# Economic structural change over time: Brazil and the United States compared*

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## RESUMO

Usando as matrizes de insumo-produto para as economias do Brasil e dos Estados Unidos, este estudo comparativo tem como objetivo analisar como a estrutura produtiva de dois grandes países, com níveis diferentes de desenvolvimento, mudou através do tempo (1958-77 para os Estados Unidos e 1959-80 para o Brasil). A mudança na estrutura produtiva é decomposta em três componentes iniciais (demanda final, tecnológia, e sua interação sinergética), após o que estes componentes são divididos em mudanças que são iniciadas dentro e fora do setor. A partir destas análises é possível identificar os padrões de mudanças estruturais nas duas economias. Os resultados indicam um grande grau de semelhança nos padrões do processo de crescimento de ambos os países, com diferenças mais significantes entre setores do que entre países. A análise capaz de capturar diferenças importantes na origem das mudanças da demanda, isto é mudanças internas versus mudanças externas ao setor.

**Palavras-chave:** insumo-produto, estrutura produtiva, Brasil, Estados Unidos.

## ABSTRACT

Using input-output tables for the economies of Brazil and the United States, this comparative study focuses on changes in the economic structure of two large countries with different levels of development over time (1958-77 for the United States and 1959-80 for Brazil). The change in the economic structure is decomposed into three initial components (final demand, technology, and their synergistic interaction) and thereafter these components are further divided into change initiated within the sector and outside the sector. From this analysis it is possible to identify patterns of structural change in the two economies. The results indicate a rather remarkable degree of commonality in the patterns of growth processes in both countries, with more significant differences between sectors than between countries. The analysis confirmed earlier findings about the role of demand changes but was able to capture important differences in internal-to-sector versus external-to-sector sources of demand change.

**Key words:** input-output, economic structure, Brazil, United States.

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# 1 Introduction

While input-output models continue to receive a mixed reception in the literature, the underlying input-output tables still serve as an important source of information about the structure of an economy; it is this perspective that is highlighted in this paper, where an attempt is made to examine economic structure and its changes in the economies of the US and Brazil. These countries were chosen since they are both large yet at different stages of economic development. Furthermore, the existence of a set of input-output tables over time for a roughly comparable period (1958-1980) afforded the opportunity to explore comparative changes.

The analysis draws on some recent work by Feldman, McClain and Palmer (FMP) (1987) and Sonis, Hewings and Guo (SHG) (1995b). FMP examined the degree to which changes in final demand and changes in input coefficients contributed to changes in output in the United States economy over the period 1963 to 1978. SHG proposed an alternative decomposition approach which explicitly addressed the contributions of changes in terms of their system-wide impact. This decomposition separates the pure effects of changes in technology and in final demand from those caused by the synergistic interaction between these two components. Further, each component of the change in gross output in each sector can be divided into two parts, *self-generated* and *non-self-generated changes*; in the former case, the change in output can be traced to changes in the sector itself (i.e. changes in final demand, technology or synergy ) while in the latter case, the change occurs in another sectors.

In this paper, the FMP methodology is presented in section 2 and the SHG alternative together with some additional modifications in section 3. In section 4, a brief overview of the Brazilian (1959-1980) and US (1958-1977) economies is provided prior to the presentation of the results. Section 5 offers some summary perspectives.

# 2 Analysis of the FMP approach

In their paper, FMP proposed the following decomposition for the analysis of the influence on output levels of changes in the input coefficients and in the components of final demand. Let $X_0$ and $X_t$ be the gross output vectors for the two time periods *0* and *t*. Similarly, let $B_0$ and $B_t$ be the Leontief inverses and $f_0$ and $f_t$ the vectors of final demand. Define:

$$\begin{aligned} \Delta X &= X_t - X_0 \\ \Delta B &= B_t - B_0 \\ \Delta f &= f_t - f_0 \end{aligned} \tag{1}$$

Assume, further, that the matrix, $A$, of direct input coefficients is ($nxn$) and that the vectors are of dimension ($nx1$). Consider the following representation of change in gross output:

$$\Delta X = X_t - X_0 = B_t f_t - B_0 f_0 \tag{2}$$

From equation (2) it is possible to arrive at:

$$\Delta X = 1/2\{B_t(f_t - f_0) + B_0(f_t - f_0)\} + 1/2\{(B_t - B_0)f_0 + (B_t - B_0)f_t\} \tag{3}$$

where the first term on the right hand side of equation (3) represents the contribution of changes in final demand to output changes and the second term accounts for the contribution of changes in input coefficients to output changes.

The first and second righthand terms of equation (3) can be presented respectively as:

$$B_0\Delta f + 1/2\,\Delta B\Delta f \quad \text{and}$$

$$\Delta B f_0 + 1/2\,\Delta B\Delta f \tag{4}$$

Therefore, it is evident that the proposed decomposition of the changes into components (4) cannot entirely separate the effects of coefficient change from those of changes in final demand. The presence of the term, $\Delta B\Delta f$ creates a problem of how to assign the synergistic effects of coefficient change and final demand change especially if this component turns out to account for a large percentage of the change in output. FMP noted in their paper (Footnote. 7 p. 505) that their method ascribed half of this interaction term to each component. What is needed is a more flexible approach, and this is presented in the next section.

## 3 Decomposition, source, and evolution of output change[1]

This section presents the theoretical development of the ideas expressed in the previous section, and this is accomplished in three parts. In the first part, output change is divided into three components: changes in final demand; changes in technology; and synergistic interactions between changes in final demand and changes in technology The second part deals with the problem of determining if the main source of output change in a sector is due to changes in the

[1] This section draws on Sonis, Hewings and Guo (1995b)

sector itself or in other sectors of the economy. The final part presents a methodology that reveals how the shares of the three components of output change evolve through time.

## Triple decomposition of output change

Instead of the FMP approach and its decomposition of output change into only two components, one can use a Paache-type decomposition of the change described in equation (2), such that a triple decomposition is obtained, i.e.:

$$\begin{aligned}\Delta X &= (B_0 + \Delta B)(f_0 + \Delta f) - B_0 f_0 = \\ &= B_0 \Delta f + \Delta B f_0 + \Delta B \Delta f\end{aligned} \tag{5}$$

In this way the change in output is divided into changes in final demand, technology, and the synergistic interaction between final demand and technology.[2]

For sector *i*, equation (5) can be represented in the following way:

$$\Delta X_i = \Delta X_i^f + \Delta X_i^B + \Delta X_i^{Bf} \tag{6}$$

where the superscripts refer to changes associated with final demand (*f*), technology (*B*) and their synergistic interaction (*Bf*).

The first component, $\Delta X_i^f$, identifies the impact on sectoral output of a change in the structure of final demand alone keeping the technology constant. Given that the level of final demand has a tendency to increase, one would expect that positive results would be obtained for this component over time.

The second component, $\Delta X_i^B$, will give the impact of change in technology on sectoral output, given the same level of final demand. Positive values for this component mean that a higher level of total production is needed to supply the same level of final demand, while negative values reflect a lower level of total production. A negative sign for this component can mean a combination of the following: firms are enhancing their efficiency in the production process, using less material inputs; the share of value added is increasing; firms are reducing the use of local inputs and increasing the use of imported ones. A positive sign can be an indication that: there is an increase in complexity of the economy, i.e. to produce a given good industries

[2] Previous studies of the sources of structural change in interpreting sectoral output or price variations can be found in Chenery and Watanabe (1958), Syrquin (1976), Bezdek and Wendling (1976), Chenery and Syrquin (1979), Kubo and Robinson (1984), Fossell (1989), and Skolka (1989).

now need to buy inputs from more sources than before, increasing in this way the multiplier effect of this sector over the economy; the share of value added is decreasing; firms are increasing the use of domestic sources of inputs; or firms are becoming less efficient in the production process.

The third component, $\Delta X_i^{Bf}$ is the result of the synergistic interaction between changes in final demand and changes in technology, i.e. given the changes in final demand and technology, how much total production has to change to satisfy both changes. The sign of this component can be either positive or negative.

Instead of working with changes in the components shown in (6), an alternative proposal is presented whereby the analysis is conducted with growth rates. In this way, it is easier to make comparisons and to identify how the sectors are growing in the economy. Hence (6) can be simply transformed by dividing throughout by $X_{0i}$ and multiplying by 100, as follows:

$$\frac{\Delta X_i}{X_{0i}}.100 = \frac{\Delta X_i^f}{X_{0i}}.100 + \frac{\Delta X_i^B}{X_{0i}}.100 + \frac{\Delta X_i^{Bf}}{X_{0i}}.100 \qquad (7)$$

Alternatively, using lower-case letters to represent growth rates, equation (7) can be represented as:

$$x_i = x_i^f + x_i^B + x_i^{Bf} \qquad (8)$$

Thus for example if the level of production in sector $i$ increases by 10% ($x_i$), this can be accomplished by an increase of 17% in final demand ($x_i^J$), compensated in part by a decrease of 5% in the technology factor ($x_i^B$), i.e. a more efficient way of producing goods, and a 2% decrease due to synergistic interaction between the variation in final demand and technology ($x_i^{Bf}$).

## Changes generated inside and outside the sector

In addition to the decomposition into three components presented in the previous section, each one of the changes in these components can be traced to its source by determining whetherit originated in the sector itself or in other sectors of the economy. These further decompositions are referred to as *self-generated* and *non-self-generated changes* respectively. Empirical evidence suggests that the weighting attributed to these two components can be vary considerably across sectors.

The parts are defined as follows, where *s* refers to self-generated and *ns* to non-self-generated:

$$\begin{aligned} s\Delta X_i^f &= b_{ii}\Delta f_i\ ; \quad ns\Delta X_i^f = \Delta X_i^f - s\Delta X_i^f \\ s\Delta X_i^B &= \Delta b_{ii} f_i\ ; \quad ns\Delta X_i^B = \Delta X_i^B - s\Delta X_i^B \\ s\Delta X_i^{Bf} &= \Delta b_{ii}\Delta f_i\ ; \quad ns\Delta X_i^{Bf} = \Delta X_i^{Bf} - s\Delta X_i^{Bf} \end{aligned} \tag{9}$$

*Self-generated* changes are obtained by using $b_{ii}$, $f_i$, and their changes through time. Thus what we are trying to measure here are the changes in total production of sector *i* that are linked with final demand for sector *i* only. By *non-self-generated* changes we mean changes in the total production of sector *i* that are linked with final demand for other sectors of the economy. These are obtained by subtracting *self-generated* changes from total changes.[3]

Further, consider, respectively, the global self and non-self output change as:

$$s\Delta X_i = s\Delta X_i^f + s\Delta X_i^B + s\Delta X_i^{Bf} \tag{10}$$

and

$$ns\Delta X_i = ns\Delta X_i^f + ns\Delta X_i^B + ns\Delta X_i^{Bf} \tag{11}$$

Dividing equations (10) and (11) by $X_{0i}$ and multiplying each one by 100 gives us the same procedure as for equations (7) and (8) where growth rates were obtained for the change in output and its components. Thus from equations (10) and (11) we can obtain the following:

$$x_i^s = x_i^{sf} + x_i^{sB} + x_i^{sBf} \tag{12}$$

$$x_i^{ns} = x_i^{nsf} + x_i^{nsB} + x_i^{nsBf} \tag{13}$$

Furthermore, the variables in equations (8), (12), and (13) can be related in the following way:

$$x_i = x_i^s + x_i^{ns} \tag{14}$$

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[3] Despite the fact that we are using $b_{ij}$ to measure *self-generated* changes, and the value of $b_{ij}$ is related to all the other direct technical coefficients, $a_{ij}$, our real interest here is in measuring the direct and indirect production of sector *i* needed to fulfill the final demand needs of sector *i* alone.

$$\begin{cases} x_i = x_i^{sf} + x_i^{nsf} \\ x_i = x_i^{sB} + x_i^{nsB} \\ x_i = x_i^{sBf} + x_i^{nsBf} \end{cases} \tag{15}$$

Through an analysis of the components $x_i^s$ and $x_i^{ns}$ it is possible to determine whether the main source of growth in sector *i* is *self-* or to *non-self-generated changes*. In addition, by using the same kind of analysis demonstrated above for equation (8), analysis of equations (12) and (13) can reveal the major sources of *self-* and *non-self-generated changes*, i.e. final demand, technology, or synergistic interaction between final demand and technology.

## Evolution of changes

With more than two time periods it is possible to see how the importance of the three components (final demand, technology, and synergistic interaction) have evolved in the determination of output change. This is accomplished by considering the importance of a given component in the total impact on output change. Total impact is defined as follows:

$$\Delta T_i = abs(\Delta X_i^f) + abs(\Delta X_i^B) + abs(\Delta X_i^{Bf}) \tag{16}$$

where $\Delta T_i$ is the total impact in sector *i*, and $abs(\Delta X_i^f)$, $abs(\Delta X_i^B)$, and $abs(\Delta X_i^{Bf})$ are the absolute values of the final demand, technology, and synergistic components.

Note that total impact is defined in a different way from output change, since output change takes the signs of its components into consideration, whereas the total impact does not. The difference is mainly due to the fact that when output changes are measured, attention focuses on the *net effect*, while with total impact the interest focuses on the magnitude of the components, regardless of their negative or positive influence on sectoral output change.

Dividing equation (16) by $\Delta T_i$ and multiplying by 100 gives the following result:

$$100 = \frac{abs(\Delta X_i^f)}{\Delta T_i}.100 + \frac{abs(\Delta X_i^B)}{\Delta T_i}.100 + \frac{abs(\Delta X_i^{Bf})}{\Delta T_i}.100 \tag{17}$$

Or in shares:

$$100 = Z_i^f + Z_i^B + Z_i^{Bf} \tag{18}$$

where $Z_i^J$ $Z_i^B$ and $Z_i^{BJ}$ in equation (18) represent the shares of final demand, technology and synergistic interaction in the total impact on sector *i* for a given time period. The evolution of changes through different time periods is obtained by estimating the difference between the shares of the three components in (18) for two time periods, thus:

$$\begin{cases} \Delta Z_i^f = Z_{it}^f - Z_{i0}^f \\ \Delta Z_i^B = Z_{it}^B - Z_{i0}^B \\ \Delta Z_i^{Bf} = Z_{it}^{Bf} - Z_{i0}^{Bf} \end{cases} \tag{19}$$

where a positive value for any one component, $\Delta Z_i^f$ $\Delta Z_i^B$ or $\Delta Z_i^{Bf}$ implies an increase over time of the importance of final demand, technology or synergistic interaction in determining the output change in sector *i*. Concomitantly, a negative value means a decrease in importance.

Just as (19) was used to measure the evolution of changes in total output of sector *i*, it can also be used to measure the evolution of changes in self-generated and non-self-generated changes in total output. Thus application of the procedure presented in (16) through (19) to self-generated and non-self-generated changes gives the following result:

$$\begin{cases} \Delta Z_i^{sf} = Z_{it}^{sf} - Z_{i0}^{sf} \\ \Delta Z_i^{sB} = Z_{it}^{sB} - Z_{i0}^{sB} \\ \Delta Z_i^{sBf} = Z_{it}^{sBf} - Z_{i0}^{sBf} \end{cases} \tag{20}$$

$$\begin{cases} \Delta Z_i^{nsf} = Z_{it}^{nsf} - Z_{i0}^{nsf} \\ \Delta Z_i^{nsB} = Z_{it}^{nsB} - Z_{i0}^{nsB} \\ \Delta Z_i^{nsBf} = Z_{it}^{nsBf} - Z_{i0}^{nsBf} \end{cases} \tag{21}$$

where the interpretation of equations (20) and (21) is identical to that of equation (19), except for the fact that *s* refers to self-generated and *ns* refers to non-self-generated changes.

In the next section, after a brief overview of both economies, these techniques will be applied to the economies of Brazil and the United States, and a comparison will be made of the results.

# 4 The Brazilian (1959-1980) and American economies (1958-1977) compared

## A brief overview of the brazilian and United States economies

This section gives a brief overview of the key developments in the Brazilian economy from the 1950s to the 1980s. In the 1950s the Brazilian economy experienced an intense import substitution industrialization (ISI) program accompanied by relatively high rates of growth. This period of expansion ended in the first half of the 1960s and was followed by several years of economic stagnation. The crisis of the latter period coincided with the end of the earlier ISI experience that had been characterized by import substitution of durable and nondurable consumer goods for the most part. In the period 1968 to 1973, the Brazilian economy again experienced fast economic growth with yearly real rates of growth above 10%; from 1974 to 1981, growth continued but at more modest rates. In the period from 1968 to 1981 the focus of attention was on ISI in the sectors producing capital goods (Baer, Fonseca, and Guilhoto, 1987), and at the same time there was an increase in exports of industrialized goods (Guilhoto, 1992). The 1980s were marked by high rates of inflation, excessive participation of the state in the economy, and restrictions on the balance of payments. All of these factors contributed to low rates of annual economic growth (average of 2.22% in the 1980-90 period). From the 1950s through the 1980s there was also an increase in income concentration.

The US economy was not immune from the vicissitudes of economic fortune; however, the period from the 1950s through the early 1970s was an era in which manufacturing reached its zenith both in valued added terms and in the dominating position that it exercised in employment generation. Beginning in the late 1960s, the US economy began to experience the effects of penetration from the world economy. Manufacturing employment growth was flat but, more importantly, it began to be redistributed spatially, with significant declines in the Midwest and growth in the south and western parts of the country. By the end of the period covered by this analysis, nonmanufacturing growth, especially in employment terms, was ascendant but would not be revealed in a dramatic fashion until about a decade later (late 1980s). Carter (1970) and FMP both comment on the important role that demand growth had on the economy; however, there were some important technological changes taking place, such that by the end of the 1970s, there was increasing evidence of significant capital-for-labor substitution in the manufacturing sectors of the economy.

**Figure 1**

Signs of the Growth Rates of Output and of Its Components - Brazil

| Sector | Period | Total | Total | | Total | | | Self | | | Non-Self | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Self | Non | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 59-70 | + | | + | + | | | - | + | | + | | |
| | 70-75 | + | + | + | + | | | + | | | + | | |
| | 75-80 | + | | + | + | | | - | + | | + | | |
| 2. Mining | 59-70 | + | + | + | + | | | + | | | + | | |
| | 70-75 | + | + | + | + | | | + | + | + | + | | |
| | 75-80 | + | + | + | + | + | + | + | | | + | + | + |
| 3. Construction | 59-70 | + | + | | + | | | + | | | + | - | - |
| | 70-75 | + | + | | + | | | + | | | + | - | |
| | 75-80 | + | + | + | + | + | + | + | + | + | + | + | + |
| 4. Manufacturing | 59-70 | + | + | + | + | | | + | | | + | | |
| | 70-75 | + | + | + | + | + | + | + | + | + | + | + | + |
| | 75-80 | + | + | + | + | + | + | + | + | + | + | + | + |
| 5. Trade and Transp. | 59-70 | + | + | + | + | | | + | | | + | + | |
| | 70-75 | + | + | + | + | + | + | + | + | + | + | + | + |
| | 75-80 | + | + | + | + | | + | + | + | + | + | | + |
| 6. Services | 59-70 | + | + | | + | | | + | | | + | - | - |
| | 70-75 | + | + | + | + | + | + | + | + | + | + | + | + |
| | 75-80 | + | + | + | + | + | + | + | + | + | + | + | + |

**Figure 2**

Signs of the Evolution of Changes - Brazil

| Sector | Period | Total | | | Self | | | Non-Self | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 59/70 70/75 | + | | | + | | | + | + | |
| | 70/75 - 75/80 | | + | | | + | + | | + | |
| 2. Mining | 59/70 70/75 | + | | | | + | | + | | |
| | 70/75 75/80 | | + | + | + | | | | + | + |
| 3. Construction | 59/70 70/75 | + | | | + | | | | + | |
| | 70/75 75/80 | | + | + | | + | + | | | + |
| 4. Manufacturing | 59/70 - 70/75 | | + | + | | + | + | | + | + |
| | 70/75 - 75/80 | | + | + | | + | | | + | |
| 5. Trade and Transp. | 59/70 - 70/75 | | + | + | + | | | | + | + |
| | 70/75 75/80 | + | | | | + | + | + | + | |
| 6. Services | 59/70 70/75 | + | | | + | | + | + | | |
| | 70/75 75/80 | | + | + | | + | + | | + | + |

**Figure 3**

Signs of the Growth Rates of Output and of Its Components - United States

| Sector | Period | Total | Total | | Total | | | Self | | | Non-Self | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Self | Non | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 58-63 | + | + | + | + | | | + | + | + | + | | |
| | 63-67 | + | | + | + | | | - | | + | + | | |
| | 67-72 | + | + | | + | | | + | + | + | + | - | - |
| | 72-77 | + | + | | + | | | + | | | + | - | |
| 2. Mining | 58-63 | + | + | + | + | | | + | | + | + | | |
| | 63-67 | + | + | + | + | | | + | | | + | | |
| | 67-72 | | - | + | + | - | - | - | + | | + | | |
| | 72-77 | | - | + | - | + | + | - | | | + | + | + |
| 3. Construction | 58-63 | + | + | + | + | | | + | | | + | | |
| | 63-67 | + | + | + | + | | | + | | | + | | |
| | 67-72 | + | + | + | + | | | + | | | + | | |
| | 72-77 | + | | + | | + | + | - | + | | + | + | + |
| 4. Manufacturing | 58-63 | + | + | + | + | | + | + | + | + | + | | |
| | 63-67 | + | + | + | + | | | + | | | + | + | + |
| | 67-72 | + | + | + | + | | | + | | | + | | |
| | 72-77 | + | + | + | + | + | + | + | + | + | + | + | + |
| 5. Trade and Transp. | 58-63 | + | + | + | + | | | + | + | + | + | | |
| | 63-67 | + | + | + | + | | | + | + | + | + | | |
| | 67-72 | + | + | + | + | | | + | | | + | | |
| | 72-77 | + | + | + | + | + | + | + | + | + | + | + | + |
| 6. Services | 58-63 | + | + | + | + | | | + | + | + | + | | |
| | 63-67 | + | + | + | + | + | + | + | + | + | + | + | + |
| | 67-72 | + | + | | + | | | + | | | + | - | |
| | 72-77 | + | + | + | + | + | + | + | | | + | + | + |

**Figure 4**

Signs of the Evolution of Changes - United States

| Sector | Period | Total | | | Self | | | Non-Self | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 58/63 - 63/67 | | + | + | + | | | | + | + |
| | 63/67 - 67/72 | | | + | | + | + | | + | + |
| | 67/72 72/77 | + | | | + | | + | | + | |
| 2. Mining | 58/63 63/67 | + | | | + | | | + | | |
| | 63/67 67/72 | | + | + | + | | | | + | + |
| | 67/72 72/77 | + | + | | | + | + | | + | |
| 3. Construction | 58/63 - 63/67 | | + | + | | + | | | + | + |
| | 63/67 67/72 | | | + | + | | + | | | + |
| | 67/72 72/77 | | + | | | + | + | | + | |
| 4. Manufacturing | 58/63 63/67 | + | | + | + | | | + | | |
| | 63/67 67/72 | | + | + | | + | | | | + |
| | 67/72 - 72/77 | | + | | + | | + | | + | |
| 5. Trade and Transp. | 58/63 - 63/67 | + | | | | + | + | + | | |
| | 63/67 67/72 | | + | + | | + | | | + | + |
| | 67/72 - 72/77 | | + | | + | | + | | + | |
| 6. Services | 58/63 - 63/67 | + | | | + | | | + | | |
| | 63/67 - 67/72 | | + | + | | + | + | | + | + |
| | 67/72 - 72/77 | + | + | | + | | | + | | |

## Analysis of the results

In this section, interpretation will be made of the application of the techniques introduced in section 3 above to the input-output data for the economies of Brazil and the United States. The period of the analysis for Brazil is from 1959 to 1980 while the data for the United States is from 1958 to 1977. To isolate the components of output change from price changes in these economies, the input-output tables are expressed in constant values,[4] millions of 1982 Cruzeiros for Brazil and millions of 1982 Dollars for the United States. Furthermore, both sets of input-output tables were aggregated to comparable sector classifications; there are of course important differences in the compositions of these aggregate sectors but it is felt that the analysis at this level still provides an important foundation for comparative analysis.

Tables A.1 and A.2 in the Appendix provide the gross flows, aggregated final demand, primary inputs and gross outputs for each of the input-output tables for the economies of Brazil[5] and of the United States,[6] and Tables A.3 through A.6 summarize the results of the application of the methodology developed in sections 2 and 3 to the economies of Brazil and of the United States. The results are represented in a schematic way in Figures 1 through 4. These Figures show the signs of the growth rates of sectoral output and of all of its components; the cells marked in dark gray represent the component that is the key determinant of output growth, either for total growth or for self-generated and non-selfgenerated growth. In Figures 1 and 3 cells marked in light gray are cells that by themselves are not the main component of growth, but when combined represent the majority of the growth. For example, in Figure 1, if one refers to sector 3 (Construction) for the period 1959-70, the sign of non-selfgenerated growth is minus (-) as a result of the combination of changes in technology and synergistic components; however, the most important component in this case is final demand (dark gray cell).

Examining Figures 1 and 3, one can see general patterns of growth that apply both to Brazil and to the United States. For instance, in both countries, the selfgenerated component dominates growth in sectors 3 (Construction), 4 (Manufacturing), 5 (Trade and Transportation) and 6 (Services), while in sectors 1 (Agriculture) and 2 (Mining) non-selfgenerated growth is the dominant factor for Brazil and a very strong one for the United States. This can be explained by the fact that sectors 1 (Agriculture) and 2 (Mining) are mainly suppliers of raw material, and hence their level of production depends much more on the other sectors in the economy than it would if they were mainly producers of final goods. As a result, the other sectors play a major role in these sectors' growth, while the reverse is not necessarily the case. In both countries, final

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[4] See Bulmer-Thomas (1982), especially Chapter 10, for the idea behind the methodology used to express the input-output tables in constant values.

[5] The Brazilian tables were aggregated from the original sources: 1959 from Taylor et al (1980), 1970 from IBGE (1979), 1975 from IBGE (1987), and 1980 from IBGE (1989). The appropriate price index for each sector was then used to express the values of the tables in 1982 cruzeiros.

[6] The U.S. tables were taken from Miller and Blair (1985), and it was used the appropriated price index for each sector to express the values of the tables in 1982 dollars.

demand contributes to positive growth rates in almost all sectors with few exceptions, and at the same time it is in general the dominant component of total, self-generated and non-selfgenerated change. In both Brazil and the United States the sign of the technology component tends to be negative in the earlier periods and positive in the later periods. This suggests that in the 1960s the impact of technological changes led to productivity gains in these economies, while in the 1970s, owing in part to laws setting higher standards of quality and to changes in consumer preferences, firms were required to introduce more sophisticated methods of production, thus increasing complexity in the economy. For both countries, an exception to the above explanation is the agricultural sector, where the technological component of total growth and of non-self-generated growth is always negative, showing better utilization of agricultural products in the production process through more efficient use of material inputs.

Figures 2 and 4 show the evolution of change, i.e.the importance of the components of change over time. In this case, there does not appearto be a fully discernible pattern for either country, implying that changes have occurred in a non-systematic fashion. Thus components become more or less important over time, depending partly on complex adjustment processes within the economic systems.

For Brazil, Figure 1 shows that in sector 1 (Agriculture) the dominant factor in output growth in the 1959-70 period and again in the 1975-80 period is the demand component of non-selfgenerated change, while for the 1970-75 period it is the demand component of self-generated change. This can be explained by the fact that in 1970-75, a period associated with a high rate of growth in the Brazilian economy, the source of change in the agricultural sector was internal, while in the other periods it was more dependent on the other sectors, in keeping with its role as a major supplier of raw materials.

For sector 2 (Mining) in Brazil, growth is mainly dependent on non-self-generated growth of demand in 1959-70 and 1970-75, and on non-self-generated technology change for the 1975-80 period. In essence, with some subtle differences, Mining and Agriculture share common patterns of change.

It is interesting to note that for sector 3 (Construction) in Brazil, non-selfgenerated changes show a predominance of the technology and synergistic components; a similar pattern is found in sector 6 (Services) in the same country. This suggests that the way in which non-selfgenerated growth occurs in these sectors is linked to technology change in the other sectors.

Turning to the United States, for sectors 1 (Agriculture) and 2 (Mining) the dominant factor in output growth from 1958 to 1967 is the demand component of non-selfgenerated change, while for the period 1967 to 1977, it is the demand component of self-generated change. Hence, these sectors at first experienced an externally generated growth process, while in the later periods there was an increase in the importance of growth inside the sector. Sector 3 (Construction) in the United States in the last period (1972-77) shows a predominance of non-selfgenerated growth as well as a predominance of the technological component. Similarly, for

sector 4 (Manufacturing) in the United States in 1967-1972, there is also a predominance of non-selfgenerated change, but the dominant component is still growth in demand. It should also be noted that technology becomes the dominant component for non-self-generated change in the United States in the later periods analyzed.,.

## 5 Conclusion

The methodology presented here is offered as a complementary tool in the analysis of structural changes in economies and, further, as a methodology that could be employed in comparative analysis. It will not replace the kind of detailed evaluations conducted over many years by Syrquin (1976) and Chenery and Syrquin (1979); however, it offers the possibility of presenting, graphically as well as analytically, some of the major characteristics associated with change. The tripartite decomposition and the evolutionary patterns that can be derived from time series of input-output tables offer the possibility of developing a taxonomy of change, particularly if applied to a large sample of countries.

The methodology is also a useful tool in the detailed analysis of structural changes over time, allowing for the separation of total sectoral output change (growth) into changes (growth) due to final demand, technological coefficients, and synergistic interaction between final demand and technology. Furthermore, it also allows for the separation of total change (growth) into self-generated and non-selfgenerated changes (growth) and for the dominance of these components to be tracked over time.

Application to the economies of Brazil and the United States revealed rather similar patterns of association in the nature of changes experienced by comparable sectors. Sectors that are mainly producers of raw material experienced growth dominated by non-self-generated changes, whereas sectors that mainly produce goods exhibited dependence on self-generated changes. These patterns of growth may be an indication of some universal macro-level economic processes that may apply to economies no matter what the level of economic development. However, with a sample of two economies, the comment is raised as a suggestion and motivation for further work.

Confirming the finds of FMP for the United States and of Hewings et al. (1989) and Guilhoto et al. (1994) for the Brazilian economy, the final demand component plays a key role in determining the growth rate of sectoral output, no matter whether sectoral output growth is dominated by self-generated or non-selfgenerated changes. The evolution of changes in components over time shows that there is no pattern either for Brazil or for the United States, implying that changes in both countries occur in a dynamic way, such that the importance of components increases or decreases over time depending on how the economic system is adjusting.

As more input-output tables become available, it will be possible to extend the analysis through the 1980s, a period of important change in the structure of both economies. The methodology here could be extended to a two-region version, namely the interactions between an individual economy and the rest of the world; in this fashion the notions of self-generated and non-self-generated impacts could be merged with the developments proposed by Miyazawa (1976) and extended by Sonis and Hewings (1993). The objective here would be to view changes as generated internally (to the economy) or externally (from the rest of the world). A further extension to consider the changing form and role of feedback loops would also be possible (see Sonis et al. 1993, 1994, 1995).

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# Appendix

**Table A.1**

Brazil Input-Output Tables, 1959-1980 (Millions of 1982 Cruzeiros)

| 1959 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 163209 | 3968 | 1701 | 1034977 | 39436 | 6557 | 1292685 | 2542532 |
| 2. Mining | 1895 | 5381 | 436 | 35240 | 10104 | 813 | 11429 | 65299 |
| 3. Construction | 8145 | 0 | 0 | 0 | 8764 | 109883 | 677482 | 804274 |
| 4. Manufacturing | 58213 | 11683 | 307427 | 1569096 | 213915 | 89644 | 2525687 | 4775665 |
| 5. Trade and Transp. | 12442 | 6897 | 130943 | 223646 | 107400 | 13871 | 1442575 | 1937773 |
| 6. Services | 27022 | 4014 | 30618 | 276297 | 210334 | 90629 | 1150533 | 1789446 |
| VA | 2271606 | 33354 | 333149 | 1636410 | 1347821 | 1478048 | | |
| T. Input | 2542532 | 65299 | 804274 | 4775665 | 1937773 | 1789446 | | |
| 1970 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 417445 | 416 | 28856 | 1696802 | 362 | 17239 | 1177288 | 3338408 |
| 2. Mining | 1213 | 3343 | 11350 | 86238 | 187 | 21 | 47534 | 149885 |
| 3. Construction | 0 | 0 | 0 | 0 | 33453 | 0 | 2482833 | 2516286 |
| 4. Manufacturing | 248426 | 19002 | 861974 | 3480252 | 333523 | 174440 | 5774223 | 10891841 |
| 5. Trade and Transp. | 33074 | 5442 | 274500 | 618752 | 140965 | 69905 | 3333823 | 4476460 |
| 6. Services | 5800 | 3679 | 11772 | 109293 | 85040 | 89033 | 2128788 | 2433405 |
| VA | 2632450 | 118003 | 1327834 | 4900504 | 3882930 | 2082768 | | |
| T. Input | 3338408 | 149885 | 2516286 | 10891841 | 4476460 | 2433405 | | |
| 1975 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 732191 | 1173 | 7269 | 2926633 | 611 | 30812 | 2519304 | 6217994 |
| 2. Mining | 122 | 22920 | 14484 | 163319 | 152 | 3055 | 99690 | 303742 |
| 3. Construction | 0 | 0 | 0 | 0 | 0 | 0 | 5843012 | 5843012 |
| 4. Manufacturing | 694579 | 59336 | 2353328 | 9925701 | 875951 | 603564 | 12492607 | 27005066 |
| 5. Trade and Transp. | 187550 | 12843 | 815884 | 2058407 | 245780 | 228505 | 5128034 | 8677005 |
| 6. Services | 66658 | 6436 | 24705 | 203335 | 201193 | 377475 | 5495003 | 6374805 |
| VA | 4536893 | 201033 | 2627341 | 11727670 | 7353318 | 5131394 | | |
| T. Input | 6217994 | 303742 | 5843012 | 27005066 | 8677005 | 6374805 | | |
| 1980 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 892193 | 624 | 2812 | 3273611 | 1215 | 153191 | 2411958 | 6735603 |
| 2. Mining | 6092 | 43276 | 30733 | 500188 | 637 | 7820 | 386378 | 975124 |
| 3. Construction | 263 | 0 | 427235 | 0 | 51897 | 686052 | 7298117 | 8463564 |
| 4. Manufacturing | 1464089 | 168279 | 3178526 | 16919053 | 2260356 | 2589070 | 16328766 | 42908138 |
| 5. Trade and Transp. | 360602 | 32517 | 790171 | 1461210 | 925420 | 1809651 | 7356479 | 12736050 |
| 6. Services | 172367 | 157512 | 308389 | 3387080 | 977110 | 4812153 | 19222716 | 29037327 |
| VA | 3839998 | 572917 | 3725698 | 17366995 | 8519416 | 18979390 | | |
| T. Input | 6735603 | 975124 | 8463564 | 42908138 | 12736050 | 29037327 | | |

**Table A.2**

United States Input-Output Tables, 1958-1977 (Millions of 1982 US Dollars)

| 1958 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 38759 | 0 | 620 | 65649 | 497 | 7665 | 22830 | 136021 |
| 2. Mining | 823 | 8847 | 6097 | 107653 | 298 | 16621 | 2403 | 47958 |
| 3. Construction | 2322 | 42 | 30 | 2848 | 7667 | 34273 | 148783 | 181390 |
| 4. Manufacturing | 18797 | 4495 | 81671 | 403778 | 24545 | 76409 | 403183 | 921903 |
| 5. Trade and Transp. | 8560 | 2678 | 25440 | 65982 | 15184 | 27428 | 212309 | 338565 |
| 6. Services | 16797 | 10645 | 16928 | 90636 | 91027 | 14404 | 302230 | 547403 |
| VA | 49963 | 21252 | 50604 | 185356 | 199348 | 24095 | | |
| T. Input | 136021 | 47958 | 181390 | 921903 | 338565 | 54740 | | |
| 1963 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 44945 | 0 | 860 | 70586 | 686 | 8997 | 23504 | 149578 |
| 2. Mining | 1041 | 9033 | 5992 | 119000 | 374 | 23707 | 7862 | 167008 |
| 3. Construction | 2077 | 1520 | 92 | 5128 | 5700 | 39945 | 258040 | 312502 |
| 4. Manufacturing | 22697 | 4970 | 93733 | 531231 | 30184 | 70332 | 609973 | 1363122 |
| 5. Trade and Transp. | 8009 | 2510 | 28049 | 69398 | 20756 | 33252 | 295888 | 457862 |
| 6. Services | 16257 | 12040 | 19879 | 108234 | 91367 | 186130 | 533669 | 967576 |
| VA | 54553 | 136935 | 163897 | 459544 | 308795 | 605212 | | |
| T. Input | 149578 | 167008 | 312502 | 1363122 | 457862 | 967576 | | |
| 1967 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 45224 | 0 | 641 | 76561 | 478 | 8307 | 22683 | 153895 |
| 2. Mining | 1095 | 9968 | 7381 | 137143 | 333 | 30405 | 11540 | 197865 |
| 3. Construction | 1984 | 1882 | 99 | 8421 | 6030 | 39799 | 281523 | 339737 |
| 4. Manufacturing | 24042 | 6490 | 104053 | 643346 | 37964 | 97975 | 772291 | 1686161 |
| 5. Trade and Transp. | 10820 | 1927 | 28300 | 80890 | 29888 | 43206 | 369368 | 564399 |
| 6. Services | 16466 | 13082 | 23701 | 143788 | 112262 | 22423 | 637016 | 1170555 |
| VA | 54265 | 164516 | 175562 | 596011 | 377444 | 72662 | | |
| T. Input | 153895 | 197865 | 339737 | 1686161 | 564399 | 11705 | | |
| 1972 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 48562 | 0 | 862 | 75991 | 337 | 5464 | 23381 | 154597 |
| 2. Mining | 1026 | 10708 | 9727 | 145565 | 474 | 41734 | -11929 | 197305 |
| 3. Construction | 1391 | 2048 | 112 | 7742 | 7458 | 45671 | 331754 | 396177 |
| 4. Manufacturing | 28410 | 6759 | 137833 | 672396 | 28976 | 12049 | 800542 | 1795413 |
| 5. Trade and Transp. | 9063 | 1488 | 35289 | 101128 | 33954 | 30514 | 398969 | 610405 |
| 6. Services | 19049 | 12395 | 28870 | 149425 | 110655 | 28308 | 1149071 | 1752553 |
| VA | 47095 | 163906 | 183483 | 643165 | 428550 | 12255 | | |
| T. Input | 154597 | 197305 | 396177 | 1795413 | 610405 | 17525 | | |
| 1977 | | | | | | | | |
| Sector | 1 | 2 | 3 | 4 | 5 | 6 | FD | T. Output |
| 1. Agriculture | 40831 | 37 | 1194 | 81476 | 937 | 6288 | 35045 | 165808 |
| 2. Mining | 676 | 13676 | 5889 | 190919 | 914 | 51624 | -71978 | 191720 |
| 3. Construction | 2131 | 4504 | 467 | 13414 | 11066 | 57055 | 318658 | 407296 |
| 4. Manufacturing | 39754 | 11267 | 149222 | 785141 | 46607 | 14631 | 877819 | 2056120 |
| 5. Trade and Transp. | 11073 | 2561 | 42982 | 130953 | 45690 | 43853 | 480515 | 757626 |
| 6. Services | 20837 | 15795 | 33822 | 173587 | 146829 | 31848 | 1339589 | 2048950 |
| VA | 50506 | 143880 | 173719 | 680630 | 505582 | 14253 | | |
| T. Input | 165808 | 191720 | 407296 | 2056120 | 757626 | 20489 | | |

## Table A.3

Growth Rates (%) of Output and of Its Components - Brazil

| Sector | Period | Output Change | | | | Self Generated | | | | Non-Self Generated | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Dem | Tech | Syn | Total | Dem | Tech | Syn | Total | Dem | Tech | Syn |
| 1. Agriculture | 59-70 | 31.30 | 58.32 | -8.41 | -18.61 | -0.85 | -4.90 | 4.45 | -0.40 | 32.15 | 63.22 | -12.86 | - |
| | 70-75 | 86.26 | 116.30 | -13.73 | -16.31 | 46.42 | 46.88 | -0.21 | -0.24 | 39.83 | 69.42 | -13.52 | - |
| | 75-80 | 8.32 | 19.49 | -8.51 | -2.65 | -0.66 | -2.00 | 1.41 | -0.06 | 8.98 | 21.49 | -9.92 | -2.59 |
| 2. Mining | 59-70 | 129.54 | 170.03 | -17.84 | -22.65 | 55.44 | 60.46 | -1.21 | -3.81 | 74.10 | 109.57 | -16.63 | - |
| | 70-75 | 102.65 | 116.07 | -6.02 | -7.40 | 39.61 | 35.65 | 1.89 | 2.07 | 63.04 | 80.42 | -7.91 | -9.47 |
| | 75-80 | 221.04 | 127.82 | 69.33 | 23.88 | 98.13 | 102.31 | -1.08 | -3.10 | 122.91 | 25.51 | 70.41 | 26.99 |
| 3. Construction | 59-70 | 212.86 | 240.65 | -13.99 | -13.79 | 224.15 | 226.23 | -0.57 | -1.51 | -11.28 | 14.42 | -13.43 | - |
| | 70-75 | 132.21 | 134.47 | -1.33 | -0.93 | 133.43 | 133.68 | -0.11 | -0.15 | -1.22 | 0.79 | -1.22 | -0.79 |
| | 75-80 | 44.85 | 24.90 | 10.55 | 9.40 | 32.04 | 24.90 | 5.72 | 1.42 | 12.81 | 0.00 | 4.84 | 7.97 |
| 4. Manufacturing | 59-70 | 128.07 | 138.23 | -2.23 | -7.92 | 102.06 | 104.15 | -0.92 | -1.18 | 26.01 | 34.08 | -1.32 | -6.75 |
| | 70-75 | 147.94 | 117.23 | 14.15 | 16.56 | 108.40 | 93.38 | 6.95 | 8.08 | 39.53 | 23.86 | 7.20 | 8.48 |
| | 75-80 | 58.89 | 37.64 | 14.32 | 6.93 | 30.90 | 23.37 | 5.77 | 1.77 | 27.99 | 14.27 | 8.55 | 5.16 |
| 5. Trade Transp | 59-70 | 131.01 | 139.25 | -1.67 | -6.56 | 99.29 | 104.74 | -2.36 | -3.09 | 31.72 | 34.50 | 0.69 | -3.47 |
| | 70-75 | 93.84 | 70.12 | 10.62 | 13.09 | 42.10 | 41.75 | 0.23 | 0.12 | 51.74 | 28.38 | 10.39 | 12.96 |
| | 75-80 | 46.78 | 44.95 | -3.32 | 5.15 | 31.85 | 26.83 | 3.50 | 1.52 | 14.93 | 18.12 | -6.82 | 3.63 |
| 6. Services | 59-70 | 35.99 | 102.97 | -27.95 | -39.04 | 55.12 | 58.33 | -1.73 | -1.47 | -19.14 | 44.64 | -26.21 | - |
| | 70-75 | 161.97 | 152.74 | 4.03 | 5.20 | 149.74 | 143.87 | 2.27 | 3.59 | 12.23 | 8.87 | 1.76 | 1.61 |
| | 75-80 | 355.50 | 232.14 | 69.97 | 53.39 | 279.97 | 229.56 | 14.41 | 36.00 | 75.54 | 2.58 | 55.56 | 17.40 |

## Table A.4

Evolution of Changes (%) - Brazil

| Sector | Period | Output Change | | | Self Generated | | | Non-Self Generated | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 59/70-70/75 | 11.13 | -0.48 | -10.66 | 48.77 | -45.20 | -3.56 | 3.07 | 0.01 | -3.08 |
| | 70/75-75/80 | -15.89 | 18.39 | -2.49 | -41.31 | 40.10 | 1.22 | -6.91 | 15.52 | -8.61 |
| 2. Mining | 59/70-70/75 | 8.87 | -3.83 | -5.05 | -2.32 | 2.92 | -0.60 | 6.69 | -3.38 | -3.30 |
| | 70/75-75/80 | -31.81 | 26.72 | 5.09 | 6.07 | -3.75 | -2.32 | -61.48 | 49.20 | 12.27 |
| 3. Construction | 59/70-70/75 | 8.70 | -4.24 | -4.45 | 0.72 | -0.17 | -0.55 | -7.80 | 10.25 | -2.45 |
| | 70/75-75/80 | -42.82 | 22.55 | 20.27 | -22.09 | 17.76 | 4.33 | -28.14 | -5.96 | 34.10 |
| 4. Manufacturing | 59/70-70/75 | -13.91 | 8.06 | 5.85 | -11.89 | 5.55 | 6.35 | -20.52 | 15.08 | 5.43 |
| | 70/75-75/80 | -15.33 | 14.75 | 0.58 | -10.52 | 12.25 | -1.73 | -9.35 | 12.35 | -3.00 |
| 5. Trade Transp. | 59/70-70/75 | -19.68 | 10.19 | 9.50 | 4.10 | -1.59 | -2.51 | -34.40 | 18.31 | 16.08 |
| | 70/75-75/80 | 9.41 | -5.11 | -4.31 | -14.91 | 10.43 | 4.48 | 8.58 | 3.78 | -12.35 |
| 6. Services | 59/70-70/75 | 33.72 | -13.96 | -19.76 | 1.30 | -1.30 | 0.00 | 31.33 | -9.81 | -21.52 |
| | 70/75-75/80 | -29.00 | 17.19 | 11.81 | -14.09 | 3.63 | 10.46 | -69.09 | 59.19 | 9.90 |

## Table A.5

Growth Rates (%) of Output and of Its Components United States

| Sector | Period | Output Change | | | | Self Generated | | | | Non-Self Generated | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Dem | Tech | Syn | Total | Dem | Tech | Syn | Total | Dem | Tech | Syn |
| 1. Agriculture | 58-63 | 9.97 | 20.33 | -8.17 | -2.19 | 1.21 | 0.71 | 0.48 | 0.01 | 8.76 | 19.61 | -8.65 | -2.21 |
| | 63-67 | 2.89 | 17.36 | -11.78 | -2.70 | -1.08 | -0.80 | -0.28 | 0.01 | 3.96 | 18.16 | -11.49 | -2.71 |
| | 67-72 | 0.46 | 13.20 | -8.87 | -3.88 | 1.31 | 0.66 | 0.63 | 0.02 | -0.85 | 12.55 | -9.50 | -3.90 |
| | 72-77 | 7.25 | 18.38 | -9.34 | -1.78 | 8.29 | 11.24 | -1.97 | -0.98 | -1.04 | 7.13 | -7.37 | -0.80 |
| 2. Mining | 58-63 | 13.04 | 24.26 | -8.91 | -2.31 | 0.30 | 0.33 | -0.03 | 0.00 | 12.74 | 23.93 | -8.87 | -2.31 |
| | 63-67 | 18.48 | 24.00 | -4.34 | -1.19 | 2.32 | 2.35 | -0.02 | -0.01 | 16.16 | 21.65 | -4.32 | -1.18 |
| | 67-72 | -0.28 | 6.12 | -4.08 | -2.32 | -12.63 | -12.61 | 0.02 | -0.04 | 12.35 | 18.73 | -4.10 | -2.27 |
| | 72-77 | -2.83 | -21.57 | 17.56 | 1.18 | -33.51 | -32.47 | -0.17 | -0.87 | 30.68 | 10.91 | 17.73 | 2.05 |
| 3. Construction | 58-63 | 19.06 | 20.13 | -0.89 | -0.17 | 16.43 | 16.51 | -0.07 | -0.01 | 2.63 | 3.61 | -0.82 | -0.16 |
| | 63-67 | 8.72 | 11.16 | -2.04 | -0.41 | 7.55 | 7.61 | -0.06 | -0.01 | 1.17 | 3.55 | -1.98 | -0.40 |
| | 67-72 | 16.61 | 22.25 | -3.64 | -1.99 | 14.84 | 14.96 | -0.11 | -0.02 | 1.77 | 7.28 | -3.54 | -1.97 |
| | 72-77 | 2.81 | -1.11 | 3.73 | 0.19 | -2.87 | -3.34 | 0.49 | -0.02 | 5.67 | 2.23 | 3.23 | 0.21 |
| 4. Manufacturing | 58-63 | 25.80 | 26.30 | -0.52 | 0.02 | 23.19 | 21.30 | 1.47 | 0.42 | 2.60 | 5.00 | -1.99 | -0.40 |
| | 63-67 | 23.70 | 23.95 | -0.14 | -0.11 | 19.34 | 20.59 | -0.99 | -0.26 | 4.36 | 3.35 | 0.85 | 0.16 |
| | 67-72 | 6.48 | 11.24 | -3.25 | -1.51 | 1.56 | 2.86 | -1.25 | -0.05 | 4.92 | 8.37 | -1.99 | -1.47 |
| | 72-77 | 14.52 | 9.14 | 5.04 | 0.34 | 9.50 | 7.23 | 2.07 | 0.20 | 5.02 | 1.91 | 2.97 | 0.14 |
| 5. Trade and Transp. | 58-63 | 17.53 | 21.95 | -3.53 | -0.88 | 14.29 | 14.16 | 0.11 | 0.02 | 3.24 | 7.79 | -3.64 | -0.91 |
| | 63-67 | 23.27 | 23.33 | -0.04 | -0.02 | 17.88 | 17.18 | 0.56 | 0.14 | 5.39 | 6.14 | -0.59 | -0.16 |
| | 67-72 | 8.15 | 13.42 | -2.57 | -2.69 | 5.25 | 5.66 | -0.38 | -0.03 | 2.90 | 7.76 | -2.19 | -2.66 |
| | 72-77 | 24.12 | 16.72 | 6.88 | 0.52 | 15.27 | 14.34 | 0.77 | 0.16 | 8.85 | 2.38 | 6.11 | 0.36 |
| 6. Services | 58-63 | 18.48 | 20.87 | -1.91 | -0.47 | 14.55 | 13.57 | 0.82 | 0.16 | 3.93 | 7.29 | -2.73 | -0.63 |
| | 63-67 | 20.98 | 20.28 | 0.59 | 0.11 | 13.83 | 13.75 | 0.07 | 0.01 | 7.15 | 6.54 | 0.52 | 0.09 |
| | 67-72 | 49.72 | 58.28 | -5.70 | -2.86 | 50.19 | 56.36 | -3.42 | -2.75 | -0.47 | 1.92 | -2.28 | -0.11 |
| | 72-77 | 16.91 | 15.19 | 1.72 | 0.01 | 13.16 | 13.32 | -0.14 | -0.02 | 3.76 | 1.87 | 1.86 | 0.03 |

**Table A.6**

Evolution of Changes (%) United States

| Sector | Period | Output Change | | | Self Generated | | | Non-Self Generated | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dem | Tech | Syn | Dem | Tech | Syn | Dem | Tech | Syn |
| 1. Agriculture | 58/63-63/67 | -11.71 | 10.38 | 1.32 | 14.47 | -14.19 | -0.28 | -8.24 | 7.12 | 1.12 |
| | 63/67-67/72 | -3.66 | -2.82 | 6.47 | -23.06 | 22.47 | 0.58 | -7.77 | 1.11 | 6.66 |
| | 67/72-72/77 | 11.41 | -2.51 | -8.90 | 29.02 | -34.45 | 5.43 | -1.76 | 11.54 | -9.79 |
| 2. Mining | 58/63-63/67 | 12.90 | -10.42 | -2.48 | 8.55 | -8.38 | -0.17 | 11.60 | -9.37 | -2.23 |
| | 63/67-67/72 | -32.41 | 17.91 | 14.50 | 0.75 | -0.70 | -0.06 | -5.15 | 0.44 | 4.71 |
| | 67/72-72/77 | 4.64 | 10.96 | -15.60 | -2.57 | 0.34 | 2.23 | -39.05 | 41.45 | -2.39 |
| 3. Construction | 58/63-63/67 | -12.96 | 10.78 | 2.18 | -0.36 | 0.37 | -0.01 | -18.79 | 15.46 | 3.33 |
| | 63/67-67/72 | -2.23 | -1.93 | 4.16 | 0.03 | -0.08 | 0.05 | -2.93 | -5.74 | 8.67 |
| | 67/72-72/77 | -57.73 | 61.16 | -3.44 | -12.50 | 12.12 | 0.38 | -17.57 | 29.38 | -11.80 |
| 4. Manufacturing | 58/63-63/67 | 0.96 | -1.34 | 0.38 | 2.43 | -1.81 | -0.62 | 9.29 | -7.40 | -1.89 |
| | 63/67-67/72 | -28.71 | 19.71 | 9.00 | -25.48 | 25.58 | -0.11 | -6.12 | -2.68 | 8.80 |
| | 67/72-72/77 | -7.31 | 14.42 | -7.12 | 7.34 | -8.34 | 1.00 | -32.73 | 42.34 | -9.61 |
| 5. Trade and Transp. | 58/63-63/67 | 16.50 | -13.23 | -3.27 | -2.98 | 2.37 | 0.62 | 25.94 | -20.88 | -5.06 |
| | 63/67-67/72 | -27.93 | 13.60 | 14.33 | -2.86 | 3.14 | -0.27 | -27.59 | 8.78 | 18.81 |
| | 67/72-72/77 | -2.50 | 14.76 | -12.26 | 0.69 | -1.22 | 0.53 | -34.64 | 51.67 | -17.02 |
| 6. Services | 58/63-63/67 | 6.94 | -5.40 | -1.54 | 6.17 | -5.16 | -1.01 | 22.95 | -18.29 | -4.65 |
| | 63/67-67/72 | -9.50 | 5.72 | 3.78 | -9.29 | 4.99 | 4.30 | -46.88 | 45.52 | 1.35 |
| | 67/72-72/77 | 2.61 | 1.64 | -4.25 | 8.62 | -4.40 | -4.22 | 5.14 | -3.26 | -1.88 |