Appendix SA8.2 Additional Early Additive Structural Decomposition Studies

In what follows, we present brief overviews of several (from among many) additional empirical SDA studies concerned with identifying components of total output change (in chronological order). The main characteristics of these (and other studies) are summarized in Table A8.2.1. The percentage figures in tables like these are extremely sensitive to the differences between various changes. When a large positive effect (for example, final demand contribution) is nearly offset by a large negative effect (for example, technology change contribution), the percentages can be enormous. A simple table with several hypothetical results illustrates this fairly obvious fact (Table A8.2.2).

1. Skolka (1989) describes the structural decomposition methodology in some detail and applies it to a 19-sector data set for Austria (1964–1976). Both net output (value added) change and employment change were decomposed into an intermediate demand (technology) component (with separate domestic and imports parts) and a final-demand component (with separate domestic and exports parts).
2. Fujimagari (1989). Fujimagari suggests that bundling **L** and **B** together (as in Feldman, McClain and Palmer, 1987) is inappropriate. Instead he uses two tripartite decompositions and averages their results. These are

$$\Delta\mathbf{x} = (\Delta\mathbf{L})\mathbf{B}^0\mathbf{f}^0 + \mathbf{L}^1(\Delta\mathbf{B})\mathbf{f}^0 + \mathbf{L}^1\mathbf{B}^1(\Delta\mathbf{f}) \quad \text{and}$$
$$\Delta\mathbf{x} = (\Delta\mathbf{L})\mathbf{B}^1\mathbf{f}^1 + \mathbf{L}^0(\Delta\mathbf{B})\mathbf{f}^1 + \mathbf{L}^0\mathbf{B}^0(\Delta\mathbf{f})$$

   [as in (8.8) and (8.9)] in a 189-sector Canadian model for 1961–1971 and 1971–1981. This approach has been used often in many more recent studies.
3. Barker (1990). Changes over 1979–1984 in the output of market service industries in the UK are investigated – including distribution, transport, communications, business services, and others. The decomposition – into changes internal to the services group, external to the group in the rest of manufacturing and external in the rest of industry – uses partitioned matrices extensively. Each of these is further decomposed into changes in: input-output coefficients, total final demand (level) and the structure of final demand (the distribution, as reflected in the bridge matrix).
4. Martin and Holland (1992). Changes over 1972–1977 in the output of some 477 US industries are decomposed from the defining equation

$$\mathbf{x}^t = (\mathbf{I} - \hat{\mathbf{u}}^t\mathbf{A}^t)^{-1}(\hat{\mathbf{u}}^t\mathbf{f}^t + \mathbf{e}^t) = \mathbf{L}^t(\hat{\mathbf{u}}^t\mathbf{f}^t + \mathbf{e}^t)$$

   in which (all for year t) $\hat{\mathbf{u}}$ is a diagonal matrix containing the domestic supply ratio for each sector, **A** is the technical coefficient matrix (including imports), **f** is the domestic final-demand vector and **e** is a vector of exports. Thus $\hat{\mathbf{u}}^t\mathbf{A}^t$ is an estimate of the domestic direct input coefficients matrix and $\hat{\mathbf{u}}^t\mathbf{f}^t$ is an estimate of the vector of domestic final demand that is satisfied from domestic sources. The decomposition used is essentially that in (8.9), namely

$$\Delta\mathbf{x} = (\Delta\mathbf{L})(\hat{\mathbf{u}}^1\mathbf{f}^1 + \mathbf{e}^1) + \mathbf{L}^0(\Delta\mathbf{u})\mathbf{f}^1 + \mathbf{L}^0\hat{\mathbf{u}}^0(\Delta\mathbf{f}) + \mathbf{L}^0(\Delta\mathbf{e})$$

After a good deal of algebra this can be expressed as

$$\Delta\mathbf{x} = \mathbf{L}^0\hat{\mathbf{u}}^0(\Delta\mathbf{f}) + \mathbf{L}^0(\Delta\mathbf{e}) + \mathbf{L}^0(\Delta\mathbf{u})(\mathbf{f}^1 + \mathbf{A}^1\mathbf{x}^1) + \mathbf{L}^0\hat{\mathbf{u}}^0(\Delta\mathbf{A})\mathbf{x}^1$$

(No alternative decompositions were used and so the results were not averages.) The decomposition is thus apportioned to changes due to: domestic final demand, export demand, import substitution, and input–output coefficients. With results for 477 sectors, groupings were necessary – these included aggregations into: (1) primary (25 natural resource related industries), secondary (409 manufacturing and processing industries) and tertiary (43 support and service oriented industries); (2) nine sectors that represent the BEA one-digit aggregation level; and (3) the 30 fastest growing and the 30 slowest growing industries.

When commodity sectors were categorized according to 1972–1977 growth rates, the importance of the technical change contribution was seen to increase with categories of increasing growth or decline – results consistent with those in Feldman, McClain and Palmer (1987). At the same time, examination of the specific decompositions for the 30 fastest growing and 30 fastest declining sectors indicated that final demand was the dominant component in output change in 60 and 67 percent of the cases, respectively, whereas technical coefficient change was dominant in about 30 percent of the cases (both for rapidly growing and rapidly declining sectors). This view of their results is at variance with those of Feldman, McClain and Palmer.

5. Liu and Saal (2001). This study examines changes in gross outputs in South Africa over 1975–1993. It employs essentially the same decomposition as Martin and Holland (1992), except that final demand is separated into changes in private consumption, investment spending, government spending, exports, and import substitution.
6. Dietzenbacher and Hoekstra (2002). This study focuses on output change for 25 sectors in the Netherlands over 1975-85. The Netherlands data are embedded in an intercountry model for the European Union, and final demand categories include separate columns for exports to each of five EU member countries (Germany, France, Italy, Belgium and Denmark), the rest of the EU, the rest of the world, household consumption and other final demand. As might be expected, large differences were observed across sectors, countries and final demand categories.
7. Roy, Das and Chakraborty (2002). The particular interest of this study is to identify sources of growth in the information sectors in a 31-sector input–output model of the Indian economy over 1983–1984 to 1989–1990. Instead of partitioning the matrices into quadrants of information and non-information sectors, the authors simply define a matrix $\hat{\mathbf{z}}$, created from an identity matrix by replacing the main-diagonal ones with zeros for all non-information sectors. Then $\hat{\mathbf{z}}\mathbf{x}$ selects only the information rows from the results of various decompositions.

Table A8.2.1 Selected Early Empirical Additive Structural Decomposition Studies (1987 – 2002)

Author(s) and Source	Details (country; dates; changed variable(s); aggregation level)	Decomposition Components (percentage of total change[a])		
		Technology	Final Demand	
Skolka (1989, pp. 59–60)	Austria; 1964–76; Δ (value added) and also Δ (employment); 19 industries	26 (v.a.), 34 (emp.)	74 (v.a.), 66 (emp.) *Domestic* 18 (v.a.) 46 (emp.)	 *Foreign* 56 (v.a.) 20 (emp.)
Fujimagari (1989, Tables 1 and 2)	Canada; 1961–71 and 1971–81; Δ**x**; 189 industries (results for 15 fastest and 15 slowest growing industries)	*1961–71* 28 (top 15) –86 (last 15) *1971–81* 22 (top 15) 159 (last 15)	*1961–71* 72 (top 15) 186 (bottom 15) *1971–81* 78 (top 15) –59 (bottom 15) *Level* *1961-71* 38 (top 15) 69 (last15) *1971–81* 61 (top 15) –120 (last 15)	*Mix* *1961–71* 34 (top 15) 117 (last 15) *1971–81* 17 (top 15) 61 (last 15)
Barker (1990, Table 4)	UK; 1979–84; Δ**x** (service industries); 101 industries, 13 service ind. (aggregated to 5 service industries)	63	18 *Level* −1	 *Mix* 20

Martin and Holland (1992, Table 1)	US; 1972–77; $\Delta\mathbf{x}$; 477 sectors	6	94 *Domestic* 81 *Export* 23 *Import Use* −10
Liu and Saal (2001, Table 5)	South Africa; 1975–93; $\Delta\mathbf{x}$; 34 and 10 sectors; results for 10 sectors only	28	72 (Pvt. Cons., 61; Gov. Cons., 7; Inv., –32; Exp. 29, Imp. Subs., 7)
Dietzenbacher and Hoekstra (2002, Tables 10.2, 10.4)	The Netherlands; 1975–85; $\Delta\mathbf{x}$; 25 sectors	21[b] (−201, 135)	79[b] (−35, 301) *Level* 99 (−118, 2458) *Category* 1 (−2594, 257) *Product Mix* 0 (−39, 236)
Roy, Das and Chakraborty (2002, Table 4)	India; 1983/4–89/90; $\Delta\mathbf{x}$ (information sectors); 30 non-information sectors plus 5 information sectors	3 *Info. coeffs.* 3 *Non-info. coeffs.* 0	97 *Domestic* 91 Level 65, Mix 26 *Exports* 6 *Import Substitution* 0

[a] Figures may not add to 100 percent due to rounding.

[b] Figures in parentheses indicate boundaries in the range of values across the 25 sectors in the study.

Table A8.2.2 SDA Percentage Change Sensitivities

Technology Change	Final-Demand Change	Total Change	Technology Change as a Percentage of Total Change	Final-Demand Change as a Percentage of Total Change
–50	51	1	–5000	5100
–50	52	2	–2500	2600
–48	52	4	–1200	1300
–55	45	10	–550	450

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