0.1	0.6	2.2
Data processing services	0.5	8.3	-1.1	0.9	0.5	0.2	2.2	5.5
Management of companies and enterp	3.5	2.1	-0.2	0.4	0.0	0.1	0.5	1.2
Legal services	2.3	1.5	-0.6	0.3	0.1	0.2	0.8	0.5
Miscellaneous professional, scienti	5.9	3.9	-0.2	0.6	0.3	0.2	1.3	1.7
Administrative and support services	3.4	6.5	0.3	0.3	0.4	0.1	2.9	2.6
Waste management and remediation se	0.5	4.5	0.7	0.3	0.2	0.5	0.1	2.7
1995-2000								
Finance and Business	32.3	6.6	-0.6	1.5	0.7	0.4	1.9	2.8
Finance, insurance and real estate	17.0	7.1	0.8	1.1	0.5	0.6	1.0	3.1
Real Estate - excl Housing	6.0	3.7	0.5	0.1	-0.1	1.0	0.5	1.7
Federal Reserve banks, credit inte	5.8	4.8	-3.4	2.2	1.0	0.5	0.5	3.9
Securities, commodity contracts, a	2.8	26.6	13.0	0.7	0.1	0.1	3.5	9.2
Insurance carriers and related act	3.4	2.1	-0.8	0.7	0.5	0.3	0.6	0.8
Funds, trusts, and other financial	0.9	12.5	-2.3	0.2	0.2	0.5	-0.6	14.5
Business and professional services	18.6	6.6	-1.8	1.6	0.8	0.1	2.3	3.5
Rental and leasing services and le	2.3	9.2	-7.7	5.7	5.1	0.1	0.8	5.2
Data processing services	0.5	3.4	-8.6	1.5	0.1	0.2	3.7	6.5
Management of companies and enterp	3.6	2.9	-0.6	0.6	0.0	0.1	0.8	2.1
Legal services	2.2	2.8	-0.6	0.8	0.3	0.0	0.7	1.7
Miscellaneous professional, scienti	7.1	8.9	0.0	1.4	0.3	0.1	2.7	4.4
Administrative and support services	4.6	7.8	-1.7	0.6	0.4	0.1	3.6	4.9
Waste management and remediation se	0.6	3.5	1.8	0.1	-0.5	0.1	0.1	1.9

Detailed Table 4
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
2000-2004								
Finance and Business	34.5	2.8	1.9	0.7	0.3	0.2	-0.3	0.1
Finance, insurance and real estate	18.1	2.9	3.0	0.3	0.1	0.2	0.1	-0.8
Real Estate - excl Housing	6.5	5.6	4.6	0.1	0.0	0.2	0.4	0.3
Federal Reserve banks, credit inte	6.4	2.5	2.6	0.4	0.2	0.5	0.7	-1.9
Securities, commodity contracts, a	2.6	-1.9	3.8	0.2	0.0	0.0	-1.7	-4.3
Insurance carriers and related act	3.5	2.2	-1.0	0.4	0.3	-0.1	-0.4	2.9
Funds, trusts, and other financial	0.9	-3.2	-0.4	0.0	0.0	0.2	0.2	-3.2
Business and professional services	19.9	2.4	0.6	0.9	0.3	0.0	-0.5	1.0
Rental and leasing services and le	2.4	0.9	-2.7	1.1	1.3	0.0	-0.4	1.6
Data processing services	0.7	7.1	5.4	1.1	0.1	0.0	-2.3	2.8
Management of companies and enterp	3.5	1.3	0.8	0.8	0.1	0.1	-0.2	-0.4
Legal services	2.3	1.9	-1.3	0.5	0.1	0.0	0.7	2.1
Miscellaneous professional, scienti	8.2	4.3	0.9	1.1	0.2	0.1	-0.7	2.7
Administrative and support services	4.9	1.5	1.3	0.5	0.2	0.0	-0.6	0.0
Waste management and remediation se	0.5	0.2	-0.3	0.2	0.1	-0.1	0.3	0.1
(1995 to 2000) vs (1987 to 1995)								
Finance and Business	3.4	3.2	-0.1	0.7	0.3	-0.2	0.9	1.7
Finance, insurance and real estate	1.4	4.4	1.3	0.3	0.1	-0.3	0.7	2.2
Real Estate - excl Housing	-0.1	0.0	0.4	0.1	-0.1	-0.4	0.4	-0.4
Federal Reserve banks, credit inte	0.7	3.8	-1.1	0.7	0.4	0.0	0.8	3.0
Securities, commodity contracts, a	1.3	17.9	8.6	0.3	0.0	-0.3	2.2	7.0
Insurance carriers and related act	-0.2	-0.3	-0.2	-0.2	0.1	-0.5	-0.1	0.5
Funds, trusts, and other financial	0.1	12.4	-2.0	0.2	0.2	0.0	-0.9	14.9
Business and professional services	2.4	2.5	-1.4	0.9	0.3	-0.1	0.9	1.8
Rental and leasing services and le	0.3	3.8	-6.1	4.0	2.8	0.0	0.3	2.9
Data processing services	0.1	-4.9	-7.5	0.5	-0.4	0.0	1.4	1.0
Management of companies and enterp	0.1	0.8	-0.5	0.1	0.0	-0.1	0.3	0.9
Legal services	-0.1	1.3	-0.1	0.4	0.1	-0.2	-0.1	1.1
Miscellaneous professional, scienti	1.2	4.9	0.2	0.7	0.0	0.0	1.3	2.7
Administrative and support services	1.2	1.3	-2.0	0.4	0.0	0.0	0.7	2.2
Waste management and remediation se	0.0	-1.0	1.0	-0.2	-0.7	-0.4	0.0	-0.7
(2000 to 2004) vs (1995 to 2000)								
Finance and Business	2.2	-3.8	2.5	-0.8	-0.5	-0.2	-2.1	-2.7
Finance, insurance and real estate	1.1	-4.2	2.2	-0.8	-0.3	-0.4	-0.9	-4.0
Real Estate - excl Housing	0.5	1.9	4.1	0.0	0.1	-0.8	-0.1	-1.4
Federal Reserve banks, credit inte	0.6	-2.3	5.9	-1.8	-0.9	0.0	0.2	-5.8
Securities, commodity contracts, a	-0.2	-28.5	-9.1	-0.5	-0.1	-0.1	-5.2	-13.5
Insurance carriers and related act	0.1	0.1	-0.1	-0.3	-0.3	-0.5	-1.0	2.2
Funds, trusts, and other financial	0.0	-15.7	1.9	-0.2	-0.2	-0.3	0.8	-17.7
Business and professional services	1.3	-4.2	2.3	-0.7	-0.5	-0.1	-2.8	-2.5
Rental and leasing services and le	0.1	-8.3	5.0	-4.6	-3.8	-0.1	-1.2	-3.6
Data processing services	0.1	3.7	14.0	-0.4	0.0	-0.2	-6.0	-3.7
Management of companies and enterp	-0.1	-1.6	1.5	0.3	0.0	0.0	-1.0	-2.5
Legal services	0.1	-0.9	-0.7	-0.3	-0.2	0.0	-0.1	0.4
Miscellaneous professional, scienti	1.1	-4.6	1.0	-0.3	-0.1	-0.1	-3.4	-1.7
Administrative and support services	0.4	-6.3	3.0	-0.1	-0.1	0.0	-4.1	-4.9
Waste management and remediation se	0.0	-3.3	-2.1	0.1	0.5	-0.1	0.1	-1.8

For each row, column (2) equals the sum of columns (3) through (8).
IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.

Detailed Table 5
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
1987-2004								
Personal and Cultural	20.2	2.9	-0.5	0.2	0.2	0.2	1.1	1.6
Leisure and entertainment industries	4.6	2.6	-0.6	0.6	0.1	0.4	1.3	0.8
Publishing (exc Software inc internet	1.6	-0.3	-1.1	0.6	0.0	0.1	0.5	-0.4
Motion picture and sound recording	0.7	3.5	-0.7	0.3	0.0	0.2	1.9	1.8
Radio/TV and cable broadcasting	1.1	4.5	0.7	1.4	0.1	0.6	0.4	1.2
Performing arts, spectator sports	0.7	3.8	-0.6	0.1	0.0	0.5	2.6	1.3
Amusements, gambling, and recreatio	0.9	4.8	-0.4	0.1	0.4	0.5	1.8	2.3
Home health care services, business	6.1	3.4	-1.0	0.2	0.4	0.2	2.0	1.8
Offices of physicians, dentists, an	4.2	3.1	-1.3	0.2	0.4	0.2	2.1	1.5
Home and other ambulatory health ca	0.8	6.2	-0.2	0.2	0.4	0.2	2.2	3.4
Hospitals, business	0.4	2.6	-1.6	0.2	0.2	0.1	1.3	2.3
Nursing and residential care facili	0.8	3.1	-0.2	0.2	0.2	0.1	1.4	1.4
Accommodation, food services and drinking pla	6.2	2.7	0.3	0.1	0.2	0.1	0.5	1.6
Accommodation	1.6	2.5	0.5	0.1	0.1	0.2	0.4	1.2
Food services and drinking places	4.6	2.8	0.2	0.1	0.2	0.1	0.5	1.8
Repair and other personal services	3.4	2.8	-0.6	0.1	0.0	0.3	0.4	2.7
1987-1995								
Personal and Cultural	19.7	2.8	-0.7	0.2	0.2	0.3	1.4	1.5
Leisure and entertainment industries	4.3	2.5	-0.5	0.5	0.2	0.4	1.6	0.3
Publishing (exc Software inc internet	1.7	-1.3	-2.4	0.6	0.1	0.2	0.8	-0.6
Motion picture and sound recording	0.6	3.9	-2.8	0.6	0.3	0.4	2.8	2.6
Radio/TV and cable broadcasting	0.9	3.9	3.8	0.9	0.2	0.6	0.0	-1.7
Performing arts, spectator sports	0.6	5.7	0.2	0.0	0.0	0.3	3.2	2.0
Amusements, gambling, and recreatio	0.9	6.6	0.3	0.1	0.3	0.3	2.2	3.6
Home health care services, business	5.9	3.3	-2.0	0.2	0.4	0.3	2.6	1.8
Offices of physicians, dentists, an	4.1	2.3	-2.8	0.2	0.5	0.4	2.8	1.3
Home and other ambulatory health ca	0.7	8.0	-0.3	0.2	0.5	0.4	2.8	4.4
Hospitals, business	0.4	2.1	-2.3	0.2	0.2	0.1	1.9	2.1
Nursing and residential care facili	0.7	5.1	0.5	0.2	0.2	0.1	1.9	2.3
Accommodation, food services and drinking pla	6.3	2.4	0.1	0.0	0.1	0.1	0.5	1.6
Accommodation	1.6	2.5	0.5	0.1	0.1	0.2	0.6	1.0
Food services and drinking places	4.7	2.4	-0.1	0.0	0.1	0.1	0.5	1.8
Repair and other personal services	3.3	3.4	-0.1	0.1	0.0	0.3	0.4	2.6
1995-2000								
Personal and Cultural	20.2	3.6	-0.6	0.3	0.2	0.3	1.1	2.3
Leisure and entertainment industries	4.8	4.4	-1.6	0.9	0.1	0.5	1.9	2.6
Publishing (exc Software inc internet	1.6	3.5	-0.7	0.7	-0.2	0.2	2.0	1.6
Motion picture and sound recording	0.7	3.6	-0.5	0.0	-0.2	0.1	1.6	2.5
Radio/TV and cable broadcasting	1.1	6.4	-3.9	2.6	0.1	0.7	1.2	5.7
Performing arts, spectator sports	0.7	2.7	-1.4	0.1	0.0	0.7	2.4	0.9
Amusements, gambling, and recreatio	1.0	3.9	-1.2	0.2	0.6	0.9	1.6	1.8
Home health care services, business	6.0	2.8	-0.8	0.1	0.3	0.0	1.2	1.9
Offices of physicians, dentists, an	4.0	3.0	-0.7	0.1	0.3	0.0	1.3	1.9
Home and other ambulatory health ca	0.8	3.5	-0.9	0.1	0.3	0.0	1.4	2.6
Hospitals, business	0.4	2.4	-0.9	0.2	0.3	0.1	0.5	2.3
Nursing and residential care facili	0.8	1.5	-0.9	0.2	0.2	0.1	1.0	0.9
Accommodation, food services and drinking pla	6.0	3.6	0.7	0.1	0.2	0.2	0.7	1.7
Accommodation	1.6	3.5	0.2	0.1	0.1	0.6	0.9	1.6
Food services and drinking places	4.4	3.7	0.8	0.1	0.2	0.1	0.7	1.7
Repair and other personal services	3.4	4.0	-1.0	0.1	0.0	0.3	0.2	4.3

Detailed Table 5
Contribution to Sectoral Output Growth
Average Contribution, Ex-Post Returns

	Domar Weight (1)	Sectoral Output (2)	MFP (3)	Capital IT (4)	Capital EQX (5)	Capital STR (6)	Labor (7)	Intmd. (8)
2000-2004								
Personal and Cultural	21.1	2.1	0.2	0.2	0.2	0.1	0.6	0.8
Leisure and entertainment industries	5.0	0.6	0.6	0.3	0.0	0.3	0.0	-0.7
Publishing (exc Software inc internet	1.5	-3.1	1.1	0.5	-0.1	0.0	-2.0	-2.5
Motion picture and sound recording	0.7	2.4	3.1	-0.1	-0.3	-0.1	0.5	-0.7
Radio/TV and cable broadcasting	1.3	3.4	0.4	0.7	0.0	0.5	0.3	1.5
Performing arts, spectator sports	0.7	1.5	-1.2	0.1	0.0	0.7	1.6	0.2
Amusements, gambling, and recreatio	1.0	2.3	-0.6	0.2	0.6	0.5	1.1	0.6
Home health care services, business	6.6	4.6	0.7	0.2	0.5	0.0	1.5	1.7
Offices of physicians, dentists, an	4.4	5.0	1.0	0.2	0.5	0.0	1.6	1.6
Home and other ambulatory health ca	0.9	5.9	1.0	0.2	0.5	0.0	1.9	2.3
Hospitals, business	0.5	3.7	-1.2	0.2	0.3	0.1	1.4	3.0
Nursing and residential care facili	0.8	1.2	-0.8	0.2	0.3	0.1	1.0	0.5
Accommodation, food services and drinking pla	6.1	2.3	0.3	0.1	0.2	0.0	0.2	1.5
Accommodation	1.6	0.9	0.8	0.1	0.1	-0.1	-0.8	0.9
Food services and drinking places	4.6	2.8	0.1	0.1	0.3	0.0	0.5	1.8
Repair and other personal services	3.6	0.2	-1.4	0.1	0.0	0.2	0.7	0.6
(1995 to 2000) vs (1987 to 1995)								
Personal and Cultural	0.5	0.8	0.1	0.1	0.0	0.0	-0.3	0.8
Leisure and entertainment industries	0.5	1.9	-1.1	0.4	-0.1	0.2	0.3	2.3
Publishing (exc Software inc internet	0.0	4.8	1.7	0.1	-0.3	0.0	1.1	2.1
Motion picture and sound recording	0.1	-0.4	2.3	-0.6	-0.5	-0.3	-1.2	-0.2
Radio/TV and cable broadcasting	0.2	2.5	-7.7	1.7	-0.1	0.1	1.1	7.4
Performing arts, spectator sports	0.1	-3.0	-1.6	0.0	0.0	0.4	-0.8	-1.0
Amusements, gambling, and recreatio	0.1	-2.8	-1.5	0.1	0.3	0.6	-0.5	-1.8
Home health care services, business	0.1	-0.5	1.2	0.0	-0.2	-0.3	-1.4	0.1
Offices of physicians, dentists, an	-0.1	0.7	2.0	-0.1	-0.2	-0.3	-1.4	0.7
Home and other ambulatory health ca	0.1	-4.5	-0.6	-0.1	-0.2	-0.3	-1.4	-1.8
Hospitals, business	0.0	0.2	1.4	0.0	0.1	0.0	-1.4	0.2
Nursing and residential care facili	0.1	-3.6	-1.4	0.0	0.0	0.0	-0.9	-1.4
Accommodation, food services and drinking pla	-0.3	1.2	0.6	0.0	0.1	0.1	0.2	0.1
Accommodation	0.0	1.0	-0.3	0.0	0.0	0.4	0.3	0.6
Food services and drinking places	-0.3	1.3	1.0	0.0	0.1	0.0	0.2	0.0
Repair and other personal services	0.1	0.6	-0.9	0.0	0.0	0.0	-0.2	1.7
(2000 to 2004) vs (1995 to 2000)								
Personal and Cultural	1.0	-1.5	0.8	-0.1	0.1	-0.1	-0.5	-1.6
Leisure and entertainment industries	0.2	-3.7	2.3	-0.6	0.0	-0.2	-1.9	-3.3
Publishing (exc Software inc internet	-0.1	-6.7	1.8	-0.2	0.1	-0.2	-4.0	-4.1
Motion picture and sound recording	0.1	-1.1	3.6	-0.1	-0.1	-0.2	-1.2	-3.2
Radio/TV and cable broadcasting	0.2	-3.1	4.3	-2.0	-0.2	-0.2	-0.9	-4.2
Performing arts, spectator sports	0.0	-1.3	0.3	0.0	0.0	0.0	-0.9	-0.7
Amusements, gambling, and recreatio	0.0	-1.5	0.6	0.0	0.0	-0.4	-0.5	-1.2
Home health care services, business	0.6	1.8	1.4	0.1	0.2	0.0	0.3	-0.2
Offices of physicians, dentists, an	0.4	2.0	1.8	0.1	0.2	0.0	0.3	-0.3
Home and other ambulatory health ca	0.1	2.4	1.9	0.1	0.2	0.0	0.5	-0.3
Hospitals, business	0.1	1.3	-0.3	0.0	0.1	0.0	0.9	0.7
Nursing and residential care facili	0.0	-0.2	0.1	0.0	0.1	0.0	0.0	-0.4
Accommodation, food services and drinking pla	0.1	-1.4	-0.4	0.0	0.0	-0.2	-0.6	-0.2
Accommodation	0.0	-2.6	0.6	0.0	0.0	-0.7	-1.7	-0.7
Food services and drinking places	0.2	-0.9	-0.8	0.0	0.1	0.0	-0.2	0.0
Repair and other personal services	0.1	-3.8	-0.4	-0.1	0.0	-0.1	0.5	-3.7

For each row, column (2) equals the sum of columns (3) through (8).

IT is computers and peripherals, communication equipment, and software. EQX is other equipment, and STR is structures. Labor input is hours worked by all persons.