A Time-Series Analysis of Self-Employment in the United States

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In the early 1970s the proportion of the nonagricultural labor force self-employed in the United States ceased its downward trend and has been rising ever since. This study provides an analysis of the causes of this change. A general equilibrium model of self-employment and wage employment is analyzed, and aggregate U.S. time-series data are used to test predictions derived from the model. The empirical analysis indicates that changes in technology, industrial structure, tax rates, and social security retirement benefits have contributed to the reversal of the previous downward trend, which had persisted for over a century.

I. Introduction

One of the most widely observed trends in labor force composition is the declining proportion of self-employed workers in the labor force. This trend can be observed in international cross-section data by comparing countries at different levels of development and in aggregate time-series data for the United States and other developed countries.[1]

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[1] The available international cross-section and time-series data are in the International Labour Organization (ILO) *Yearbook of Labour Statistics*. The aggregate time-series data for the United States are from the Current Population Survey (CPS) and are available in various Bureau of Labor Statistics and Census Bureau sources. See the Appendix for a description of the data sources used in this paper.

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Even in most developing countries, where self-employment is typically a much larger proportion of the labor force than in developed countries, the trend is away from self-employment.[2]

The decline in the proportion of the labor force self-employed appears consistent with the existence of economies of scale and specialization of labor possible only in relatively large enterprises. As income grows and markets expand during the course of economic development, larger enterprises are able to bid workers away from self-employment. This explanation is based on characteristics of technology and is reinforced by the observation that technological change has itself been biased toward capital-intensive, large-scale production methods for many decades in response to rising relative labor costs.

The decline in self-employment also coincides with a shift of the labor force away from agriculture, where self-employment is universally more common than in nonagricultural activities. The portion of the decline in self-employment due to this sectoral shift in the labor force is also thought to be attributable in part to technology. Engel effects imply that rising income yields relatively slow growth in demand for food and other agricultural products compared with nonagricultural products. Since economies of scale are generally absent in agriculture, labor shifts from a sector in which self-employed workers can compete with relative ease against larger firms to sectors in which this is generally more difficult.[3]

Even within the nonagricultural sector self-employment has typically declined over time, and it is this sector that is the subject of the present paper. While both the proportion of the labor force in agriculture and the proportion of self-employed workers in agriculture have continued to decline up to the present in the United States, the proportion of self-employed workers in the nonagricultural labor force bottomed out in the early 1970s and has been rising ever since. This is illustrated in figure 1 for both male and female workers.[4]

[2] Blau (1986) documents this for the case of Malaysia using retrospective labor market histories.

[3] Many studies of agricultural production functions have confirmed the prevalence of constant returns to scale in agriculture (see, e.g., Heady and Dillon 1961; Bardhan 1973).

[4] The self-employed consist of independent owner-operators, proprietors, and partners. A worker is counted as self-employed if he or she is self-employed on the primary job, i.e., the job that occupies the largest number of hours per week. As described in the Appendix, the CPS counts owner-operators of incorporated businesses as wage-salary employees rather than self-employed workers. However, since these workers resemble the self-employed much more closely than employees, they have been reclassified here as self-employed. Other measures of self-employment available from the CPS, such as the proportions of the labor force with (*a*) any self-employment earnings, (*b*) only self-employment earnings, and (*c*) both self-employment and wage-salary earnings, show trends similar to those in fig. 1.

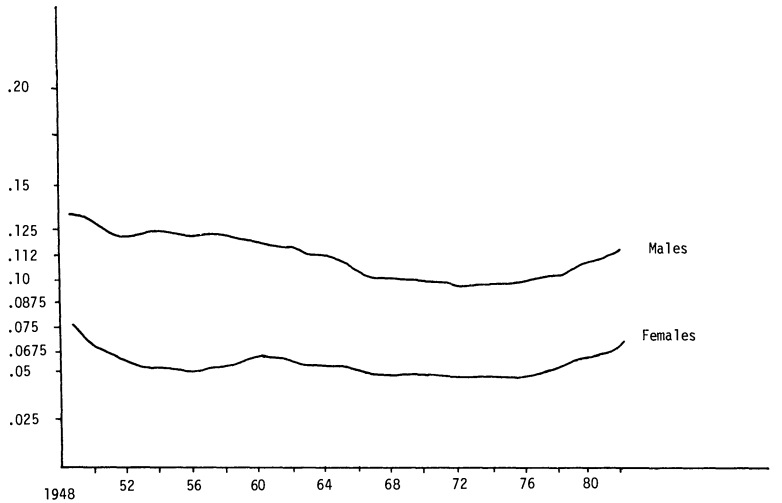

FIG. 1.—Proportions of the male and female labor forces self-employed, 1948–82. See the Appendix for data sources.

Several points about this phenomenon may be noted. First, it has apparently not been widely recognized by economists, although two recent articles from the Bureau of Labor Statistics have called attention to it.[5] Second, although figure 1 shows the data only back to 1948, the downward trend in self-employment appears to have been steady for at least a century prior to 1970.[6] The reversal of the trend in the last decade is therefore all the more striking. Third, a similar reversal of long-run declining trends in nonagricultural self-employment occurred in Japan and several European countries at roughly the same time as in the United States.[7] This rather remarkable simultaneous occurrence strongly suggests that a change of a fundamental nature has occurred in the advanced industrial economies that has made self-employment more attractive and/or competitive. The goal of this paper is to provide an initial analysis of the nature and causes of this change in the case of the United States.

[5] See Fain (1980) and Becker (1984). Long (1982) mentions the phenomenon in passing. A recent labor economics textbook states that self-employment is still declining as a proportion of the labor force (Hamermesh and Rees 1984, p. 356).

[6] See Phillips (1962, chap. 2) for a summary and discussion of the historical trends.

[7] This statement is based on ILO data for Japan, France, West Germany, and Italy. Although precise dates are difficult to establish because of the absence of data for some years, the trough in self-employment occurred around the early 1970s in Japan, in 1975 in France and Germany, and in 1971 in Italy. Self-employment is defined somewhat differently for some of these countries than in the United States.

There have apparently been no analytical studies of the long-run trend in self-employment. Phillips (1962) provided a comprehensive descriptive analysis of self-employment in the United States that remains a very useful source of information on the self-employed. Long (1982), Moore (1983*b*), and Rees and Shah (1986) estimate the determinants of the choice of self-employment using cross-sectional microdata but have little to say about trends over time.[8] Quinn (1980) and Fuchs (1982) both draw attention to the strong positive relationship between age and self-employment and show that flexibility in hours worked contributes to a significantly higher propensity for self-employed older workers to postpone retirement compared with wage-salary workers. Other studies have used comparisons between self-employed and wage-salary workers to make inferences about education and screening (Wolpin 1977) and labor market discrimination (Moore 1983*a*).

This study proposes a model within which the effects of a variety of possible causes of the reversal in the long-run trend away from self-employment may be analyzed and uses aggregate U.S. time-series data to test predictions derived from the model. The main hypotheses considered include the following: (*a*) Recent changes in industrial structure have favored industries in which small firms are viable and scale economies are relatively unimportant. In addition, changes in technology, such as personal computers, have made small firms more competitive in many industries. (*b*) Relative prices have shifted in favor of industries in which self-employment is relatively common, inducing growth in such industries relative to others.[9] (*c*) Rising marginal tax rates have made self-employment more attractive because of the ease of underreporting income from self-employment compared with wage-salary earnings.[10] (*d*) Increased wage rigidity has increased the proportion of the labor force that resorts to self-employment as a response to being rationed out of wage jobs. (*e*) Rising real retirement benefit levels under the Old Age Security and Disability Insurance (OASDI) program have increased the rate at which older workers shift from wage-salary to self-employment in order to obtain greater flexibility in hours worked and "partially retire." In addition, higher

[8] The goal of the Long and Moore studies is to determine the effects of personal income taxes and payroll taxes on self-employment. This issue will be addressed here as well. For models of the choice of self-employment in the developing country context, see Vijverberg (1983) and Blau (1985).

[9] Industries in which self-employment is relatively common include services of various kinds and retail trade.

[10] See Carson (1984) and the references therein for a recent discussion of the prevalence of underreporting of income from various sources. See also Long (1982) and Moore (1983*b*) on this topic.

OASDI benefits have made full retirement more attractive, and it is wage-salary workers that are most likely to fully retire in response to such a change (Quinn 1980; Fuchs 1982).

The empirical analysis in this study reveals that the most important causes of rising self-employment in the past decade are changes in industrial structure and technology. Some speculation is offered below regarding the reasons for these changes, but it is not possible to identify the precise sources of the changes. This is an important topic for future research. The empirical results also show that changes in marginal tax rates have contributed to rising self-employment, but in a rather surprising way that has not been noted in previous studies of taxes and self-employment. Most of the other factors mentioned above are also shown to have contributed to some extent to rising self-employment.

Section II presents and analyzes a general equilibrium model of the determinants of self-employment. Section III discusses econometric estimation issues and describes the data. Section IV presents and discusses the empirical results, and Section V summarizes and concludes the paper.

II. A General Equilibrium Model of Self-Employment

The model presented in this section is intended to yield predictions concerning the effects of several key variables on the proportion of the labor force self-employed. These variables include relative prices, technology, and tax structure. In addition, the model yields expressions for the effects of these variables on the earnings of self-employed workers and employees.

The structure of the model is simple. The economy has two sectors, self-employment and wage employment, which are assumed to produce different goods.[11] Workers are heterogeneous and choose which sector to join on the basis of utility maximization subject to (among other things) their endowment of one or more characteristics such as managerial ability that are distributed among workers according to

[11] In some industries the self-employed may in fact specialize in producing products that larger firms with employees do not produce. For example, self-employed lawyers might specialize in divorces or accident claims while large law firms are more likely to provide legal services for corporations. For analytical convenience this assumption is maintained, although it may be inaccurate for industries such as housecleaning, in which self-employed individuals compete against larger commercial establishments to provide the same service.

some distribution function. There is no uncertainty and no time in the model.[12]

Below, a number of further simplifications are imposed in order to make the results as transparent as possible. These simplifications include exogenous goods prices, no capital, fixed leisure, no unearned income, no unemployment, no wage distortions, no taxes, and only one degree of heterogeneity. The consequences of dropping these simplifications are briefly discussed below.

A typical worker is assumed to maximize the utility of income, $U(Y)$. Income is earned by working h hours as a wage employee at wage rate W, which is exogenous to the worker, or by becoming self-employed and producing output Q according to a production function

$$Q = Q(L; M, T), \tag{1}$$

where L is labor input, M is the individual's endowment of managerial ability, and T is an index of the state of technology. This formulation assumes that it is possible to separate an individual's input of time from his or her managerial ability and that individuals are homogeneous in all respects other than their endowments of managerial ability. The production function is assumed to be concave in L, M, and T, with $Q(0; M, T) = 0$. It is assumed that the self-employed do not hire labor, although this assumption can be relaxed without changing the basic results.[13] The individual chooses a value for L, while M and T are given. Note that managerial ability is assumed to earn no return in wage employment.

Income is

$$Y = Wh + PQ, \tag{2}$$

where P is the price of Q.

The individual chooses a value for L to maximize $U(Y)$ subject to (1), (2), and the time constraint

$$L + h = 1, \tag{3}$$

where each individual is assumed to supply one unit of labor inelastically. The interior solution to this problem is straightforward and

[12] A previous model of self-employment by Kanbur (1979) made uncertainty concerning one's own endowment of managerial ability the centerpiece of an analysis of the effects of risk aversion on income distribution. In the present context this issue is not of concern, so it is assumed that workers know their own managerial ability. For the time-series analysis described below, this assumption is misleading only to the extent that either the relative uncertainty of returns in self-employment compared with wage employment or the average degree of risk aversion in the economy has changed systematically over time.

[13] The typical self-employed worker does not have any full-time employees (see Phillips 1962). For models with hired labor, see Kanbur (1979) and Blau (1985).

can be expressed in the form of a labor supply to wage employment function:

$$h = h(\overset{+}{W}, \bar{P}, \bar{T}, \bar{M}), \tag{4}$$

with the signs of partial derivatives indicated above each variable.

This formulation embodies the assumption that an individual can work in both sectors at once. As described in the following section, this does occur in practice but is relatively infrequent. Since the corner solutions $L = 1$ and $h = 1$ are common, they are analyzed extensively below.

Labor demand in the wage employment sector is assumed to be generated by profit maximization subject to an aggregate production function $G = G(H)$, where G is output and H is aggregate labor input. Technology is fixed in this sector, so T is interpreted as the state of technology in the self-employment sector relative to technology in the wage employment sector. Profits in this sector are $G - WH$, where G is treated as the numeraire good, with a unit price. Maximization of profits subject to the production function yields a labor demand function $H = H(W)$, with $H' < 0$.

General equilibrium in this model occurs when the wage rate is such that the demand for labor hours in the wage employment sector equals the supply of labor hours to this sector. Let the cumulative distribution function of managerial ability in the labor force be $F(M)$, with associated density function $f(M)$. With the size of the labor force fixed at unity, the labor market equilibrium condition is

$$H(W) = \int_{-\infty}^{\infty} h(W, P, T, M) f(M) dM. \tag{5}$$

The solution to this equation is a wage function

$$W = W(\overset{+}{P}, \overset{+}{T}), \tag{6}$$

with the signs of partial derivatives indicated above each variable.[14] Increases in the (exogenous) relative price and state of technology in the self-employment sector reduce the supply of labor hours to the wage employment sector and therefore bid the wage up.

As discussed in the next section in more detail, the basic data available to estimate the model do not include hours of work but do include fractions of the labor force in various employment categories and median earnings of workers by employment category. These endogenous variables can be defined in terms of the model as follows.

[14] The wage function as expressed in (6) assumes a stationary distribution of M, so the moments of the distribution do not appear in (6) since they are constants.

Let M^*, M^{**}, and M^{***} be critical values of M defined by

$$h(W(P, T), P, T, M^*) = \tfrac{1}{2}, \tag{7}$$

$$h(W(P, T), P, T, M^{**}) = 0, \tag{8}$$

$$h(W(P, T), P, T, M^{***}) = 1, \tag{9}$$

where M^* is the value of M for which a worker finds it optimal to divide his or her time equally between self- and wage employment. In the data used in this paper, a worker is classified as self-employed if $h \leq \tfrac{1}{2}$ and as a wage employee if $h > \tfrac{1}{2}$. Hence the fraction of the labor force classified as self-employed is simply $N_s = 1 - F(M^*)$. The term M^{**} is the value of M above which it becomes optimal to be fully self-employed, so the fraction of the labor force that is self-employed only (i.e., earns no wage income) is $N_{so} = 1 - F(M^{**})$. Finally, M^{***} is the value of M below which full-time wage employment is optimal. The fraction of the labor force that has any earnings from self-employment (including some workers classified as wage employees but who are self-employed on a second job) is $N_{sa} = 1 - F(M^{***})$.[15]

In order to determine the effects of changes in the exogenous variables on these labor force fractions, the effects of the exogenous variables on M^*, M^{**}, and M^{***} must first be determined. To illustrate for the effect of T on M^*, differentiating (7) with respect to M^* and T and rearranging the result yields

$$\frac{dM^*}{dT} = \frac{-(h_W W_T + h_T)}{h_M}, \tag{10}$$

where the subscripts represent partial derivatives. This effect is ambiguous in sign, consisting of a negative direct effect, $-h_T/h_M$, and a positive indirect effect via the effect of T on W, $-h_W W_T/h_M$. An increase in T raises the return to self-employment and therefore directly reduces the critical value of M above which it becomes optimal to spend the majority of work time self-employed. But T has a positive effect on W, and increases in W raise this critical value of M. However, it is easy to show that the negative direct effect dominates the positive indirect effect if the aggregate demand curve for labor in the wage employment sector, $H(W)$, is downward sloping, as assumed above. All the exogenous variables have effects on M^* similar in form to (10). With $H' < 0$, the signs of the partial derivatives of M^* with respect to the exogenous variables P and T are given in (11):

$$M^* = M^*(\bar{P}, \bar{T}). \tag{11}$$

[15] Although it may appear redundant to analyze all three of these self-employment proportions, it turns out that a test of the model can be developed involving cross-equation restrictions on the equations for these three variables. Hence it is worthwhile considering all three. The test is described in Sec. III.

The effects of the exogenous variables on M^{**} and M^{***} are identical to those for M^* not only in sign but in exact form as well. That is, for example, $dM^{***}/dP = dM^{**}/dP = dM^*/dP$. The reason for this is that equations (7), (8), and (9), which define these critical values of M, differ only by constants. This fact will be exploited in the next section to provide a test of the model.

With the results in (11) and the corresponding results for M^{**} and M^{***}, it is straightforward to show that, for example, $dN_s/dT = -f(M^*)dM^*/dT > 0$ and that in general

$$N_s = N_s(\overset{+}{P}, \overset{+}{T}). \tag{12}$$

Similar functions exist for the other two self-employment fractions with partial derivatives of the same signs as those indicated in (12). Hence, the model confirms the intuition that increases in relative prices or technology in the self-employment sector cause increases in the fraction of the labor force self-employed.

Other observable variables that can be defined in terms of the underlying model include average earnings of workers in various employment categories. For example, average earnings of workers classified as self-employed are

$$Y_s = \frac{1}{1 - F(M^*)}\left[P\int_{M^*}^{\infty} Q(L(W(\cdot), \ldots), T, P, M)f(M)dM + W(\cdot)\int_{M^*}^{\infty} h(W(\cdot), T, P, M)f(M)dM\right], \tag{13}$$

where $L(W(\cdot), \ldots) = 1 - h(W(\cdot), \ldots)$. Average self-employment earnings of all workers with any self-employment earnings are found by replacing M^* with M^{**} in (13) and omitting the second term. Analogous expressions can be defined for wage-salary workers. Derivatives of these expressions with respect to T and P do not in general yield unambiguous predictions. This is attributable to the fact that, while increases in T and P raise average earnings of those who were already self-employed, new entrants to the self-employment sector are attracted as well. The new entrants have lower average managerial ability and therefore tend to pull average earnings down. If the latter effect is relatively small, then increases in T and P raise average earnings of the self-employed, and since they also bid up the wage rate, as previously shown, average earnings of wage-salary workers rise as well. Intuition suggests that increases in T and P will raise earnings of the self-employed relative to wage-salary workers, but this cannot be demonstrated unambiguously.

The model presented above is extremely simple and yields fairly strong, testable predictions concerning the effects of prices and technology on the allocation of workers between self- and wage employ-

ment. Other features that can be included in the model without qualitatively altering the main results are endogenous leisure, capital, and taxes.[16] Relaxing the assumption of an exogenously given relative price of goods (P) yields an intractable model. Although analytical results with P endogenous cannot be obtained, the empirical analysis treats P as an endogenous variable. Allowing for a different source of heterogeneity, such as tastes for self-employment, leaves the results unchanged if there is only one source of heterogeneity, but if two or more unobservables are included, the model loses its predictive power. Thus the single-unobservable structure of the model is an important simplification, and it is shown in Section III that it can be tested against a more complex structure. Any source of wage rigidity that prevents the economy from reaching equilibrium, such as a minimum wage, induces a greater amount of self-employment than in the absence of such rigidity, as workers who are rationed out of wage employment move into self-employment. No attempt has been made to model life cycle issues, but the empirical analysis incorporates some variables that are intended to capture life cycle effects.

III. Econometric Specification and Data

Two approaches to econometric specification and estimation of the model described above are possible. The full-information approach would involve specifying functional forms for the utility and production functions and for $F(M)$, adding disturbances in the utility and production functions, solving explicitly for the reduced forms of the observable endogenous labor force fractions and earnings variables in terms of the structural parameters and disturbances, and estimating the model by maximum likelihood with the numerous linear and nonlinear cross-equation restrictions implied by the model imposed and tested. This method is not feasible in this case because even the simplest reasonable forms for the production functions result in intractable expressions for the endogenous variables, with no closed-form solutions at all in some cases.

The alternative approach is to specify linear (or other) approxima-

[16] Proportional tax rates on self-employment and wage-salary income, as well as payroll taxes, can be included in the model easily and with predictable effects on the fraction of the labor force self-employed. It has been speculated that the major effect of the tax system on self-employment occurs because of the presumed greater ease of underreporting self-employment income compared with wage-salary income (Long 1982). This effect is difficult to test directly, but if the incentive to underreport income rises with tax rates, then as tax schedules change over time it would be possible in principle to detect an effect on the fraction of the labor force self-employed. This effect is tested for in the empirical section.

tions to the reduced-form equations and estimate them by ordinary least squares or generalized least squares, depending on the properties of the disturbances, with any linear restrictions on reduced-form parameters implied by the model imposed and tested. This approach does not provide estimates of structural parameters but does permit estimates of the net effects of the exogenous variables. This approach is followed here, and it will be shown below that with one additional assumption it is possible to test a number of linear cross-equation parameter restrictions implied by the structural model. The empirical specification of the reduced-form model follows directly from the nature of the structural model.

Consider the following specification of reduced-form equations (based on the simplest version of the model) for the ith labor force fraction and average earning variable in year t:

$$N_{it} = a_{0i} + a_{1i}P_t + a_{2i}T_t + e_{it}, \tag{14}$$

$$Y_{it} = b_{0i} + b_{1i}P_t + b_{2i}T_t + u_{it}, \tag{15}$$

where e_{it} and u_{it} are disturbances, and the variables are as defined previously. If these equations are interpreted as linear approximations to the equations derived from the model in Section II, then the parameters can be interpreted as estimates of the comparative static derivatives. Under this interpretation a number of linear cross-equation restrictions on the parameters of the labor force fraction equations are implied by the model. Consider N_s and N_{so}, the fractions of the labor force classified as self-employed and self-employed only, respectively, and let $i = 1$ represent the former and $i = 2$ the latter. From the definitions of these fractions ($N_s = 1 - F(M^*)$, $N_{so} = 1 - F(M^{**})$) and with (12) and (13), it is easily shown that

$$a_{11} = \frac{dN_s}{dP} = -f(M^*)\frac{h_W W_P + h_P}{h_M},$$

$$a_{12} = \frac{dN_{so}}{dP} = -f(M^{**})\frac{h_W W_P + h_P}{h_M}$$

so that $a_{11}/a_{12} = f(M^*)/f(M^{**})$. If a form is specified for the cumulative distribution function (cdf) $F(\cdot)$, then M^*, M^{**}, $f(M^*)$, and $f(M^{**})$ can be calculated from, say, the mean values of N_s and N_{so}, using the inverse of the cdf. Hence the linear constraint $a_{11} - a_{12}[f(M^*)/f(M^{**})] = 0$ can be imposed and tested. Similar restrictions apply across the other labor force fraction equations for each of the exogenous variables. Testing this set of restrictions implied by the theory essentially amounts to a test of the one-factor structure of the model, with managerial ability as the single latent variable. A more complex structure, for example, with an unobserved taste factor for owning one's own

business in addition to managerial ability, yields much more complicated relationships among the parameters. Hence the greatly simplified structure of the model implied by having a single unobservable is testable.[17]

The model is estimated with aggregate annual time-series data for men in the United States for the period 1948–82.[18] The labor force fractions and average earnings variables are from the Current Population Survey, as described in the Appendix.[19]

Several of the empirical counterparts to the exogenous variables require explanation. The theoretical model postulates that it is possible to define prices and technology separately for the self-employment and wage employment sectors, as if the two sectors produced different goods. In practice, of course, the self-employed are found in the same industries as wage employees, producing products and services that are often similar if not identical to those produced by large firms in the same industries. However, the self-employed are disproportionately concentrated in certain industries, and this provides some leverage for calculating price and technology indexes specific to the self-employed.[20] Letting T_i represent the total factor productivity (TFP) index for industry i and s_i the proportion of total self-employment accounted for by industry i, define the self-employment TFP index T_s as

$$T_s = \sum_{i=1}^{n} s_i T_i; \sum_{i=1}^{n} s_i = 1,$$

where n is the number of industries. Similarly define a wage employment TFP index T_e as

$$T_e = \sum_{i=1}^{n} e_i T_i; \sum_{i=1}^{n} e_i = 1,$$

[17] In practice, the restrictions could also be rejected if either the assumed linearity of the reduced-form equations or the assumed form for the cdf is inappropriate.

[18] Some of the data cover a slightly shorter period, as discussed below. Estimates for women were also performed, but the results are omitted for the sake of brevity.

[19] One difficulty with the data for this analysis is that a significant change in the definition of self-employment occurred in 1967. Prior to 1967 individuals who reported themselves self-employed and who owned incorporated businesses were classified as self-employed. Since 1967 these individuals have been classified as employees because technically they are employees of their own corporations. Periodically, estimates of the number of such individuals have been published, and I have used these estimates together with interpolations for missing years to calculate corrected fractions self-employed that include the incorporated self-employed for the entire 1948–82 period. See the Appendix for the exact description of the method used to estimate the number of incorporated self-employed. It was not possible to adjust the earnings variables in a corresponding way.

[20] The price index, which was calculated in a manner analogous to the technology index described in the text, was not used as an explanatory variable in the reduced-form estimation in recognition of the fact that it is likely to be endogenous.

where the e_i are defined analogously to the s_i for wage employment. The relative self-employment TFP index is then $T = T_s/T_e$.[21]

It is interesting to note that this index of relative technology can at best explain only the part of the economywide change in self-employment proportions due to interindustry shifts in employment. By construction it cannot account for within-industry changes in the proportion self-employed. Hence, if this index does help explain changes in the aggregate proportion self-employed, it is a strong indication that technology plays an important role in determining choice between self- and wage employment. The trend in the proportion self-employed within industries has in several cases mirrored the aggregate trend. Explaining these intraindustry trends would provide considerable additional support for the proposed model, but lack of data prevents the calculation of self-employment-specific technology indexes for each industry.

Other exogenous variables in the model include tax rates on self-employment earnings and wages. The main effect of higher tax rates is expected to be an increase in self-employment due to the increased attractiveness of underreporting income at higher tax rates and the presumed greater ease of underreporting self-employment income relative to wage-salary income. Therefore, marginal tax rates under the personal income and payroll taxes are used to represent tax rates facing workers who must choose between self- and wage employment. Since the personal and payroll tax schedules are nonlinear (the latter because of the ceiling on income subject to the payroll tax), it is not easy to summarize them in a single parameter. Instead, marginal tax rates for the combined personal income and payroll taxes have been calculated for two annual income levels in each year, the real equivalents of $7,000 and $17,000 in 1967 (the consumer price index [CPI] base year).[22] These income levels were equivalent to $20,237 and $49,147, respectively, in 1982 and are intended to represent typical moderately low and high income levels. The two marginal tax rates are illustrated in figure 2.

Several other variables suggested by the discussion in Section II are included in the specification reported below. The minimum wage (in real terms) measures the effects of possible wage rigidity on self-

[21] The weights used in calculating T (s_i and e_i) change over time. The models reported below were reestimated with a fixed-weight index using the 1950, 1960, 1970, and 1980 weights alternatively. The results were not materially affected by this change.

[22] No deductions were allowed, so these two income levels should be interpreted as taxable income, not gross income. The statutory tax rates used here are preferable to the data available on actual tax rates paid since the latter are average rather than marginal and may be affected by both the allocation of workers between self- and wage employment and the allocation of self-employment income between profits and salary in the case of incorporated businesses.

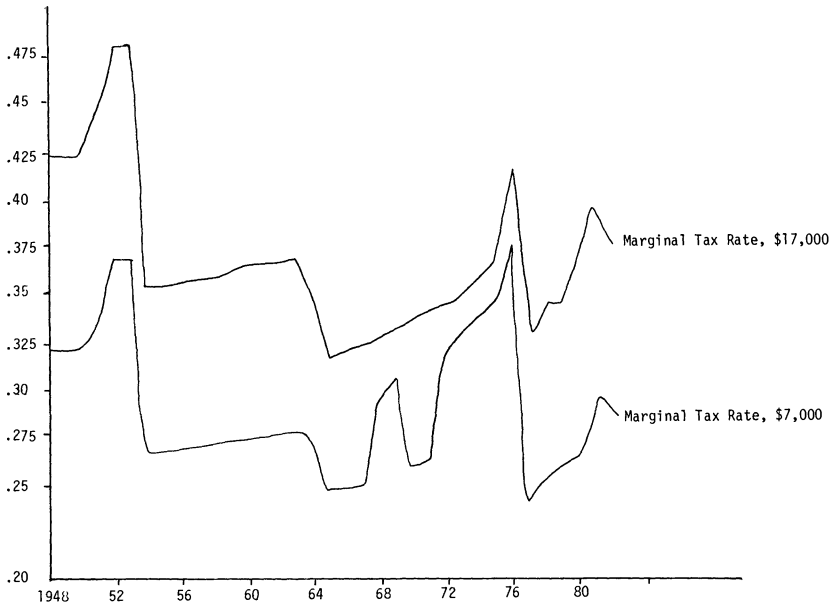

FIG. 2.—Marginal tax rates at the real equivalents of $7,000 and $17,000, 1967 dollars, 1948–82. The tax rates include both the personal income tax and the payroll tax.

employment. The average age of the labor force is included to capture the effects of changing age structure of the labor force under the assumption that life cycle effects are important. Finally, the average monthly social security benefit in real terms under the OASDI program is included to test for the possibility that increases in retirement benefits induce increases in self-employment.

IV. Empirical Results

A. *Self-Employment Fractions*

Table 1 presents estimates of the determinants of fractions of the male labor force in each of the self-employment categories defined earlier.[23] The three self-employment fractions are highly correlated and have all exhibited an upturn in recent years. Estimates for all

[23] The estimates were corrected for serial correlation using a variant of the Cochrane-Orcutt procedure contained in Statistical Analysis System (SAS). In the majority of cases first-order serial correlation was present, and second-order serial correlation was also present in a few cases. The only occupational groups that can be identified separately in the aggregate time-series data are professional/technical and managerial workers. Estimates for these groups are qualitatively very similar to those in table 1.

TABLE 1

LINEAR REGRESSION ESTIMATES OF THE DETERMINANTS OF FRACTIONS OF THE MALE LABOR FORCE IN VARIOUS SELF-EMPLOYMENT CATEGORIES

	Self-employed	Any Self-Employment Earnings	Only Self-employed
Intercept	.01	−.34**	−.16
	(.10)	(.15)	(.17)
TFP ratio	.129	.266**	.227*
	(.097)	(.103)	(.126)
MTR-7	−.137***	−.140***	−.185***
	(.039)	(.039)	(.048)
MTR-17	.156***	.186***	.169**
	(.044)	(.052)	(.062)
Average age	−.0005	.0024	.0006
	(.0023)	(.0036)	(.0042)
OASDI	.00004	.00060***	.00013
	(.00009)	(.00015)	(.00018)
Minimum wage	−.019***	.025***	−.015
	(.007)	(.008)	(.010)
Dummy: 1967–82	−.010***	.008**	−.027***
	(.004)	(.004)	(.004)
R^2	.89	.95	.95

NOTE.—Standard errors are in parentheses. The TFP ratio is for self-employment relative to wage-salary employment. The marginal tax rates at $7,000 and $17,000 real income equivalents were calculated as described in the text. See the Appendix for descriptions of average age, OASDI, and minimum wage.

* Coefficient estimate is statistically significant at the 10 percent level.

** Coefficient estimate is statistically significant at the 5 percent level.

*** Coefficient estimate is statistically significant at the 1 percent level.

three are presented because the structural model implies a set of linear cross-equation restrictions, which are imposed and tested below. The three fractions measure related but distinct aspects of self-employment and are of equal interest. The TFP ratio has positive effects on all the self-employment measures, with coefficient estimates that are statistically significant twice. This indicates the possible importance of changes in technology and/or industrial structure in explaining the recent upturn in self-employment.

The coefficient on the marginal tax rate (MTR) at $17,000 (1967 dollars) is positive and statistically significant in each equation, while the coefficient on the MTR at $7,000 is negative and significant. Increases in tax rates at high income levels induce shifts toward self-employment, as hypothesized by Long (1982) and others, but the opposite is true at lower income levels. The positive coefficients on MTR-17 are consistent with the notions discussed above that higher tax rates increase the incentive to underreport income and that it is easier to underreport income from self-employment than from wage employment. The negative effect of MTR-7 is puzzling. The two tax

rates are highly correlated, as figure 2 illustrates, and omitting MTR-7 from the equations reduces dramatically the magnitude and significance of the MTR-17 coefficients. Thus it is not apparent whether the negative effect of MTR-7 has an economic explanation or is a statistical artifact. Because the two tax rate coefficients are fairly close in absolute value, uniform changes in marginal tax rates at all income levels have little impact on self-employment. However, it is shown below that changes in tax rates could have contributed substantially to recent changes in self-employment because of the highly nonuniform nature of recent tax rate changes.

The average age of the labor force is estimated to have mixed effects on the self-employment proportions and is never statistically significant.

The estimated effect of the OASDI benefit level is positive in each case and is statistically significant once. This finding is consistent with the notion that higher real retirement benefit levels will induce disproportionately greater retirement by wage-salary workers compared with self-employed workers and will increase the rate at which older workers shift from wage-salary employment to self-employment. These results confirm the findings of Quinn (1980) and Fuchs (1982) that self-employment is an attractive way for older workers to partially retire, given the increased incentive to retire provided by higher real retirement benefits and the penalty for full-time work imposed by the social security earnings test.

The real minimum wage has mixed effects on self-employment, with two out of the three coefficient estimates negative. The theoretical model predicted a positive effect of the minimum wage on self-employment, and these empirical results do not provide much support for this prediction. The minimum wage variable is no doubt a relatively crude proxy for wage rigidity.

A dummy variable is included for the years 1967–82 for which the number of incorporated self-employed had to be estimated (see n. 19). The statistically significant coefficient estimates on this variable indicate that the number of incorporated self-employed may have been misestimated.

B. Accounting for Rising Self-Employment

Can the estimates presented in table 1 account for the rise in self-employment in the past decade and, if so, which of the explanatory variables are most important quantitatively in causing the increase? These questions are addressed in table 2, in which the coefficient estimates from table 1 are combined with the actual changes in the explanatory variables over the period 1973–82 to account for the

TABLE 2

ACCOUNTING FOR CHANGES IN MALE SELF-EMPLOYMENT PROPORTIONS, 1973–82

	Self-employed		Any Self-Employment Earnings		Only Self-employed	
Change from 1973 to 1982	.020		.025		.019	
Effects of explanatory variables:[a]						
TFP ratio	.0037	(19)	.0077*	(31)	.0066	(35)
MTR-7	.0063*	(32)	.0064*	(26)	.0085*	(45)
MTR-17	.0039*	(20)	.0046*	(19)	.0042*	(22)
Age	.0006	(3)	−.0026	(−11)	−.0007	(−3)
OASDI	.0008	(4)	.0121*	(48)	.0026	(14)
Minimum wage	.0008*	(4)	−.0011*	(−4)	.0006	(3)
Sum[b]	.0161	(80)	.0271	(108)	.0218	(115)

NOTE.—Figures in parentheses are the percentages of the total change accounted for by each explanatory variable.

[a] The effects of the explanatory variables are equal to the coefficient estimate on the explanatory variable multiplied by the change in the explanatory variable from 1973 to 1982. The changes in the explanatory variables between 1973 and 1982 were .029 for the TFP ratio, −.046 for MTR-7, .025 for MTR-17, −1.1 for age of the male labor force, 20.2 for OASDI, and −.043 for the minimum wage.

[b] The figure in parentheses next to each sum is the percentage of the total change in the self-employment fraction accounted for by all the explanatory variables together.

* The coefficient estimate from which the figure is calculated is significantly different from zero at at least the 10 percent level.

changes in self-employment fractions over this period. The approximate year in which the lowest level of self-employment was reached is 1973, and the 1973–82 period corresponds to increasing self-employment according to all three measures used.

The calculations in table 2 reveal that the estimated models can account roughly for the increases in the self-employment fractions between 1973 and 1982. The two tax rate variables together account for a substantial share of increased self-employment. Recall that the coefficient estimates on MTR-7 and MTR-17 were negative and positive, respectively, and that figure 2 (and n. a in table 2) illustrates that MTR-7 declined while MTR-17 increased during the 1973–82 period. This explains the positive contribution of both tax variables to increases in the self-employment fractions.

The TFP ratio accounts for fairly large shares of the observed increases in self-employment. Changes in OASDI benefits also contributed substantially to rising self-employment in one case, while changes in the average age of the labor force and the minimum wage made no significant contributions.

C. *Testing the Model*

As described in Section III, it is possible under some assumptions to test a set of cross-equation restrictions implied by the single-

unobservable structure of the model. The basic assumption required in order to perform this test is a functional form for the distribution of managerial ability, $F(\cdot)$. Under the assumption that M is a standard normal random variable and with the means of the self-employment fractions used to calculate values of M^* and so forth (e.g., M^* is calculated as $M^* = F^{-1}(1 - \bar{N}_s)$, where F^{-1} is the inverse of the standard normal cdf and $\bar{N}_s$ is the mean of N_s), the linear cross-equation restrictions described above in Section III were tested. Under all model specifications tried, the restrictions were rejected by an F-test at the 5 percent level.[24] It appears, therefore, that a single-factor explanation of self-employment is not a rich enough structure to account for the observed pattern of interrelationships among the self-employment fractions. A worthwhile approach for future research would be to specify and estimate structural models of self-employment with more than one unobservable.

D. Earnings Ratios

In addition to the self-employment fractions discussed so far, the model of Section II also has implications for average earnings of workers in various self-employment and wage employment categories. Although the expressions for the average earnings variables were complex and did not yield unambiguous predictions for the effects of explanatory variables, empirical analysis can indicate whether these effects are in accord with expectations. The earnings of self-employed workers include returns to capital as well as labor, so they cannot be compared directly with the earnings of employees. Nevertheless, the effects of the explanatory variables on relative earnings of the self-employed are of interest.

Table 3 presents estimates of the determinants of the ratio of median self-employment to median wage-salary earnings for three categories of workers. The most striking thing about these results is that the coefficient estimates are generally opposite in sign from the corresponding estimates in table 1. For example, higher OASDI benefits induce higher self-employment proportions but lower relative earnings for the self-employed. This is consistent with the theoretical model because, as shown in Section II, anything that increases self-employment drives the wage rate up as the supply of wage workers

[24] The actual procedure used to test the restrictions was first to use the estimated autoregressive parameters to difference the data, creating a model free of autocorrelation. Then the restrictions were imposed and tested using a "seemingly unrelated regression" package in SAS both with and without restricting the variance-covariance matrix of the disturbances to be diagonal. The restrictions were rejected both with and without a diagonal variance-covariance matrix.

TABLE 3

LINEAR REGRESSION ESTIMATES OF THE DETERMINANTS OF THE RATIO OF MEDIAN SELF-EMPLOYMENT TO WAGE-SALARY EARNINGS FOR VARIOUS CATEGORIES OF MALE WORKERS

	Year-round Full-Time Workers	Self-Employment Earnings of All Workers Relative to Wage-Salary Earnings of All Workers	Only Self-employed Relative to Only Wage-Salary
Intercept	−.03	2.04	.99
	(2.04)	(1.69)	(1.50)
TFP ratio	.271	−.981	−1.66
	(1.323)	(1.270)	(1.03)
MTR-7	.971**	.172	.679*
	(.430)	(.478)	(.391)
MTR-17	−1.457**	−.525	−.770
	(.647)	(.600)	(.553)
Average age	.032	.012	.048
	(.047)	(.041)	(.037)
OASDI	−.0008	−.0041**	−.0003
	(.0023)	(.0017)	(.0016)
Minimum wage	−.182	−.205**	−.100
	(.150)	(.099)	(.085)
Dummy: 1967–82	.013	−.004	.013
	(.050)	(.046)	(.036)
R^2	.74	.91	.74

NOTE.—Standard errors are in parentheses. All estimates have been corrected for serial correlation.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.

falls. At the same time, the lower average managerial ability of new entrants to self-employment (when managerial ability is assumed to be the only source of worker heterogeneity) tends to drive average self-employment earnings down. Although increases in some variables such as TFP also have a direct positive impact on self-employment earnings, it appears that the wage rate increases by enough in response to TFP increases to cause a decline in relative self-employment earnings.

V. Summary and Conclusions

This paper has attempted to explain the recent increase in the proportion of the labor force self-employed following many decades of decline. The determinants of the self-employment decision were modeled for a typical worker, and the resulting labor supply functions to self- and wage employment were consistently aggregated to an economywide level. The key assumption of the model was the

heterogeneity of workers with respect to managerial ability, although it was noted that an observationally identical reduced-form model can be derived if the source of heterogeneity is in the utility function instead of the production function. The model yielded a number of testable hypotheses, particularly concerning the effects of technology.

The empirical analysis of aggregate U.S. time-series data provided several important pieces of evidence concerning the causes of rising self-employment. First, one of the most consistent results was the positive effect of the relative TFP index for the self-employed on the proportion self-employed. Changes in the TFP ratio favoring industries in which self-employment is common appear to be one of the causes of rising self-employment in the past decade. The source of this favorable shift in TFP for the self-employed is uncertain. A topic for further research on this issue is an examination of the determinants of the change in self-employment TFP, particularly the relative contributions of genuine technological changes, such as personal computers, government safety and health regulations that favor the self-employed over businesses with employees, and demand-induced changes in industrial structure favoring industries in which self-employment is common.

Second, previous evidence concerning the effects of taxes on self-employment is confirmed here. Higher marginal tax rates in the upper income brackets of the personal income tax have a positive effect on self-employment, suggesting that the relative ease of underreporting self-employment income is a significant motivation for becoming self-employed at high income levels in response to increasing tax rates. Interestingly, higher marginal tax rates at lower income levels have the opposite effect on self-employment, for reasons that are not clear. In any case, the recent widening of marginal tax rates by income level has contributed significantly to the increase in self-employment.

Third, higher real OASDI benefits have also contributed to rising self-employment, by a substantial amount in some cases.

These findings suggest a possible (inadvertent) role of government policy in inducing the rise in self-employment. Further research into the causes of rising self-employment and the possible role of government policy is warranted by these findings.

Data Appendix

A. *Self-Employment Fractions*

Data on the number of nonagricultural workers classified as self-employed by sex are from *Employment and Earnings* (1959–82) and *Current Population Re-*

ports, series P-57 (1948–58). The numbers of workers with any nonfarm self-employment earnings and with only nonfarm self-employment earnings are from *Current Population Reports*, series P-60.[25] From 1967 to 1982 all these series have been adjusted to include estimates of the numbers of incorporated self-employed workers since starting in 1967 the CPS reclassified such workers as wage-salary workers. Data on the total numbers of incorporated self-employed workers were published sporadically in *Monthly Labor Review* articles (January 1975, November 1980, July 1984). Interpolations for missing years were made by eye, and it was assumed that the proportions of male and female incorporated self-employed were the same as the corresponding proportions for unincorporated self-employed. Similarly, it was assumed that the proportions of incorporated self-employed workers with only self-employment earnings and any self-employment earnings were the same as among the unincorporated self-employed. Finally, to calculate the fractions of the labor force in each self-employment category, data on total civilian nonagricultural employment plus unemployment by sex from the *Handbook of Labor Statistics* were used. For professional/technical and managerial workers (see n. 23) the fractions were taken directly from the *Current Population Reports*, series P-60, and represent fractions of employed workers rather than labor force fractions.

B. Earnings

All median earnings variables are from the *Current Population Reports*, series P-60. For 1975–77 only mean earnings for workers with any wage-salary or nonfarm self-employment earnings were available. Medians were estimated by using the average ratio of median to mean earnings for 1970–74 and 1978–82 for each type of earnings and applying these ratios to mean earnings for 1975–77. Unpublished data from the CPS, provided by the Census Bureau, permitted several of these series, as well as some of the labor force series, to be carried through 1982 in cases in which publication of the series in the *Current Population Reports* ceased with the 1979 data.

C. Total Factor Productivity

Total factor productivity indexes for 10 broad industry groups (manufacturing, mining, construction, transportation, communication, public utilities, trade, finance and insurance, real estate, and services) were taken from Kendrick and Grossman (1980) for 1948–76 and updated to 1982 with data from American Productivity Center, *Multiple Input Productivity Indexes* (vol. 4, no. 1, July 1983), converted to the same base year as the Kendrick-Grossman series.

[25] For 1948–66 the latter series is available only in the form of the fraction of the population over age 14 or 16 with any earnings of any type. Since the number with any earnings was not provided, I had to estimate it in order to calculate the numbers of workers in the category. For men, there was little variation and no trend in the ratio of the total number with any earnings to the number of employees for 1967–82. The average value of this ratio was 1.237 for 1967–82, so assuming that this value applies for 1948–66 and using data on the number of male employees from *Employment and Earnings*, I estimated the number with earnings for 1948–66 and used it together with the fractions of the population with only nonfarm self-employment earnings to calculate the number of workers in this category.

The weights used to calculate the weighted-average self-employment and wage-salary TFP indexes were constructed from unpublished data on the numbers of self-employed and wage-salary workers by industry, provided by the Bureau of Labor Statistics (BLS). The industry groups in the BLS data for the most part match the industry groups for which TFP indexes are available, but there are some exceptions. For example, the BLS data lump transportation, communications, and public utilities together and the TFP data disaggregate them. Discrepancies such as these were adjusted using more detailed industry breakdowns available in the 1950, 1960, 1970, and 1980 U.S. censuses, with interpolations for other years. The relevant weights were then calculated, as described in the text, as the fractions of total self-employment and wage-salary employment accounted for by each industry.

D. Other Variables

The average age of the male labor force was calculated from data on the numbers of workers in various age groups published in the *Handbook of Labor Statistics* (1983). The OASDI benefit level and minimum wage series are from the *Social Security Bulletin,* Annual Statistical Supplement for various years, and were both deflated by the CPI. Tax rates were calculated from the personal income tax rate schedules for each year together with data on payroll tax rates and maximum income levels from the *Social Security Bulletin.*

References

Bardhan, Pranab K. "Size, Productivity, and Returns to Scale: An Analysis of Farm-Level Data in Indian Agriculture." *J.P.E.* 81 (November/December 1973): 1370–86.

Becker, Eugene H. "Self-employed Workers: An Update to 1983." *Monthly Labor Rev.* 107 (July 1984): 14–18.

Blau, David M. "Self-Employment and Self-Selection in Developing Country Labor Markets." *Southern Econ. J.* 52 (October 1985): 351–63.

———. "Self-Employment, Earnings, and Mobility in Peninsular Malaysia." *World Development* 14 (July 1986): 839–52.

Carson, Carol S. "The Underground Economy: An Introduction." *Survey Current Bus.* 64 (May 1984): 21–37.

Fain, T. Scott. "Self-employed Americans: Their Number Has Increased." *Monthly Labor Rev.* 103 (November 1980): 3–8.

Fuchs, Victor R. "Self-Employment and Labor Force Participation of Older Males." *J. Human Resources* 17 (Summer 1982): 339–57.

Hamermesh, Daniel, and Rees, Albert. *The Economics of Work and Pay.* 3d ed. New York: Harper and Row, 1984.

Heady, Earl O., and Dillon, John L. *Agricultural Production Functions.* Ames: Iowa State Univ. Press, 1961.

Kanbur, S. M. "Of Risk Taking and the Personal Distribution of Income." *J.P.E.* 87 (August 1979): 769–97.

Kendrick, John W., and Grossman, Elliot S. *Productivity in the United States: Trends and Cycles.* Baltimore: Johns Hopkins Univ. Press, 1980.

Long, James E. "The Income Tax and Self-Employment." *Nat. Tax J.* 35 (March 1982): 31–42.

Moore, Robert L. "Employer Discrimination: Evidence from Self-employed Workers." *Rev. Econ. and Statis.* 65 (August 1983): 496–501. (*a*)

———. "Self-Employment and the Incidence of the Payroll Tax." *Nat. Tax J.* 36 (December 1983): 491–501. (*b*)

Phillips, Joseph D. "The Self-employed in the United States." *Univ. Illinois Bull.* 59 (June 1962): 1–100.

Quinn, Joseph F. "Labor-Force Participation Patterns of Older Self-employed Workers." *Soc. Security Bull.* 43 (April 1980): 17–28.

Rees, Hedley, and Shah, Anup. "An Empirical Analysis of Self-Employment in the U.K." *J. Appl. Econometrics* 1 (January 1986): 95–108.

Vijverberg, Wim P. M. "Consistent Estimates of the Wage Equation When Individuals Choose among Income-earning Activities." Manuscript. New Haven, Conn.: Yale Univ., Econ. Growth Center, 1983.

Wolpin, Kenneth I. "Education and Screening." *A.E.R.* 67 (December 1977): 949–58.