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FARM MECHANIZATION AND THE FARM LABOR MARKET: A SOCIOECONOMIC MODEL OF INDUCED INNOVATION

By

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FARM MECHANIZATION AND THE FARM LABOR MARKET:

A SOCIOECONOMIC MODEL OF INDUCED INNOVATION

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FARM MECHANIZATION AND THE FARM LABOR MARKET: A SOCIOECONOMIC MODEL OF INDUCED INNOVATION

Introduction

Hayami and Ruttan's (1970, 1985) theory of induced innovation has been widely applied in the study of technological change. The basic concept of this theory is that the development and adoption of technology to save an input is induced by its relatively higher price. The empirical studies of technological change in U.S. agriculture by Binswanger (1974a, 1974b), Antle, Shumway and Alexander are also based on this theory. These early works of induced innovation theory assume market perfection; in other words, the demand for technological change is the same for all producers since they face the same prices. Moreover, the previous studies ignore the importance of the socioeconomic environment (e.g. political and cultural), resulting from institutional changes and its impact on technological change.

The new direction of induced innovation theory emphasizes the role of institutions and their relationship with technological change as suggested by Binswanger (1978), De Janvry (1973, 1978a, 1978b), Ruttan, and several other economists. In this study of the change of U.S. agricultural technology, we take into account structural changes in the agricultural industry as well as the political influences. Some examples of political factors that influence the farm commodity program are found in Gardner and those that influence technological change are found in De Janvry (1978a, 1978b). The paper emphasizes the demand for farm mechanization (capital using, labor saving

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technology) through the change in farm worker demographic characteristics, more specifically the legal status, which may result from changes in immigration policy and political interests in the labor market. The other socioeconomic influences from institutional change include farm policy through government payments, and the demand for new technology by large producers as expressed through the experiment station system and the political process.

A vast majority of the agricultural work force is unauthorized foreign workers (U.S. Department of Labor); changes in the *de facto* legal structure of the labor market imply changes in immigration and labor policy and enforcement. The passage of the Immigration Reform and Control Act of 1986 (IRCA) was intended to reduce the extent of illegal employment. Even though it was designed to decrease the flow of illegal immigrants, all indications suggest that the number of illegal immigrants has increased, not decreased. Changes in technology, particularly mechanization, may be influenced by political interests in relation to the labor market. Different transaction costs associated with different levels of legal status also imply differing demands for technology by producers.

Government policy has a major impact on the direction of technological change. The supply of new technology is a result of the combination of government and private funding for research on new technology. Government can also indirectly change the direction of the demand for technology by farm subsidies. A government payment associated with the demand and supply of inputs can influence the type of new technology. For example, a conservation program is paid by the government to conserve land from agricultural production. This payment directly affects the use of agricultural land, and may change the demand for land.   There are other factors that may influence the direction of technological change. As Binswanger (1978), De Janvry (1973, 1978a, 1978b), and Ruttan suggest, changes in the structure of institutions will also induce a change in technology. The institutional change of different parties in the market such as producer and consumer organizations, public research institutes, and governmental agents could change the demand and supply of technology. The demand for technology by different types of producers could also be different (DeJanvry, 1978b). In this study, we hypothesize that large and small producers have different demands for technology. The percentage of large producers will capture the effectiveness and incentives to lobby for the change of technology.

Methodology

A cost function model of biased technological change is specified using a time variable to estimate the bias in technological change. Socioeconomic variables are included to capture their effects on the rate of biased technological change. The parameter estimates of the translog cost function provide estimates for elasticities of factor demand and elasticities of factor substitution.

Model

The model assumes a single aggregate agricultural output, constant returns to scale, and that the level of output does not affect the relative use of inputs. The production of the aggregate agricultural product (Y) requires n variable inputs $X = (X_1, X_2, \ldots, X_n)$ with a vector of input prices $W = (W_1, W_2, \ldots, W_n)$. Using time as representative for technological knowledge, production cost is therefore a function of input prices and the technology variable. The translog cost function C = f(W_1,…, W_n, t) can be written as

$$\ln C = \nu_0 + \sum_i \nu_i \ln W_i + \frac{1}{2}\sum_i\sum_j \gamma_{ij} \ln W_i \ln W_j + \nu_t \ln t + \omega_t (\ln t)^2 + \sum_i \omega_i \ln W_i \ln t \qquad (1)$$

Since a cost function is assumed to be homogeneous of degree one in prices,the translog cost function parameters must satisfy the following restrictions:

$$\sum_i \nu_i = 1; \qquad \sum_i \gamma_{ij} = 0; \qquad \sum_j \gamma_{ij} = 0.$$

In addition, a symmetry restriction is also assumed to hold.

$$\gamma_{ij} = \gamma_{ji} \qquad \text{for all i, j; } i \neq j$$

Utilizing Shepard's Lemma, $\partial C/\partial W_i = X_i$, a first derivative of a translog cost function generates a share equation.

$$\frac{\partial \ln C}{\partial \ln W_i} = \frac{X_i W_i}{C} = S_i \qquad i = 1,...,n \qquad (2)$$

$$S_i = \nu_i + \sum_j \gamma_{ij} \ln W_j + \omega_i \ln t \qquad i = 1,...,n \qquad (3)$$

$$\Delta S_i = \sum_j \gamma_{ij} \Delta \ln W_j + \omega_i \Delta \ln t \qquad i = 1,...,n \qquad (4)$$

For a discrete time period, a change in the factor share is a result of changes in factor prices and a change in technology. The direction of bias in technical change is measured by the change in the factor share, holding relative factor prices constant. In a many-factor case, technical change is biased toward factor i-saving, neutral, or i-using if the share of factor i in total costs decreases, stays constant, or increases.

$$B|_{\text{relative factor price}} = \frac{\partial S_i}{\partial t}\frac{1}{S_i} \begin{matrix} < \\ = \\ > \end{matrix} 0 \quad \begin{cases} \text{i-saving} \\ \text{neutral} \\ \text{i-using} \end{cases} \qquad (5)$$

Thus, changes in factor shares as a result of changes only in technology, ΔS_i* can be estimated from

$$\Delta S_i^* = \omega_i \Delta \ln t \qquad i = 1,\ldots,n \qquad (6)$$

The sign of ω_i determines the bias of technical change, and ω_i, can be interpreted as a constant rate of bias of factor i during the study period. If the rate of biased technical change is influenced by socioeconomic factors such as the political and social environment, ω_i can be written as a function of those factors. The vector of political and social factors is $M = (M_1, M_2, \ldots, M_m)$. The share equation can then be written as

$$S_i = \nu_i + \sum_j \gamma_{ij} \ln W_j + (\alpha_i + \sum_m \beta_{im} M_m) \ln t \qquad i = 1,\ldots,n \qquad (7)$$

The Allen partial elasticities of factor substitution (σ_{ij}) and price elasticities of factor demand (η_{ij}) may be calculated from the parameter estimates of share equations as follows.

$$\sigma_{ij} = \frac{1}{S_i S_j} \gamma_{ij} + 1 \qquad \text{for all } i, j; i \neq j \qquad (8)$$

$$\sigma_{ii} = \frac{1}{S_i^{\,2}} (\gamma_{ii} + S_i^{\,2} - S_i) \qquad \text{for all } i \qquad (9)$$

$$\eta_{ij} = \frac{\gamma_{ij}}{S_i} + S_j \qquad \text{for all } i, j; i \neq j \qquad (10)$$

$$\eta_{ii} = \frac{\gamma_{ii}}{S_i} + S_i - 1 \qquad \text{for all } i \qquad (11)$$

Estimation

The estimates of biased technical change for each factor are obtained from the share equation estimates. We assume that there are seven variable inputs: hired labor, self-employed labor, contract labor, chemicals, materials, land, and capital. Although there may be several socioeconomic factors that affect the rate of biased technical change, we include three major factors of interest: the number of illegal workers, farm policies, and the market share of large producers. The time variable is separated into two periods to capture potentially different structures of technical change before and after the Immigration Reform and Control Act of 1986. The first period is from 1969 to 1986, and the second period is from 1987 to 1999. In order to solve the singularity of the covariance matrix, a system of six share equations is estimated using seemingly unrelated regression (SUR). In this estimation, the share equation of capital is dropped, and the independent variables include the prices of factor inputs relative to the price of capital, socioeconomic variables, and a time variable. Each share equation can be written as

$$S_i = \nu_i + \sum_{j=1}^{6} \gamma_{ij} \ln \frac{W_j}{W_K} + (\alpha_{i1} + \sum_{m=1}^{3} \beta_{im1} M_m) \ln t + (\alpha_{i2} + \sum_{m=1}^{3} \beta_{im2} M_m) T_2 \ln t \qquad j = 1,...,6 \qquad (12)$$

where j includes all other variable inputs except capital, K represents capital, and M_m are the three socioeconomic variables. T_2 is a dummy variable, equal to one for years 1987 to 1999, and zero otherwise. A system of share equations requires that the summation of seven factor shares equals one. As a result, in addition to the homogeneity and symmetry constraints, the following additional parameter constraints must be met:

$$\sum_{i=1}^{7} \alpha_{i1} = \sum_{i=1}^{7} \alpha_{i2} = \sum_{i=1}^{7} \beta_{im1} = \sum_{i=1}^{7} \beta_{im2} = 0 \qquad (13)$$

for i = all variable inputs, and m = all socioeconomic variables.

Data

It is important for the study of biased technical change to use constant-quality prices since unadjusted-quality data will result in a biased estimation of parameters in the induced innovation model. In this paper, input prices are obtained from the unpublished U.S. data prepared by Eldon Ball, Economic Research Service, USDA. The difference between this data set and the published production account is that these data have more detailed categories of inputs, particularly contract labor which is included in the material inputs category in the published series. The input data include price and implicit quantity indices of aggregate inputs, providing total variable cost and input shares. Due to the limited availability of other socioeconomic variables, we use the study period from 1969 to 1999. We select seven variable input categories for this study: hired labor, self-employed labor, contract labor, chemicals, materials, land, and capital.

A detailed discussion of input data construction can be found in Ball, et al. (1999, 1997); the following is a brief summary. Prices of all types of labor take into account the change in demographics of farm labor force such as sex, age, and education, but not the legal status. The price of contract labor is assumed to be the same as the price of hired labor starting from 1996 due to the unavailability of the contract labor wage data. Agricultural chemicals include both fertilizers and pesticides. Agricultural chemicals are adjusted for variations in fertilizer nutrients and physical characteristics of pesticides such as toxicity and leaching potential using a hedonic regression approach. Materials include petroleum fuels, natural gas, electricity, and open-market purchases of feed, seed, and livestock inputs. Land price indices are adjusted for changes in the land stock quality using hedonic regression. Capital includes autos, trucks, tractors, other capital, inventories, and buildings.

Figure 1 illustrates the real price indices of inputs during 1969 to 1999. Prices of hired labor and self-employed labor are very close to each other, except for the last ten years. They are gradually increasing over time, particularly after IRCA in 1986. The price of contract labor increased more than hired and self-employed labor, except for the last four years. Price of contract labor was decreasing between 1979 and the passage of IRCA, but was increasing thereafter. The prices of self-employed and hired labor are very close throughout the whole period. The price of capital fluctuates considerably, but has a downward trend after IRCA. In the early 1970s, the price of chemicals dramatically increased until 1975 when it reached its highest level, and has had a downward trend thereafter. The price of materials was also increasing in the early 1970s, and then gradually declined. The land price increased dramatically during the mid 1970s to mid 1980s with high volatility, and decreased thereafter.

Figure 2 shows the expenditure share of each input during the same period. The share of hired labor is slightly increasing after IRCA, while the contract labor share is relatively stable over time. The share of hired labor, however, was gradually decreasing before IRCA, but slightly increasing afterward. The share of capital increased during the early 1970s to mid 1980s, except in 1982 and 1983,and gradually declined after IRCA. Shares of chemicals and materials are relatively stable over time. The share of land has a pattern similar to the share of capital.

The socioeconomic variables that influence the rate of technical bias are specified to reflect the number of illegal workers, farm policies, and the market share of large producers. These variables are argued to represent the demand for and supply of technological innovation and adoption in a political market. In the U.S. context, a lax immigration policy suggests to employers that relatively abundant supplies of unskilled labor will continue to be available. Correspondingly, the political market response is expected to place less emphasis on funding labor saving technological innovations; there would be less demand for such innovations than under the opposite scenario of highly restricted border crossings and stringent internal enforcement that all workers must be authorized for employment in the U.S. Data on the number of illegal farm workers are unavailable for the time period under analysis. We use instead, the number of deportable aliens located available from the INS statistical yearbook to represent the number of illegal workers. The number of all illegal workers is expected have a pattern similar to the number of illegal farm workers since most illegal workers are employed in low-skilled jobs such as in the hotel, restaurant, garment, and agricultural industries. Moreover, the level of apprehensions is a strong indicator of the political market. In the presence of large flows of illegal workers across the border as the U.S. has experienced during the 1980s and 1990s, high levels of apprehensions reflect a lax policy. By contrast, with a very stringent policy, there would be few apprehensions since there would be few attempts to cross the border for work. Although apprehension data at the farm level would be closer to the farm labor market, the stringency and frequency of enforcement are considerably less than at the border. More details on the apprehension data are available in the Statistical Yearbook of the Immigration and Naturalization Service.

A second socioeconomic variable is farm policies. There are several farm policies that could influence the direction of technological change, but many are not easily quantified for an empirical study. Farm policy is a direct impact of the political market on a change in technology. One of the most relevant and appropriate farm policies is government subsidies or payments. Since land is a major factor of agricultural production, a government payment that influences the use of land should also influence the bias in technological change. In this study, conservation program payments are used to represent farm policy. The higher the payment, the less incentive for farmers to use land for agricultural purposes. It includes payments under the conservation reserve, agricultural conservation, emergency conservation, and Great Plains programs. The conservation payment is obtained from farm income data from ERS, USDA.

The last socioeconomic variable is the market share of large producers. A higher market share of large producers is hypothesized to increase the effectiveness to influence the political market. Large producers have greater power and higher expected return to invest in time and efforts to change policies that may benefit them, but not small farmers. Their influences in the political market could influence the direction of technological change. For instance, large farmers could put more pressure on government to increase investment in research on farm mechanization that may not benefit small farmers who cannot afford the expensive machinery. We use the percentage of total market value of agricultural products sold and direct sales of $100,000 and over from Census of Agriculture. Since the census data are only available in 1969, 1974, 1978, 1982, 1987, 1992, and 1997, we interpolate the data for the remaining years using an estimated power function[1].

Figure 3 illustrates the socioeconomic variables. The number of deportable aliens increased over time with the peak in 1986. Conservation payments were relatively constant until 1986, increased dramatically in 1987, and gradually declined after 1994. The percentage of total market value of agricultural products sold and direct sales for $100,000 and over gradually increased over time.

[1] %market value = $33.224*t^{0.2849}$

Results

Parameter estimates of the share equations are summarized in table 1. The estimates of coefficients in the capital share equation and coefficients of capital price in each equation are derived from the other estimates based on homogeneity, symmetry, and adding-up restrictions in equation 13. The parameter signs of the socioeconomic variable times the variable in each share equation (β_{im} in equation 12) show the direction of the impact of the socioeconomic variable on technical change. Before IRCA, the number of illegal workers significantly induces contract labor and materials saving technology, but significantly induces capital using technology. Although the signs indicate that it also induces hired labor and self-employed workers saving technology, the estimates are not statistically significant. Conservation payments significantly induce capital saving technology, but also induce hired labor and contract labor using technology. The proportion of the market share of large producers significantly induces contract labor and materials using technology.

After IRCA, the number of illegal workers significantly induces contract labor using technology, but does not significantly induce other inputs. This result is consistent with Huffman who shows that there is an increasing amount of contract labor after IRCA, particularly in California and Florida. Even though IRCA was designed to reduce the number of illegal workers, all indicators suggest an increasing flow of illegal immigrants. In contrast to the pre-IRCA period, conservation payments significantly induce hired labor and contract labor saving technology, but induce capital using technology. It is somewhat unexpected that conservation payments do not have an impact on land-saving technology. The conservation payment may counteract the effect of the incentive not to use land for agricultural production and the incentive not to save land because of the government subsidy. The market share of large producers does not have a significant effect on biased technological change for any input during the post-IRCA period.

The rate of biased technological change is a linear function of socioeconomic variables. Table 2 summarizes the estimates of biased technological change calculated at the means of the variables. The signs of the rate of biased technological change in Table 2 indicate the combined effects of socioeconomic variables on the direction of technological change. Before IRCA, the technology was biased toward self-employed labor saving, but neutral (or insignificant) for hired labor and contract labor. The result is the similar to Binswanger's (1974a, 1974b) and Antle's results that the technology was labor saving in the early and mid 1900s. The technology was also biased toward chemical and material using during the pre-IRCA period. This result also coincides with Binswanger's (1974a, 1974b) and Antle's findings. The technology was neutral for land and capital, but most other studies have found that the technology was capital using during this period. After IRCA, the technology was biased toward self-employed labor saving and contract labor using, but neutral for hired labor. Similar to the pre-IRCA period, the technology was biased toward chemical and material using. Lastly, the technology was capital saving and land neutral during post-IRCA period.

Allen elasticities of substitution and own price demand elasticities are calculated from the parameter estimates in Table 1. Except for hired labor and self-employed labor, elasticities of demand have the correct sign. Only the elasticities of demand for chemicals and capital, however, are statistically significant. The elasticities of demand for machinery, fertilizer and land are close to those found by Binswanger (1974a), but the elasticity of labor found by Binswanger (1974a) is close to unity, thus much more elastic than our results.

Although the elasticities of substitution between self-employed and hired labor, and between self-employed and contract labor are elastic and negative, they are not statistically significant. We also cannot say that self-employed workers are compliments for hired and contract labor. Elasticities of substitution between capital and each type of labor are positive and significant as expected, indicating that capital is a substitute for labor. Elasticity of substitution between capital and contract labor is very elastic, suggesting that the adoption of mechanization is very sensitive to changes in the price of contract labor. Elasticities of substitution between capital and chemicals and between capital and materials are also positive and significant. This implies that capital is a substitute for chemicals and materials as well. This is in contrast to Binswanger's results (1974a). He found that machinery and fertilizer were compliments, although the estimate was not statistically significant. However, he found that the complementarity between fertilizer and labor was significant. Our study also shows that the elasticity of substitution between contract labor and chemicals is significantly negative and very elastic. The elasticity of substitution between contract labor and land is negative and very elastic, implying that contract labor and land are compliments.

Conclusions

This paper introduces an alternative set of socioeconomic variables that capture the political and social influences on U.S. agricultural technology over the 1969 to 1999 period. The socioeconomic factors are found to be important in determining the direction and the rate of technological change. Incorporating these factors in the empirical study of biased technological change broadens our understanding of the mechanism of demand for and supply of technological change.

Our results show that an increasingly illegal workforce significantly induces contract labor using technology, and significantly induces capital saving technology in the post-IRCA period while it induces contract labor saving technology in the pre-IRCA period. Conservation payments significantly induce capital saving technology, and hired labor and contract labor using technology in the pre-IRCA period, but they significantly induce hired labor saving, contract labor saving, and capital using technology in the post-IRCA period. The market share of large producers significantly induces contract labor and materials using technology before IRCA, but does not significantly influence any biased technology after IRCA.

The combined effects of the socioeconomic variables on the direction of technological change show that the technology was biased toward self-employed labor saving, neutral for hired labor and contract labor, and chemical and material using during the pre-IRCA period. After IRCA, the technology remains biased toward self-employed labor saving and neutral for hired labor, but becomes contract labor using. The technology remains biased toward chemical and material using, land neutral, and becomes capital saving in the post-IRCA period.

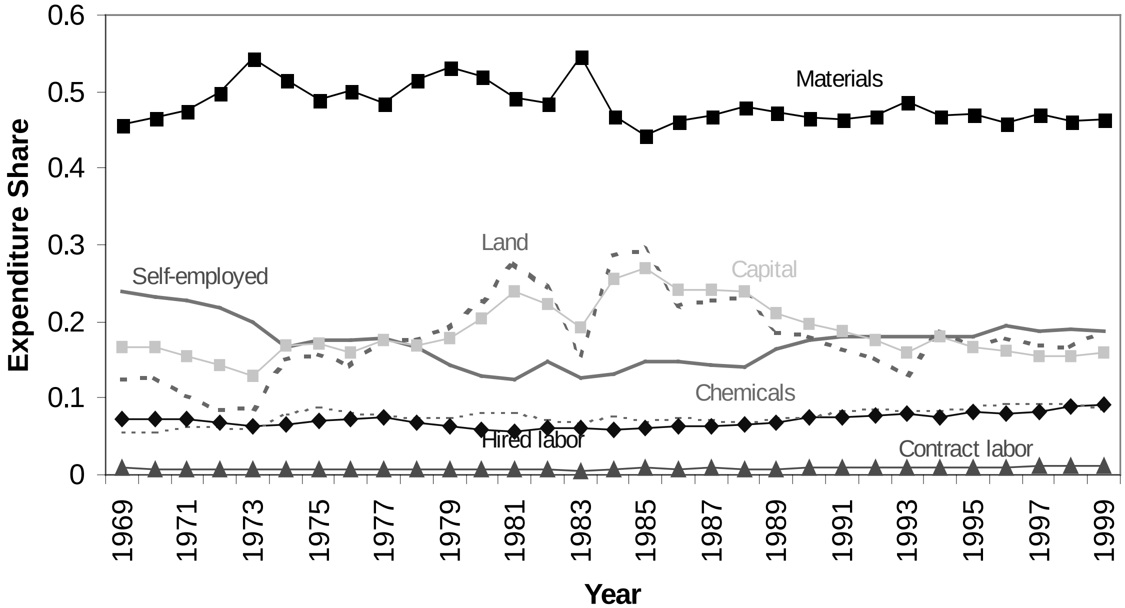

Figure1. Expenditure Share of Inputs

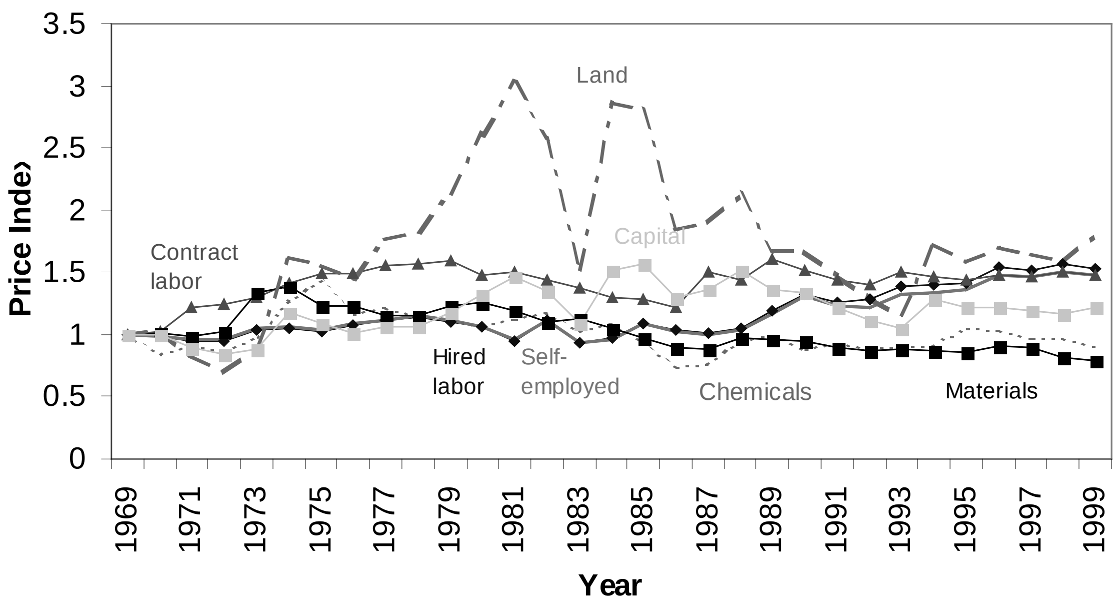

Figure 2. Input Price Indices

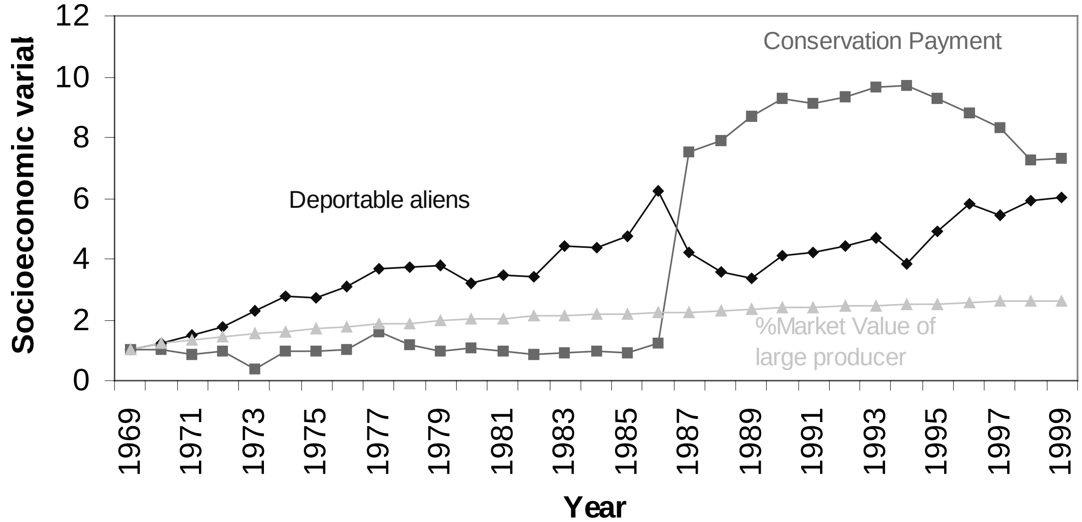

Figure 3. Socioeconomic Variables

Table1. Restricted Estimates of the Coefficients of the Translog Cost Function and Standard Errors

Input Price \ Factor Share	Hired Labor	Self-employed Labor	Contract Labor	Chemicals	Materials	Land	Capital
Hired Labor	0.1006						
	(0.0571)						
Self-employed Labor	-0.0880	0.2075*					
	(0.0567)	(0.0577)					
Contract Labor	0.0119	-0.0175	0.0024				
	(0.0077)	(0.0090)	(0.0056)				
Chemicals	0.0016	-0.0042	-0.0062	0.0206*			
	(0.0049)	(0.0078)	(0.0038)	(0.0105)			
Materials	-0.0230*	-0.0844*	0.0028	-0.0249	0.2223*		
	(0.0078)	(0.0143)	(0.0062)	(0.0135)	(0.0278)		
Land	-0.0130*	-0.0395*	-0.0230*	-0.0106	-0.0537*	0.1428*	
	(0.0046)	(0.0087)	(0.0047)	(0.0082)	(0.0141)	(0.0158)	
Capital	0.0099	0.0260	0.0295*	0.0237	-0.0392	-0.0030	-0.0469
	(0.0086)	(0.0157)	(0.0101)	(0.0151)	(0.0256)	(0.0244)	(0.0515)
Constant*ln(t)	-0.0011	0.0060	-0.0108	0.0249	-0.0380	-0.0217	0.0408
	(0.0075)	(0.0126)	(0.0087)	(0.0135)	(0.0265)	(0.0213)	(0.0403)
Aliens*ln(t)	-0.0030	-0.0060	-0.0073*	-0.0054	-0.0160*	-0.0009	0.0385*
	(0.0024)	(0.0041)	(0.0027)	(0.0044)	(0.0078)	(0.0074)	(0.0130)
Conservation Payment*ln(t)	0.00003*	0.00001	0.00003*	0.00003	0.00003	-0.00002	-0.0001*
	(0.00001)	(0.00002)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00005)
Market Share*ln(t)	-0.00003	-0.0004	0.00026*	-0.00017	0.0011*	0.0004	-0.0012
	(0.0001)	(0.0002)	(0.00013)	(0.00021)	(0.0004)	(0.0003)	(0.00062)
Constant*T_2ln(t)	-.022263	-0.0420	0.0010	-0.0407	-0.0119	0.0546	0.0613
	.014516	(0.0227)	(0.0157)	(0.0235)	(0.0424)	(0.0364)	(0.0708)
Aliens*T2ln(t)	0.0041	0.0080	0.0082*	0.0109	0.0076	0.0023	-0.0412
	(0.0034)	(0.0058)	(0.0040)	(0.0062)	(0.0112)	(0.0103)	(0.0191)
Conservation Payment*T2ln(t)	-0.00003*	-0.000008	-0.00003*	-0.00003	-0.00004	0.00002	0.0001*
	(0.00001)	(0.00002)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00005)
Market Share*T2ln(t)	0.0003	0.0004	-0.0001	0.0003	0.0002	-0.0008	-0.0003
	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0006)	(0.0006)	(0.0010)
Intercept	0.0399*	0.1652*	-0.0684*	0.0218	0.1960*	0.5956*	0.0499
	(0.0164)	(0.0306)	(0.0160)	0.0279	(0.0488)	(0.0532)	(0.0823)

* Significant at 95% confidence level.

Table2. Estimates of Rates of Biased Technical Change and Standard Errors

	Hired Labor	Self-employed	Contract Labor	Chemicals	Materials	Land	Capital
	-0.00022	-0.0186*	0.0039	0.0156*	0.0228*	-0.0044	-0.0191
Before IRCA	(0.0021)	(0.0033)	(0.0022)	(0.0033)	(0.0059)	(0.0054)	(0.0103)
	-0.0012	-0.0255*	0.0028*	0.0109*	0.0328*	-0.0015	-0.0183*
After IRCA	(0.0016)	(0.0025)	(0.0014)	(0.0021)	(0.0040)	(0.0035)	(0.0060)

* Significant at 95% confidence level.

Table 3. Estimates of Allen elasticities of substitution, own price elasticities of factor demand, and standard errors

	Hired Labor	Self-employed Labor	Contract Labor	Chemicals	Materials	Land	Capital
Elasticities of Substitution							
Hired Labor	7.0269	-6.1971	21.6624	1.2907	0.3259	-0.0311	1.7488*
	(11.4457)	(4.6431)	(13.4198)	(0.8929)	(0.2292)	(0.3681)	(0.6516)
Self-employed Labor		2.1498	-11.3688	0.6841	-0.0070	-0.2725	1.8027*
		(1.9244)	(6.3737)	(0.5838)	(0.1714)	(0.2802)	(0.4863)
Contract Labor			-84.7177	-8.8893	1.7190	-14.6849*	20.3049*
			(83.1261)	(6.0493)	(1.5735)	(3.2141)	(6.6191)
Chemicals				-8.50238*	0.3345	0.2364	2.6451*
				1.76132	(0.36091)	(0.5957)	(1.0433)
Materials					-0.1171	0.3805*	0.5672*
					(0.1188)	(0.1628)	(0.2827)
Land						-0.1331	0.9094
						(0.4924)	(0.7299)
Capital							-5.6931*
							(1.4759)
Elasticities of Demand	0.4961	0.3721	-0.6924	-0.6563*	-0.0567	-0.0238	-1.0640*
	(0.8081)	(0.3331)	(0.6794)	(0.1360)	(0.0575)	(0.0882)	(0.2758)

* Significant at 95% confidence level.

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