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A TEST OF DUAL LABOR MARKET THEORY

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ABSTRACT

Despite substantial differences in their views of the appropriate policy response to the existence of poverty, neither the proponents of dual market theory nor its critics have proposed potentially conclusive tests of the dual market hypothesis.

This paper presents a test of the two central propositions of dual market theory--1) the existence of two distinct labor markets with different wage setting mechanisms and 2) the existence of barriers to mobility between the labor markets. We find considerable support for both hypothesis.

Estimation of a switching model of wage determination with unknown regimes yields two distinct wage equations. The one which most workers are associated with closely resembles the standard human capital regression with significant returns to education and experience. The other equation is flat with no returns to human capital. These two equations resemble the predictions of dual market theory for the "primary" and "secondary" markets respectively. Further, we present evidence that (at least) some non-white workers are involuntarily confined to the secondary market. This crowding of minority workers into the low wage labor market accounts for a substantial portion of white/non-white wage differences.

We interpret these results as providing empirical support for the dual market hypothesis and for recent theoretical work on efficiency wage models. In addition, combining the efficiency wage argument with the observation that much of the white/non-white wage difference is explained by the exclusion of non-whites from the primary sector suggests an explanation for the persistance of wage differences.

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I. Introduction

This paper presents a test of two of the most important claims of dual market theory--that there is a distinct low wage (secondary) labor market in which there are no returns to schooling and workers do not receive on the job training, and that there are noneconomic barriers which prevent at least some secondary workers from obtaining better (primary) jobs.

Human capital theory has tended to emphasize differences among people, rather than among jobs, as a determinant of the distribution of income. Workers in low wage jobs are viewed simply as low productivity workers who are unwilling or unable to obtain the skills which are necessary for access to higher paying jobs. It follows from this approach that a solution to the poverty trap (if a solution is necessary) is to provide individuals with more skills or with incentives to obtain skills.

Dual market theorists have maintained that jobs can be roughly divided into two groups: those with low wages, bad working conditions, unstable employment and little opportunity for advancement (secondary jobs), and those with relatively high wages, good working conditions and opportunities for advancement into higher paying jobs (primary jobs) (Doeringer and Piore, 1971). Advocates of this view have argued that primary sector jobs are rationed and that, in particular, women, blacks and other minorities find it difficult to obtain primary employment. Since, in the view of dual market theorists (Berger and Piore, 1980), it is unlikely that rationing can be eliminated, training programs will not

be successful in eliminating poverty and the major roles for policy are providing income support, ensuring that the rationing system is "fair," and minimizing the extent of the secondary sector by stabilizing aggregate demand.

Despite significant differences in their views of the low wage labor market, neither the advocates of dual market theory nor its critics have specified potentially conclusive tests of either the dual market typology or the hypothesis of noneconomic barriers to entering the primary sector. Difficulties arise because tests of the dual market hypothesis often rely on circular definitions of the sectors.

We propose strong tests of both hypotheses. Our results provide considerable support for the view that there are two distinct labor markets--a primary labor market with a wage profile similar to that predicted by human capital theory and a secondary market with a completely flat (low) wage profile. Our results also provide support for the hypothesis that there are noneconomic barriers which prevent nonwhites from entering the primary sector.

In the next section we review some of the most noteworthy empirical work on dual market theory. In the third section, we outline what we consider to be the essential differences between dual market and human capital theory and develop a formal test which allows us to distinguish between the two hypotheses. The results are presented in section four.

II. A Partial Review of Empirical Work on Dual Market Theory

Although advocates of dual market theory may differ on the particulars, all agree on two basic tenets:

1. The dual market typology described above is a useful characterization--most jobs strongly resemble the description of either primary or secondary jobs.
2. At most times there is rationing of primary sector jobs.

A number of attempts have been made to test either or both of these hypotheses.

Studies of the validity of the dual market typology have taken two forms, factor analysis of job and/or worker characteristics and comparisons of wage equations for different occupations and industries. All authors who have used factor analysis have found a dominant factor fitting the dual market typology and have found bimodal distributions of factor scores (Gordon, 1971; Buchele 1976a, 1976b; Oster, 1979). However, the correlation of certain attributes such as low wages and bad working conditions does not provide strong support for the dual market hypothesis of the existence of sectors with distinct wage setting mechanism.

Consequently, some researchers have attempted to test more directly the hypothesis that the wage setting mechanisms are different in the two sectors. The approach these authors have followed is to divide occupations and/or industries into two sectors on the basis of the characteristics of the jobs or of workers in those occupations or industries. Having thus divided the sample, they test for differences in the wage equations for the two sectors. Some have found patterns corresponding roughly to dual market theory (Osterman, 1975; Carnoy and

Rumberger, 1980; Buchele, 1976a, 1976b; Rosenberg, 1976; Wright, 1979); others have found little support for the hypothesis (Zucker and Rosenstein, 1981; Bibb and Form, 1977; Hodson, 1977). In addition, none of these studies has been entirely free of anomalies.

Unfortunately, dividing the sample on the basis of occupation or industry has major drawbacks. Since a worker's choice of industry or occupation is not independent of unmeasured characteristics, there is considerable danger of sample selection bias. It is not surprising to find that in low wage jobs the return to schooling is relatively low (Cain, 1976). In addition, the assumption that all members of an occupation or industry are in the secondary sector may significantly reduce the power of the test. For example, no one would argue that managers and skilled workers in industries which employ a substantial number of secondary workers are themselves in secondary jobs. It is possible that the anomalous results found in this literature are due to inaccurate classification.

Both the factor analyses and attempts to test for the existence of distinct wage equations for the primary and secondary sectors described above are essentially concerned only with the dual market typology. As noted in the introduction, dual market theorists maintain not only that they have developed an accurate typology but that primary jobs are rationed. In fact, it is the latter position which constitutes the major break with human capital theory.

Several authors have suggested that the existence of distinct wage equations for the primary and secondary sectors would constitue a

refutation of human capital theory (Buchele, 1976a, 1976b; Osterman, 1975), but this is not the case. If an individual can move out of the secondary sector in order to obtain returns on experience or education, the existence of a sector in which there are no returns is inconsequential (Cain, 1976). Thus the basis of the allocation of workers between the sectors is crucial; are primary sector jobs rationed?

Several authors have addressed the issue of mobility between the two sectors. Leigh (1976) finds substantial and comparable earnings growth for black and white workers and suggests that this refutes the dual market hypothesis. Shiller (1977) reports extensive upward mobility of individuals at the bottom of the income distribution during the period 1957 to 1971. He argues that this constitutes a refutation of dual market theory.

On the other hand, Rosenberg (1976) and Carnoy and Rumberger (1980) find that minority workers are more likely to begin their careers in the secondary sector and, having started there, are less likely to leave than are whites. Rosenberg also finds that human capital variables do not help to explain the upward mobility of minority workers. These authors argue that this differential mobility supports dual market theory.

In fact, measuring mobility does not provide a test of rationing of primary market jobs. As Rosenberg (1979) notes, some mobility is consistent with dual market theory while purely random movement is not implied by human capital theory. It is easy to derive a simple human capital model with firm-specific training in which there is no mobility between jobs whatsoever. No one has specified, and it is probably

impossible to do so correctly, what levels of mobility would constitute refutations of dual market or human capital theory. Although studies of differential mobility between races are suggestive, the key issue is whether there are qualified individuals who would like to work in the primary sector but cannot find a job there. No study has addressed this issue.

Thus empirical work contrasting dual market and human capital theory has suffered from two major drawbacks. The taxonomies which have been developed simultaneously bias the results in favor of the dual market hypothesis by virtue of the selection criteria and are too gross to allow accurate testing of the hypothesis. Furthermore, the crucial issue of barriers to entry has not been addressed.

In Section III we propose a technique which allows us to derive the probability of sector attachment directly from the observed distribution of wages and worker attributes. This resolves the problem of attributing primary or secondary sector employment to everyone in a given industry or occupation. We then propose a direct test for involuntary confinement of workers to the secondary sector.

III. A Formal Test

How can we test the descriptive power of the dual markety hypothesis without prior knowledge of the sector a person is in? Consider how we might proceed if people's earnings potential could be summarized by a single observable trait--for example education and a single unobserved trait which was uncorrelated with education. In that case we could plot

a scatter diagram of log wages and education. The standard view of the labor market holds that such a scatter diagram should resember figure 1. From dual market theory we would expect a scatter diagram similar to figure 2. A straight-forward test of the theories would therefore entail plotting the scatter diagram and assessing whether it corresponds to either the human capital model, or the dual market model.

Two problems complicate such an approach. First, wages are determined by many observable characteristics other than education. To control for all variables simultaneously, we would have to plot a scatter diagram for each sub-group in the sample. As the number of other variables increased, the number of observations on each diagram would decrease considerably. With a reasonable number of controls the number of diagrams and the sparseness of observations would certainly make it impossible to discern any pattern.

Secondly, even if we were able to plot all the scatter diagrams, we would still lack a formal mechanism for testing the hypotheses. Each researcher would be free to decide for him/herself whether the diagrams correspond more nearly to the predictions of human capital or dual market theory. These problems can be resolved by the use of the formal methods described in the following paragraphs.

The question of whether a plot looks more like figure 1 or 2 can be rephrased; do two wage equations fit the data significantly better than one, and do the best fitting equations fit the predictions of the dual market hypothesis? We can imagine fitting first one, and then two lines by hand to figure 2. To compare the explanatory power we might, for

example, compute the distance from each point to the closest line. The reduction in the sum of squares going from one line to two would be much larger for figure two than for figure one.

Of course, two equations having more explanatory power than one is not, by itself, a test of the dual market hypothesis. For example, two equations might have significantly more explanatory power than one for a scatter diagram such as figure 3. However, there is no identifiable secondary market. Thus, in addition to requiring two equations to have significantly more explanatory power than one, we also require the best fitting lines to have characteristics consistent with the dual market hypothesis. To correspond to the predictions of dual market theory, one wage equation should be upward sloping in schooling and experience while the other equation should be flat with respect to human capital variables and below the other at most points. Since we are dealing with a sample of adult males we also expect that there will be fewer observations associated with the low wage line.

Formally, we may fit two wage equations using maximum likelihood techniques. Since we do not know a priori with which wage equation to compare an individual, we estimate a "switching model with unknown regimes." To do this we must specify two wage equations and a third equation which predicts sector attachment and estimate all three equations simultaneously. The likelihood function for this model can be found in Appendix 1.

Since the single equation model is nested in the switching model we may test the hypothesis that the two equation model fits significantly

better than the single equation model by comparing the log-likelihood values for the two models. We may then examine the coefficients of the two wage equations to see if they fit the dual market hypothesis.

The existence of two sectors with different wage setting mechanisms is fundamental to dual market theory, but it is not incompatible with human capital theory. While neoclassical economics tends to emphasize the development of models which are continuous and therefore tractable in calculus, if the technology were sharply discontinuous in the way suggested by Piore (1980b), no fundamental assumptions of mainstream economics would be violated. In this case, individuals would choose the sector of employment which maximized the expected present value of their lifetime utility.

The second postulate of dual market theory, that primary sector jobs are rationed, is less compatible with human capital theory. Dual market theory maintains that individuals cannot necessarily choose the sector which they prefer--some workers who would prefer to be employed in the primary sector cannot find jobs there. As a general phenomena this would be highly incompatible with the standard neoclassical view. However, rationing as a general phenomena is believed to be restricted to recession periods (Piore, 1980a). During other periods only women and minorities are likely to experience rationing. Such a contention, if true, would be no more troublesome than the widely acknowledged importance of race and sex discrimination in the determination of wages.

To test for the presence of noneconomic barriers to primary sector employment, we need to postulate a mechanism for allocating workers

between the sectors in the absence of rationing. To begin, we assume that experience in one sector raises wages in that sector more than it raises wages in the other sector.[1] We also assume that workers will behave so as to maximize utility over their lifetime. Utility is assumed to be increasing with the net present value (NPV) of lifetime income. If we then assume that people's preferences with respect to the non-pecuniary aspects of jobs do not change over their lifetime and that workers are perfectly informed about the characteristics of all jobs, we can conclude that workers will choose employment in one of the two sectors at the beginning of their careers and stay in that sector for their entire working life.[2]

If the non-pecuniary characteristics of the two sectors were similar we would expect workers to pick the sector which yields the highest lifetime income. However, this is unlikely. Dual market theorists are unanimous in maintaining that the non-pecuniary aspects of secondary employment are inferior to those obtained in primary employment. On the other hand, starting wages in the secondary sector may be higher than in the primary sector and this could be attractive to a worker who plans to leave and enter the labor force frequently or change jobs often. In addition, secondary employers may be less concerned with lateness and absenteeism and the work pace may be slower in secondary jobs. Formally, we assume that workers will choose primary sector employment if the log of the NPV of their income stream in the primary employment exceeds the log of the NPV of secondary employment by more than an amount C, where C is the additive inverse of the compensating differential for secondary

employment. We may write the probability that a worker is employed in the primary sector as:

$$P(\text{Primary sector employment}) = P(\ln(NPV_p) - \ln(NVP_s) > C) \quad (1)$$

To model the NPV in the two sectors we write two wage equations

$$\ln(W_p) = XB_p + Ya_p + e_p \quad (2)$$

and

$$\ln(W_s) = XB_s + Ya_s + e_s \quad (3)$$

where X is a vector of individual characteristics, Y is years of job experience, W_p is the wage received in the primary sector, e_p is a normally distributed error representing unobserved characteristics affecting the primary sector wage, and B_p and a_p are parameters. The terms W_s, e_s, B_s, and a_s are similarly defined for the secondary sector. Approximating the length of the individual's working life by infinity, and using (2) and (3), equation (1) becomes

$$P(\text{Primary Sector Employment}) = P(X(B_p-B_s) + e_p - e_s + C' > 0) \quad (4)$$

where

$$C' = \ln\left(\frac{d-a_s}{d-a_p}\right) - C \quad (5)$$

and d is the discount rate.

If we asume that C' is equal to a constant plus a normally distributed error term (i.e., people's preferences with respect to the non-pecuniary aspects of employment and their discount rates do not vary with observable characteristics (X), we may test the hypothesis that people choose their sector of employment to maximize their utility by estimating an equation to determine sector membership and testing the hypothesis that the coefficients on the Xs are equal to $B_p - B_s$ or that the B_3s in (6) are equal to zero.

$$X(B_p - B_s + B_3) + C' + e_p - e_s + e_3 \qquad (6)$$

It may not be reasonable to assume that preference for the non-pecuniary aspects of primary or secondary employment are not related to any observed worker characteristics. If they are related we would expect at least some of the B_3s to be different from zero even if workers are free to choose the sector they are employed in. In this case we may be able to find some Xs which should not be related to tastes or to suggest inequality constraints on the effects of certain characteristics on tastes. Specific tests of this type are proposed in Section IV.

An intuitive explanation of this approach uses the example of race. Suppose that the lines fitting the scatter diagram in figure 2 were the same for blacks and whites. Suppose further that the distribution of education was the same for the two groups, but that a higher proportion of blacks than of whites were scattered around the lower line. Under

these circumstances, we would conclude that either blacks are less averse to secondary employment than are whites or that blacks face discrimination in obtaining primary jobs. Supplementary evidence would support the latter explanation.

The data used in this study are drawn from the thirteenth wave (1980) of the Panel Study on Income Dynamics. We limited the sample to men working more than one thousand hours in the previous year, did not work in government and for whom data on education and marital status were available. Estimates were obtained for both the full sample (2812 cases) and with only members of the Survey Research Center sample (1696 cases).

IV. Results

Table 1 presents the results for both OLS estimation and the dual market model. Since the results for the samples are similar, we discuss only the restricted sample here. The OLS results are similar to those obtained by other researchers. The return to schooling is about 6 percent while the return to experience is about 1 percent. Whites receive wages about 13 percent higher than nonwhites holding other factors constant. Workers living in an SMSA earn wages almost 20 percent higher than equivalent workers outside an SMSA and workers who have never been married earn considerably less than other workers. All the coefficients are highly significant at conventional levels.

The second part of Table 1 tells a very different story from the results of OLS estimation. The primary sector wage equation resembles the OLS equation, but there are some striking differences. Most notably,

the white/nonwhite differential falls to zero (although it is measured very imprecisely). In addition, the effect of living in an SMSA declines and the returns to schooling and experience increase somewhat.

On the other hand, the secondary sector wage equation contrasts sharply with the OLS equation. None of the coefficients is statistically significant at conventional levels. We cannot reject the hypothesis that the secondary sector wage equation is completely flat. The return to experience (which is measured quite precisely) is essentially zero. Further, the secondary sector wage equation is almost everywhere below the primary sector. For a non-white living in an SMSA who has never been married and has a sixth grade education, the predicted primary sector wage is greater than the secondary wage after one year's experience. For all other workers, except those with less education, the predicted primary sector wage is always higher than the predicted secondary sector wage.

Since the coefficients of the secondary sector wage equation are measured imprecisely, it might be presumed that, in fact, there is only one labor market. However, using a likelihood ratio test, we can easily reject the single labor market (OLS) model at any conventional level of significance.[3] Two wage equations fit the data considerably better than one.

Thus we can reject the single labor market model and cannot reject the predictions of dual market theory that there are no returns to education or experience in the secondary sector. As noted above, this characterization of the market, while not commonly assumed in mainstream

economics, is not incompatible with it. A more crucial aspect of dual market theory is the assumption that primary sector jobs are rationed.

Testing this assumption entails testing constraints on the switchng equation. Using the restricted sample, we were unable to get the constrained likelihood function to converge. Since a Wald test of the constraints is not invariant with respect to the choice of normalization,[4] a likelihood ratio test is preferable. Consequently, in the following paragraphs, we report the results of likelihood ratio tests performed on the full sample.

If workers were free to choose between the sectors and tastes for the non-pecuniary aspects of employment were not related to the location of a worker's residence, his marital status, education, or race, we would expect the coefficients of these variables in the switching equation to equal the difference between the coefficients in the two wage equations.

It is probably not reasonable to expect workers' preferences with respect to non-pecuniary job attributes to be independent of these variables. For example, we would not be surprised to find that workers outside of SMSAs required less of a compensating differential to get them to take secondary work since they may often be engaged in agricultural labor we therefore test the hypothesis that B_3 in equation (6) equals zero for school, white and never married. Twice the difference between the log-likelihoods for the constrained and unconstrained models is 14.92. The one percent critical value for the chi-square with two degrees of freedom is 9.21.[5] Here, too, the hypothesis of free choice is easily rejected.

Finally, we can reject the hypothesis that the coefficients on white and never married in the switching equation are both equal to the difference between their respective coefficients in the primary and secondary wage equations (χ^2 = 14.56, critical value for one degree of freedom = 6.63). We are thus left with three potential explanations for our results. First, highly educated workers prefer secondary employment more than less educated workers. This hypothesis seems unlikely. Intuitively, we would expect more educated workers to be more averse to the poor working conditions of secondary employment. Kahn (1983) finds that the demand for occupational safety increases with education. A second explanation is that blacks are less averse to secondary jobs than are whites, but this runs counter to evidence that blacks are more likely to support unions in representation elections (Farber & Saks, 1980; Dickens, 1983), are less likely to quit a job (Viscusi, 1979) and have greater demand for occupational safety than equivalent whites (Kahn, 1983). Primary jobs are more likely to be unionized, offer more stable employment and better job safety. If we cannot accept these other two explanations we are forced to conclude that blacks face noneconomic barriers to employment in the primary sector.

At the present time there is no formal way of establishing which of these three explanations is correct. However, since the first two hypotheses appear to be inconsistent with other studies of the demand for job quality, the most reasonable explanation is the last; blacks are discriminated against when seeking primary employment.

If we accept the dual market hypothesis, we may use the model to determine the composition of the primary and secondary sector.[6]

According to this model 11.4 percent of working male heads of households are employed in the secondary sector. This seems large, especially since we would expect a sample containing teenagers, women, and the unemployed to have a higher proportion of secondary workers. Table 2 shows the makeup of the sample and the secondary market. It also shows the percent of each type of worker in the secondary market. Since many of the parameters of the switching model are estimated with a great deal of error, we also estimated a restricted model (parameter estimates in Table 3) where the wage equation in the secondary sector was constrained to be flat and education and marital status were removed from the switching equation. (A likelihood ratio test fails to reject the constraints at the .1 level.)[7]

Both models show the same pattern evident in the parameters of the switching equation: workers in SMSAs, married workers, more educated workers, and whites are less likely to be in the secondary sector.

Finally, we examine how sharply the model distinguishes between workers in the primary and secondary sectors. Figure 4 shows the distribution of predicted probabilities of being in the primary market. The distribution is distinctly bi-modal, with the two modes at 0-10% probability and 90-100%. There are a large group of workers who are clearly identifiable as being in the secondary sector, and a larger group with a high probability of being primary workers. Thus, it appears that there is a distinct secondary sector which the model can identify.

V. Conclusions

Our results provide strong support for two of the basic tenets of dual market theory: there are two distinct sectors of the labor market with different wage setting mechanisms, and there is a queue for primary sector jobs. We believe that our approach and results represent a considerable advance over previous research in this area. By allowing the distribution of wages and worker attributes to determine our "assignment" of workers to sectors, we avoid the problems of arbitrariness and sample selection bias which complicated the interpretation of earlier research. In addition, our approach allows us to estimate the size and composition of the secondary work force in a noncircular manner.

Of course, we cannot exclude other interpretations of these results which postulate different distributions of the error term or some unusual nonlinear functional form for the wage equation. While we canot deny these possibilities, we suggest that in the absence of our results, such a distribution would not be suggested. It was dual market theory which led to our test, and the results therefore tend to corroborate that theory.

However, given the strength of the reactions (deifying or executing the messenger) of some of the individuals with whom we discussed preliminary results, it is important to take stock of exactly what it is that we have and have not shown.

Piore (1983) suggests that the strength of opposition to dual market theory is due, in part, to the use of participant observer techniques

rather than econometric techniques which are more common in mainstream economics. We have shown that the dual market hypothesis can be derived and supported from standard data and statistical techniques. It is, however, unlikely that standard approaches would have uncovered labor market duality, a fact which suggests that there is a role for other methods in mainstream economics.

On the other hand, the fact that we can test dual market theory using mainstream techniques suggests that the two theories are not as incompatible as would appear from the antagonisms in the profession. We have already suggested that neoclassical economics makes few assumptions regarding the nature of technology. It is relatively straightforward to develop a model in which a high fixed cost/low variable cost technology is used in the "stable" demand sector and a low fixed cost/high variable cost technology is used to accommodate fluctuations in demand. Piore (1980b) gives a verbal description of such a theory and Applebaum and Lin (1982) present a formalization. It is a direct consequence of human capital theory that workers and firms will invest little in firm specific training if the worker is not expected to remain with the firm for very long. Thus the existence of two markets with distinct wage profiles can be easily accommodated by mainstream theory.

Similarly, while when first proposed, the view that there is a queue for primary sector jobs may have appeared to be incompatible with neoclassical theory, there are an increasing number of imperfect information models which imply that there can be a queue for jobs. In particular, Weiss (1980), Stoft (1982), Shapiro and Stiglitz (1982) and

Bowles (1983) have developed models in which job queues arise in firms in which there are unobserved skills or effort. Thus there could well be a queue for primary sector jobs. If there are few skill differences in secondary sector jobs, there would be no queues for them.

While these models are compatible with queues, we have presented evidence that rather than allocating jobs randomly, primary sector employers discriminate against nonwhites. This may appear to be incompatible with neoclassical economics. However, discrimination is an anomaly which remains to be explained whether or not one accepts dual market theory. In fact, these results may help to explain the existence and persistence of discrimination. According to the point estimates presented in the last section, more than 40% of white/non-white wage differences can be explained in the restricted model by the fact that non-whites are crowded into the secondary sector while in the unrestricted model the within sector differential is zero. If the unobservability of skills or work effort make it optimal for queues for primary jobs to exist, primary employers with a "taste" for discrimination may indulge it by hiring fewer non-whites from the queue without sacrificing profits. No economic incentive exists for the elimination of this sort of discrimination. Thus the aspects of dual market theory which we have tested do not appear to us to be incompatible with mainstream economics.

On the other hand, we do not wish to imply that there are no incompatibilities between dual market theory and neoclassical economics. For example, dual market theorists have generally assumed that

preferences are endogenous, a position strongly resisted by most mainstream economists despite some exceptions.

Perhaps more important, dual market theorists have developed very elaborate theories of the origin and operation of labor market institutions which are rich in institutional detail.[8] These descriptions are quite remote in many ways from the neoclassical description of the labor market. However, we have not attempted to test these aspects of dual market theory.[9]

Finally, we call the reader's attention to the title of this paper. We have chosen to refer to our work as a test of dual market theory rather than as a test of human capital theory because, in our view, dual market theory is not necessarily incompatible with standard neoclassical analysis. Our results therefore point to the need for additional work to understand the origins of these institutions rather than to abandon the neoclassical model of the labor market. In addition, our results point to the value of noneconometric techniques for uncovering and understanding labor market institutions.

Table 1

RESTRICTED SAMPLE

Variable	Mean	OLS	Switching Model Primary	Switching Model Secondary	Switching Model Switch
Constant	1.00	.874	.996	1.32	-.006
		(.075)	(.297)	(3.33)	(.574)
SMSA	0.67	.197	.112	.197	.361
		(.025)	(.060)	(1.28)	(.158)
Never Married	0.08	-.305	-.261	-.244	-.157
		(.044)	(.055)	(.580)	(.354)
School	12.7	.059	.067	-.003	.020
		(.005)	(.005)	(.072)	(.031)
White	.91	.134	.008	-.192	.796
		(.040)	(.166)	(2.73)	(.328)
Experience	18.4	.010	.013	.001	-
		(.001)	(.001)	(.002)	
Covariance with switching error				.068	-.009
			(.389)	(4.42)	
S.e.		.477	.374	.381	*
Log-likelihood		-1151.4		-1062.9	

FULL SAMPLE

Constant	1.00	.760	.982	1.27	-.389
		(.051)	(.108)	(.636)	(.379)
SMSA	0.69	.194	.078	.073	.526
		(.020)	(.036)	(.452)	(.144)
Never Married	0.10	-.265	-.286	-.268	.238
		(.031)	(.047)	(.263)	(.338)
School	12.07	.063	.069	.006	.037
		(.004)	(.005)	(.034)	(.024)
White	0.67	.180	.006	-.139	.885
		(.020)	(.059)	(.781)	(.190)
Experience	17.9	.010	.014	.000	-
		(.001)	(.001)	(.002)	
Covariance with switching error		-	.155	-.019	
			(.084)	(1.18)	
S.e.		.471	.392	.373	
Log-likelihood		-1875.3		-1772.9	*

Standard errors in parentheses

Dependent variable is log hourly wage

*normalized to 1

Table 2

Composition of Sample and Secondary Sector

		UNRESTRICTED MODEL		RESTRICTED MODEL	
	% of Sample	% of Secondary Sector workers	% of workers in Secondary Sector	% of Secondary	% in Secondary
SMSA	66.9	56.3	9.6	46.8	7.9
Not SMSA	33.1	43.7	15.1	53.2	18.2
Married	91.8	86.5	10.8	88.4	11.0
Not Married	8.2	13.5	14.4	11.6	11.0
Education<12	19.9	24.4	14.0	23.1	13.0
Education=12	39.8	42.8	12.2	41.0	11.7
Education>12	40.3	32.8	9.3	35.9	10.1
White	90.6	77.2	9.7	84.5	10.6
Non-White	9.4	22.8	27.6	15.5	18.1
Total	*	*	11.4	*	11.3

Table 3

Estimates for Restricted Model

Variable	Primary	Secondary	Switching
Constant	.887 (.073)	1.22 (.093)	.503 (.281)
SMSA	.108 (.026)	-	.537 (.132)
Never married	-.288 (.037)	-	-
School	.069 (.004)	-	-
White	.083 (.043)	-	.433 (.227)
Experience	.013 (.001)	-	-
Log-likelihood:	-1069.1		
s.e.	.3773	.4098	*

Standard errors in parentheses
Dependent variable: log of hourly wage
*normalized to one
- constrained to zero

Figure 1. Hypothetical Scatter Plot--
Standard Human Capital Theory

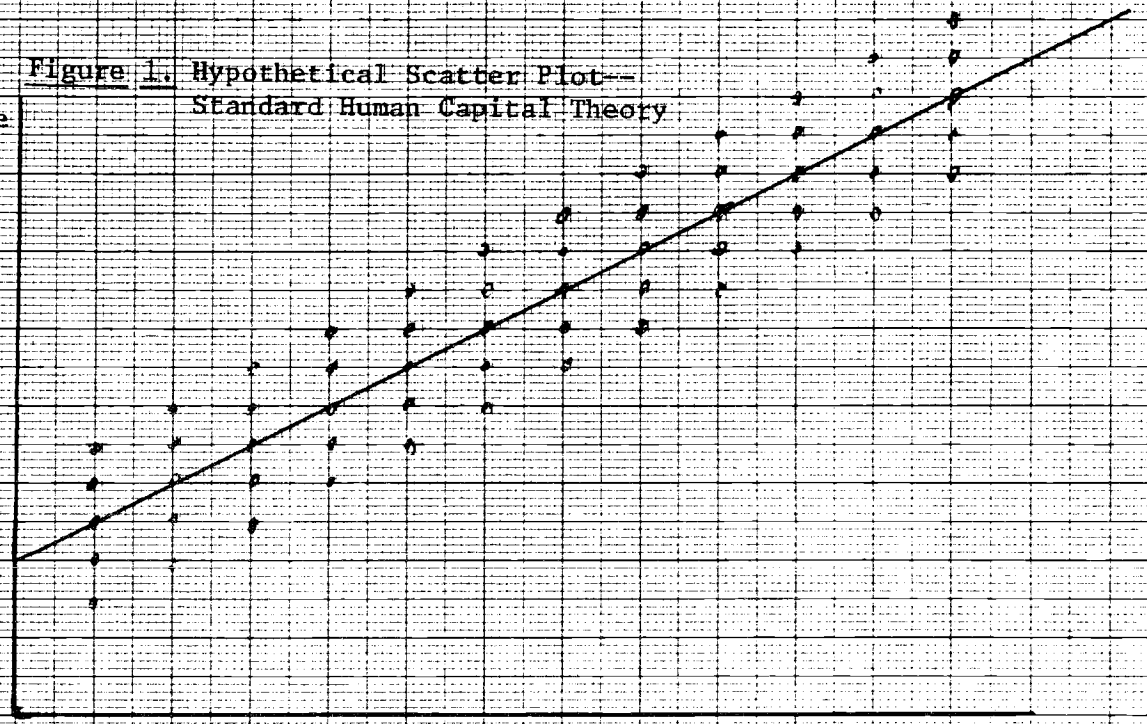


Figure 2. Hypothetical Scatter Plot--
Dual Market Theory

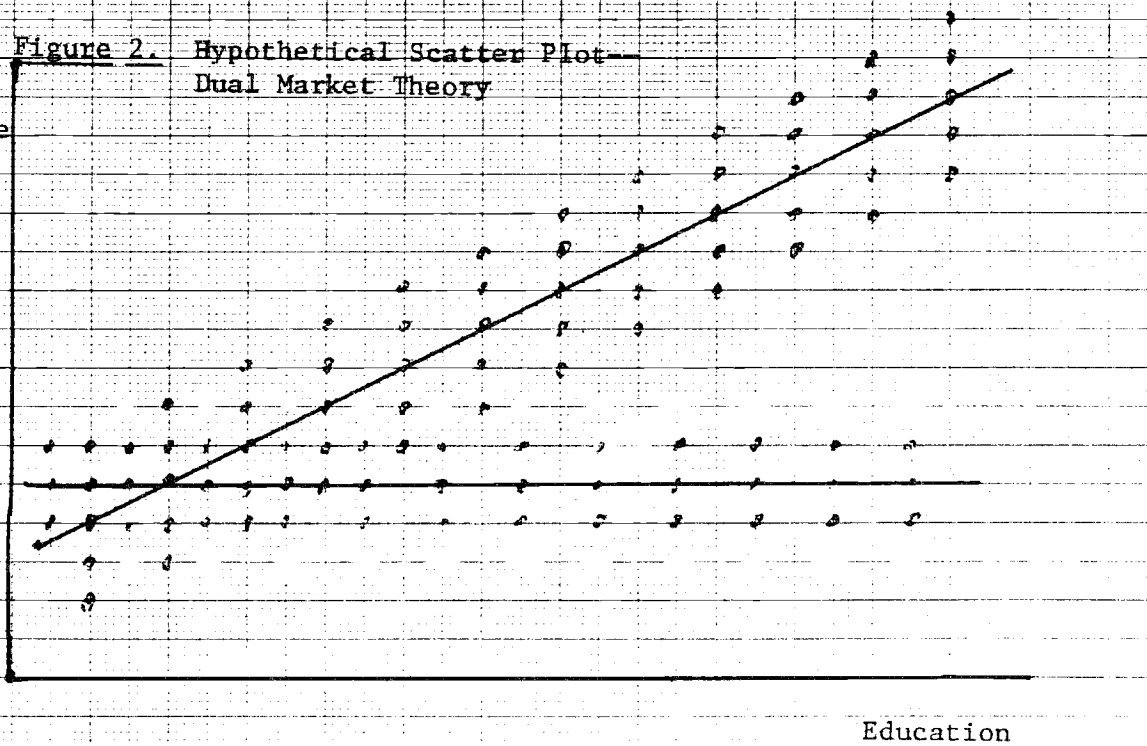


Figure 3. Hypothetical Scatter Plot--
Human Capital Theory with
Non-Linear Wage-Education
Relation.

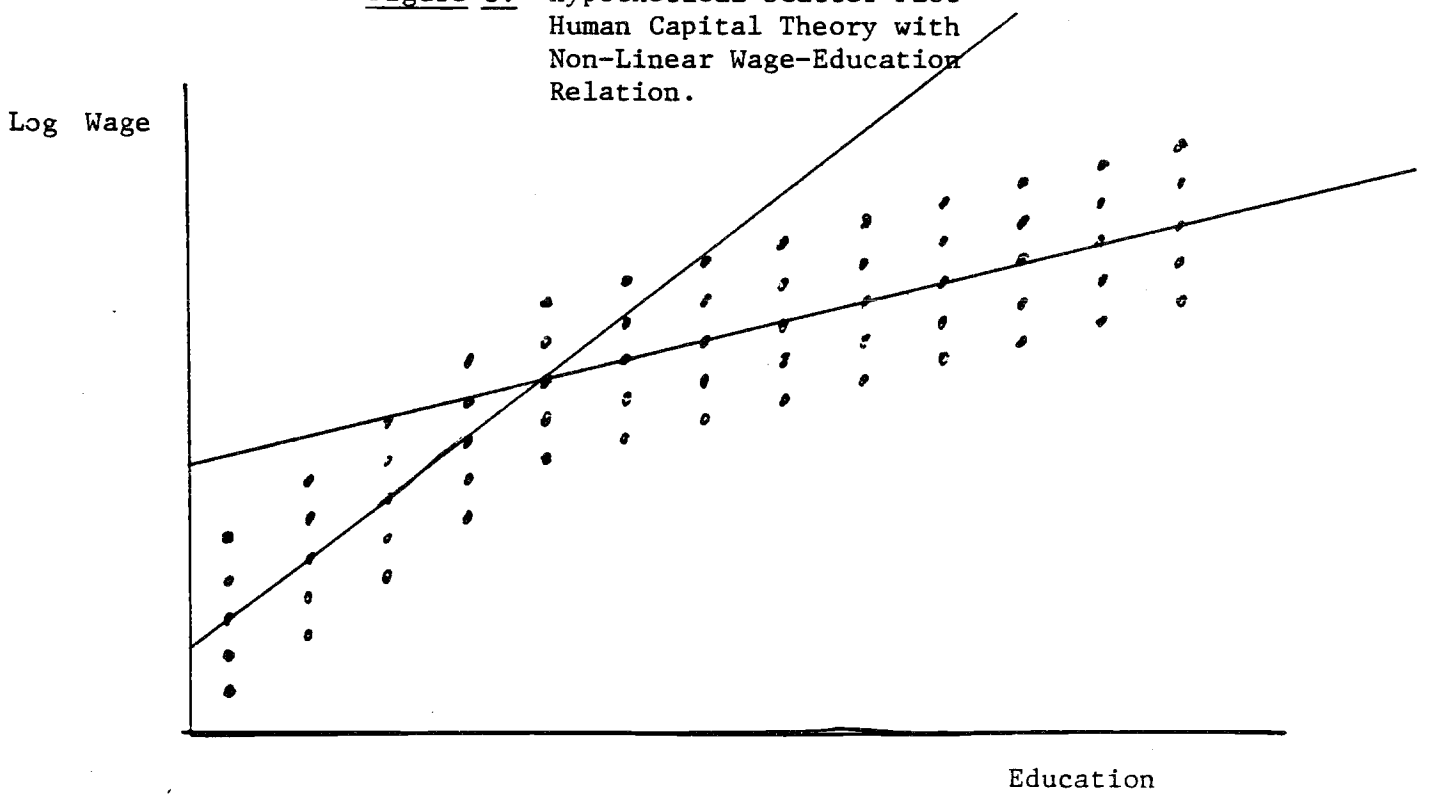
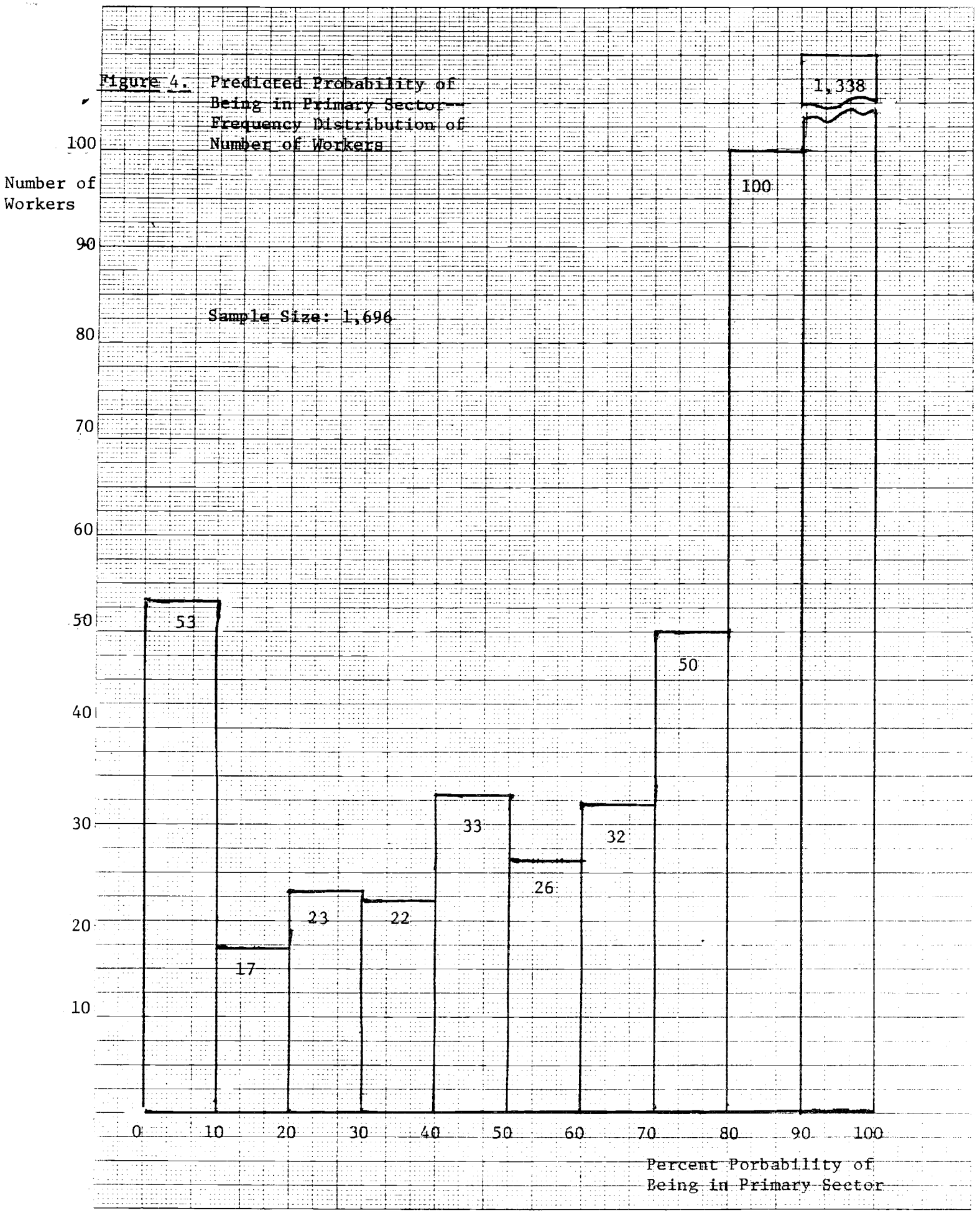


Figure 4. Predicted Probability of Being in Primary Sector--Frequency Distribution of Number of Workers



FOOTNOTES

[1]This assumption appears reasonable in light of recent empirical evidence on experience-earnings profiles. James Brown (1983) shows that experience in other firms counts very little towards earnings for workers on their current jobs. The assumption entails the existence of sector specific training. If some training is firm specific it is ipso facto sector specific.

[2]It might be argued that young people, in particular, lack the necessary career information to make informed job choices. They may also have different preferences. For our purposes, these problems should be of less importance since we estimate our model on a sample of heads of households.

[3]Twice the difference between the log-likelihood values for the two models is 177. Although the single equation model is nested in the switching model, when the switching equation model is constrained to yield the single equation model, several parameters are unidentified. This problem complicates the calculation of the degrees of freedom. In addition, it is possible that the asymptotic likelihood ratio statistic does not have a chi-squared distribution. However, Monte-Carlo tests (Goldfeld an Quandt, 1976) suggest that setting the degrees of freedom equal to the number of constraints plus the number of unidentified parameters yields a conservative test using the chi-squared distribution. For our problem, this computation yields fourteen degrees of freedom. The one percent critical value for the chi-squared

distribution with fourteen degrees of freedom is 29.14--far smaller than our computed likelihood ratio test statistic.

[4]In the unrestricted model it is not possible to simultaneously identify all the coefficients of the switching equation and its error variance. This is a problem common to all discrete dependent variable estimation. Thus any one restriction on the coefficients of the switching equation cannot be tested as it would only constitute a normalization. It is possible to perform a Wald test if there is more than one constraint but the test is not invariant to the normalization chosen. In all cases reported below the results of the Wald test were inconclusive since the Wald test rejected the null hypothesis for some reasonable normalizations but not for others.

[5]We are imposing three constraints but we also relax the normalization that the variance of the switching equation equals one. Thus there are only two degrees of freedom.

[6]A straightforward application of Bayes theorem gives the result that the probability of being in the primary sector conditional on the observed wage and personal characteristics is the likelihood given the individual is in the primary sector divided by the entire likelihood for that observation.

[7]Again we note that the measured returns to schooling and education in the primary sector are larger than in the OLS equation. Also, the "discrimination coefficient" is roughly 40% smaller.

[8]For example see Piore (1980a), Edwards (1979) and Gordon, Edwards and Reich (1982).

[9]Reich [1984] does.

APPENDIX 1

Estimation of the Switching Model with Unknown Regimes

Consider the system composed of wage equations for each sector and an equation determining "tendency to be in the primary sector."

$$\ln W_i = X_i\beta_1 + \varepsilon_{1i} \tag{A1}$$

$$\ln W_i = X_i\beta_2 + \varepsilon_{2i} \tag{A2}$$

$$y_i^* = Z_i\Gamma + \varepsilon_{3i} \tag{A3}$$

whre W_i is the individual's wages, X_i and Z_i are vectors of explanatory variables, β_1, β_2 and Γ are vectors of parameters, ε_1, ε_2 and ε_3 are normally distributed error terms and y^* is a latent variable measuring tendency to be in the primary sector. (A1) is the wage equation if the individual is in the primary sector; (A2) is the wage equation if the individual is in the secondary sector and (A3) is the switching equation.

We do not observe y^*. However, if $y^* > 0$, the individual's wage is determined by (A1); otherwise it is determined by (A2). Equivalently, the individual works in the primary sector if and only if

$$\varepsilon_{3i} > -Z_i\Gamma \tag{A4}$$

The likelihood function for the problem is therefore given by:

$$\Pr(\varepsilon_{3i} > -Z_i\Gamma | Z_i, X_i, \varepsilon_{1i}) \cdot f(\varepsilon_{1i}) \qquad \text{(A5)}$$

$$+ \Pr(\varepsilon_{3i} \leq -Z_i\Gamma | Z_i, X_i, \varepsilon_{2i}) \cdot f(\varepsilon_{2i})$$

The log-likelihood is thus:

$$\sum_{i=1}^{N} \ln \{[1-\Phi\left(\frac{-Z\Gamma-\frac{\sigma_{13}}{\sigma_{11}}\varepsilon_{1i}}{(1-\frac{\sigma_{13}^2}{\sigma_{11}})^{.5}}\right)] \cdot \phi(\varepsilon_{1i}, \sigma_{11}) \qquad \text{(A6)}$$

$$+ \Phi\left(\frac{-Z_i\Gamma-\frac{\sigma_{23}}{\sigma_{22}}\varepsilon_{2i}}{(1-\frac{\sigma_{23}^2}{\sigma_{22}})^{.5}}\right) \cdot \phi(\varepsilon_{2i}, \sigma_{22})\}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the normal density and cumulative distribution, respectively and σ_{jk} is the covariance of ε_{ji}; and ε_{ki}; σ_{33} is normalized to equal one. Maximum likelihood estimates for Γ, β_1, β_2 and the σ's can be obtained using standard search algorithms provided that care is taken to prevent the program from iterating into regions for which the likelihood function is unbounded.

It is easy to see that if β_1 equals β_2, and σ_{13} equals σ_{23}, then ε_{1i} equals ε_{2i} and the likelihood

function reduces to the standard normal density. It is therefore possible to test for the existence of two regimes by comparing the log-likelihood values for OLS and unknown regime estimates by performing a likelihood ratio test.

The likelihood functions used here were maximized using the Berndt, Hall, Hall and Hausman (1974) algorithm. While the nonlinearty of the system made convergence difficult, we did not experience any difficulties with unboundedness. All unconstrained specifications converged to interior solutions from OLS starting values.

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