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APPENDIX A

THEORETICAL DISCUSSION OF SECTOR SHIFTS IN EMPLOYMENT

In a tautological sense, the difference between the rates of growth of employment in the Service sector and in the rest of the economy (called "goods" for short) is equal to the difference in the rates of growth of output minus the difference in the rates of growth of output per man, i.e.,

$$(\dot{E}_s - \dot{E}_g) \equiv (\dot{O}_s - \dot{O}_g) - (\dot{P}_s - \dot{P}_g) \tag{1}$$

where E equals employment, O equals output, P equals output per man, the dot denotes percentage rates of change, and the subscripts s and g indicate the service and goods sectors.

This formulation is an oversimplification because it fails to specify the determinants of the differential changes in output and output per man and it assumes that these differentials are independent of one another. By pursuing each of these questions, we can identify the information that would be needed to provide a more satisfactory nontautological explanation of sector differentials in employment growth.

Assuming tastes constant, the change in output of each sector depends upon the change in per capita real income ($\dot{Y}$), the income elasticities of demand (n) for goods and services, the change in the price ($\dot{R}$) of goods relative to services and the elasticity of substitution (e_{sg}) between goods and services.

$$(\dot{O}_s - \dot{O}_g) = f[\dot{Y}, n_s, n_g, (\dot{R}_s - \dot{R}_g), e_{sg}] \tag{2}$$

The differential rate of change of price depends upon the differential rate of change of the nominal price ($\dot{N}$) and the rate of growth of real wages ($\dot{W}$) (a good measure of the value of time) and the time intensity of goods relative to services, (t).[1]

$$(\dot{R}_s - \dot{R}_g) = f[(\dot{N}_s - \dot{N}_g), \dot{W}, t_s, t_g] \tag{3}$$

[1] See Gary S. Becker, "A Theory of the Allocation of Time," *Economic Journal*, September 1965, pp. 493–517.

The differential rate of change of the nominal price will, under competitive conditions, be approximately equal to the differential rate of change of output per unit of total factor input ($\dot{T}$) with the sign reversed.[2] The latter will depend upon the rates of change of technology ($\dot{A}$) (sometimes referred to as the advance of knowledge) and the economies of scale (c) that can be realized from changes in output, i.e.,

$$(\dot{N}_s - \dot{N}_g) = -(\dot{T}_s - \dot{T}_g) = f[(\dot{A}_s - \dot{A}_g), \dot{O}_s, \dot{O}_g, c_s, c_g] \tag{4}$$

The differential rate of change of output per man ($\dot{P}_s - \dot{P}_g$) depends upon the same variables as does the differential for output per unit of total factor input, plus the differential in the rate of change of capital (physical and human) per man ($\dot{K}$) in the two sectors, the initial level of hours per man (H), and the change in hours (ΔH).[3]

$$(\dot{P}_s - \dot{P}_g) = f[(\dot{T}_s - \dot{T}_g), (\dot{K}_s - \dot{K}_g), H_s, H_g, \Delta H_s, \Delta H_g] \tag{5}$$

Combining the five equations we find that

$$(\dot{E}_s - \dot{E}_g) = f[\dot{Y}, (\dot{A}_s - \dot{A}_g), (\dot{K}_s - \dot{K}_g), n_s, n_g, c_s, c_g, e_{sg}, t_s, t_g, H_s, H_g, \Delta H_s, \Delta H_g] \tag{6}$$

The above assumes that the price of labor (W) and the price of capital (I) change at the same rate, and that the differential change in capital intensity is attributable only to factor bias in the character of technological change (B). If relative factor prices change, the change in capital per man could be a function of sector differences in the elasticity of substitution of capital for labor (m) and the factor proportions in the initial year (K) as well.

$$(\dot{K}_s - \dot{K}_g) = f[(\dot{B}_s - \dot{B}_g), K_s, K_g, \dot{W}, \dot{I}, m_s, m_g] \tag{7}$$

Moreover, when $\dot{W}$ differs from $\dot{I}$, and K_s differs from K_g, the differential rate of change of price ($\dot{R}_s - \dot{R}_g$) will depend upon these variables as well as those indicated in (3).

We know that $\dot{W}$ did differ from $\dot{I}$ over the period 1929–65 and that K_s was not equal to K_g. Therefore, we combine (6) and (7) and obtain

$$(\dot{E}_s - \dot{E}_g) = f[\dot{Y}, (\dot{A}_s - \dot{A}_g), (\dot{B}_s - \dot{B}_g), K_s, K_g, \dot{W}, \dot{I}, n_s, n_g, c_s, c_g\ e_{sg}, m_s, m_g, t_s, t_g, H_s, H_g, \Delta H_s, \Delta H_g] \tag{8}$$

[2] See p. 83.

[3] Both the initial level and the change in hours are relevant because the changes in output per man-hour that presumably accompany changes in hours are likely to vary depending upon the initial level.

This says that the sector differential in rates of growth of employment depends upon:

1. The rate of growth of per capita real income in the total economy.
2. The difference in rates of growth of technological change.
3. The differences in the factor bias of technological change.
4. The capital/labor ratios in the two sectors.
5. The rate of growth of the price of labor.
6. The rate of growth of the price of capital.
7. The income elasticities of demand for goods and services.
8. The potential economies of scale in goods and services.
9. The elasticity of substitution between services and goods.
10. The elasticities of substitution between capital and labor in each sector.
11. The time intensities of goods and services.
12. The initial level of hours per man in each sector and the changes in hours.

Additional realism could be introduced by recognizing that the price of labor (W), probably did not change at the same rate in both sectors because of the greater impact of unionization and minimum wage legislation on the goods-producing industries. Thus we should have two prices for labor in the equation, $\dot{W}_s$ and $\dot{W}_g$.