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Minimum Wages and Social Welfare in Agriculture: Results from a Programming Study of Mexico's Pacific Northwest*

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In most countries in which the agricultural sector is one of some importance, a pressing economic and social problem is the unacceptably low level of income in agriculture. Often, minimum wage laws are enacted in attempts to directly raise the wage earnings of hired agricultural labor. The theoretical implications of such laws have been widely discussed (see, for example, [2], [7] and [8]) and need not be reviewed here. However, attempts at empirical estimation of both the direct and indirect effects have not enjoyed widespread success. These empirical studies have ranged from simple analysis of labor's share in value added over industries [5] and [8], to estimations of wage determination equations [4], to the more comprehensive approach of Tyrchniewicz and Schuh [11] where supply and demand equations for the various components of the farm labor market are estimated.

In general, previous attempts at empirical estimation of minimum wage effects have suffered on two accounts: in situations where minimum wage laws exist, it is difficult to estimate what would occur in the absence of such laws; and analyses which consider only the hired labor market and ignore the ramifications of, say, induced product output and price changes, can yield invalid results since the problem is general equilibrium in nature.[1] The approach

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[1]Bauer did allow for output changes in an analysis of the effects of technology changes on the farm labor market. His results varied sharply according to the value assumed for the product price elasticity [1, pp. 616-7].

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followed here attempts to circumvent some of these problems by employing a linear programming model as a simulation tool, and including in the model measures of the welfare of the various groups involved as well as output price determining functions. By solving this model for various values of the hired labor minimum wage, we can trace out the corresponding variations in input usage, output levels, and prices. In the sections to follow, we will briefly describe the structure of the model and the assumptions involved, and discuss the results of the simulation experiments.

The Programming Model

The programming model (PACIFICO) was initially designed as a counterpart to the World Bank's large planning model of the Mexican agricultural sector, CHAC [3]. Thus it shares many of the features of that model including alternative technological choices in production, and an objective function which maximizes the sum of consumers' and producers' surpluses.

PACIFICO encompasses the production and distribution of the sixteen primary agricultural outputs in the Northwest region, defined roughly as the states of Sonora and Sinaloa. Production is spatially differentiated by five district submodels. In a given submodel, production techniques are again differentiated according to different possible planting dates, different water sources, and different degrees of mechanization. In general, three degrees of mechanization are possible for a given output; fully mechanized, partially mechanized, and non-mechanized. These alternative techniques vary only in the labor, tractor, and draft animal requirements, and are based on ratios observed in the base period of the model, 1968. Some of the non-mechanized techniques were deleted during a series of testing procedures if they failed to come into the basis at unrealistically low wage rates [6, pp. 27-35].

In addition to other inputs, the model registers annual demands for tractors with implements and draft animals (mules), and monthly demands for family farm labor and hired day labor. No possible productivity differentials between these two sources of labor are recognized. By charging a fixed reservation wage rate (ten pesos per day) to the objective function, a rate which is about two fifths the observed day labor wage rate, we assure that family farm labor will be exhausted before day labor is "hired" in any month.

In the basic version of PACIFICO, a set of monthly day labor "hiring" activities permit relaxation of the family farm labor constraints at a fixed observed wage rate. These activities are bounded at the number of laborers assumed to be in the region's "pool", i.e., available for employment at the going wage. For those months in which the demand for labor is expected to exceed the number in the pool, an upward-sloping stepped supply function is inserted to permit monthly migration into the pool, both from other professions in the region, and from neighboring regions.

For the experiments described in this note, however, we are interested only in the labor demand side, thus shall assume that an infinite supply of labor is available at the given wage rate.

For each output, a downward-sloping demand function was constructed, using estimates of the national price elasticities and the region's share of the commodity in consumption from the CHAC study. These functions were derived so that a solution to the regional model would be representative of the complete sector.[2] Most of the resultant demand functions were inelastic, with the weighted average elasticity being about -0.5.

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[2]The derivation of these functions is described in [6, pp. 50-62].

Wage Variation Experiments

In the observation year (1968), the minimum wage in the region was twenty-six pesos per day. The solution to the model using this rate and assuming infinite labor availability is shown in the rightmost column of Table I. (This solution is taken to be the basic case.) The experiments involve progressively lowering the day labor minimum wage rate, holding all other input parameters constant (including the family farm labor reservation wage rate).

The results of these experiments require elaboration, so we shall discuss each of the items separately. Consider first the variation in annual-equivalent day labor employment. This variable increased monotonically as the wage rate was reduced (see Figure I). The arc elasticities, shown in the Figure, are enlightening. In the neighborhood of the current wage, the demand for labor function is highly inelastic.[3] But as the wage is reduced, the function becomes less inelastic until, in the last segments, the elasticity is above unity. We posit the following explanation for this somewhat curious behavior: Apparently a large increase in the capital-labor price ratio is required before significant labor substitution can take place, implying that the limits of capital-for-labor substitution are approached with the current wage. Perhaps even higher wage rates would not significantly affect employment of day laborers. Note also the variations in land use by degree of mechanization: a reduction in the wage rate to 20 pesos per day is required before any significant shift away from fully mechanized techniques is induced.

[3]Schuh [10, p. 317] obtained values of -.12 and -.40 for short and long run agricultural labor demand elasticities using econometric techniques and U.S. time series data.

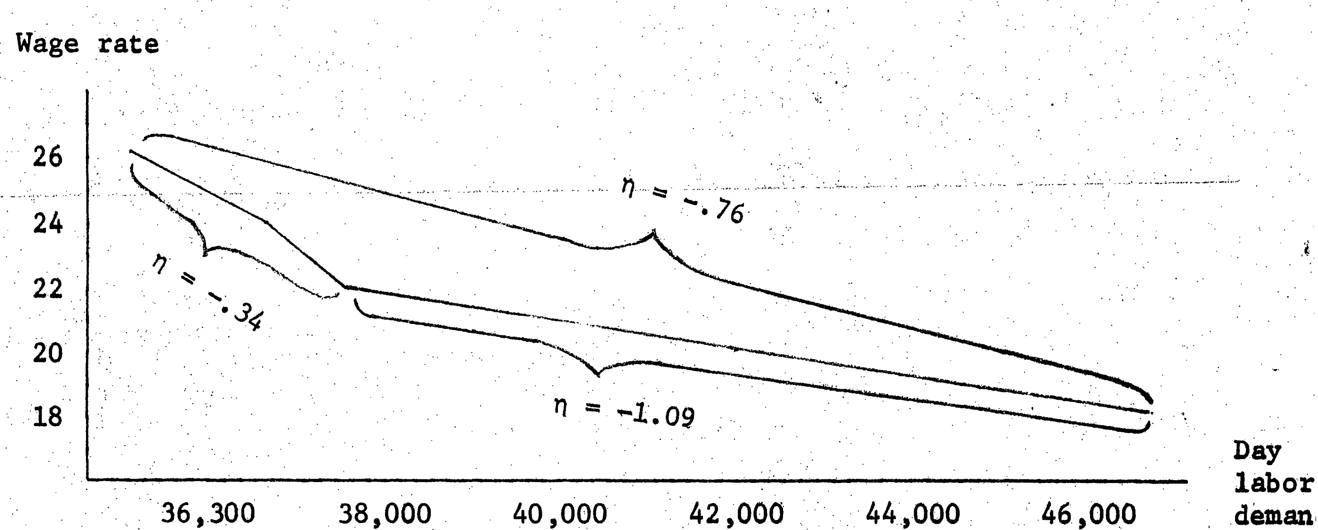
Table I

Effects of Wage Variations

	Wage				
	18 pesos	20 pesos	22 pesos	24 pesos	26 pesos
Maximand	810.56	808.20	805.99	804.03	802.08
Consumers' surplus	647.93	645.49	638.67	635.95	633.31
Producers' surplus	162.63	162.71	167.32	168.08	168.77
Producers' income	$198.43	199.27	203.85	204.57	205.55
Wage payments	$ 22.16	22.24	21.73	23.31	24.26
Labor per capita income	$177.00	$179.00	$174.00	$186.00	$194.00
Regional income[4]	$230.86	231.89	236.02	238.28	240.25
Day labor employment	46.64	42.32	37.42	36.79	35.34
Family farm labor employment	135.59	138.50	138.37	138.23	139.34
Tractor use	13.19	13.19	13.40	13.36	13.39
Draft animal use	4.12	4.24	1.68	1.74	1.71
Land use by technique:					
Mechanized	87%	90%	93%	93%	94%
Partially mechanized	9%	6%	6%	6%	5%
Non-mechanized	4%	4%	1%	1%	1%
Price Index	.976	.980	.991	.994	1.00

[4] Regional income is the sum of producers' income, hired labor wage payments, and tractor operators' income (not shown).

Figure I
Day Labor Demand Curve



As expected from the elasticities, the highest levels of total wage payments and per capita day labor income were attained at the highest wage. These per capita incomes were calculated on the basis of the number of day laborers in the region.

The maximand was not particularly sensitive to the wage variations, but the redistribution between producers' and consumers' surpluses was significant. As could be expected, consumers gain slightly when the cost of the labor input falls. But producers appear to be better off, both in terms of real income (producers' surplus) and money income, at the higher wage rates. This somewhat surprising result is due to the output effect and the form of the implicit supply function: as the minimum wage is increased, producers' revenue naturally increases as supply decreases since demand is inelastic, and total producers' costs increase only marginally since the supply function is affected only at higher ranges of output (i.e., the intercept remains unchanged since some production can occur using only family farm labor).

Figure II

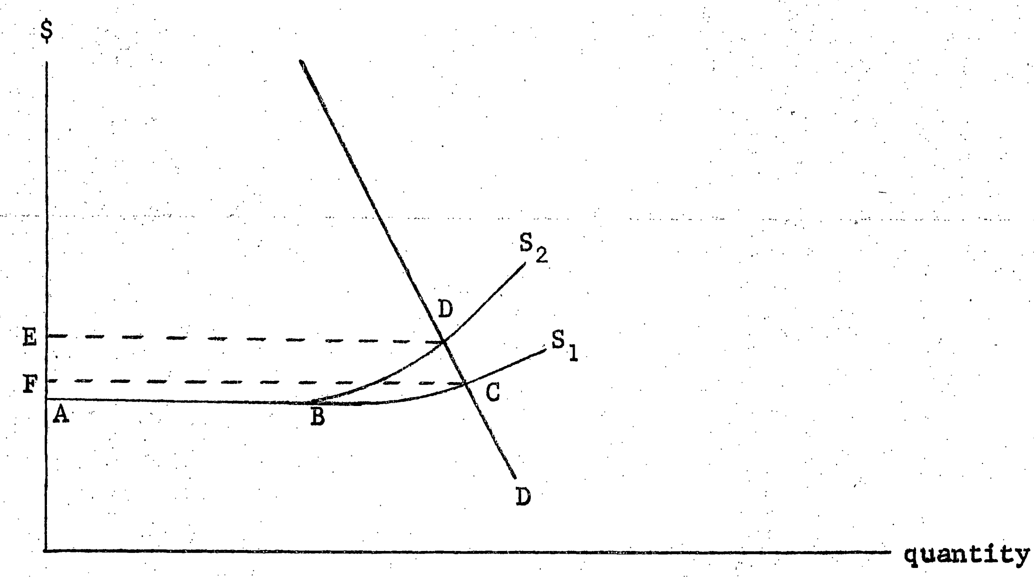


Figure II illustrates such a case. D is the inelastic demand function, S_1 is the supply function at a low hired labor wage rate, and S_2 the supply function at a higher wage rate. With S_1 prevailing, producers' surplus is ABCF which can be (is in this illustration and in the simulations) smaller than ABDE, when S_2 applies. The point B, where S_1 and S_2 diverge, can be considered the point at which family farm labor is exhausted and outside labor must be hired.

The result that producers may gain when the cost of one of their inputs rises may not be confined to this example. Indeed, this result occurred in several experiments in the CHAC study: farmers' income increased under policy changes which increased the wage rate, interest rate, and fertilizer subsidies in separate simulations. In general, these results were attributed to the dominance of the output effect and associated price increases [3, pp. 394-5]. However, there were also cases (such as a large increase in the interest rate), in which farmers' income fell. Thus it is not easy to determine *a priori* the direction of change in farmers' welfare when input prices vary.

Necessary conditions are that the product demand functions be inelastic and that producers be competitive in that they equate price and marginal cost in output decisions. Furthermore, the fewer the units of the input whose price is being increased are required in production, the more likely it will be that farmers will be better off. (Recall that, in the PACIFICO case, some production could take place using only family farm labor and no hired labor.)

If any conclusions can be drawn from these experiments, they tend to support the existing minimum wage laws. Since sharp reductions in the minimum wage are probably out of the question, there appears to be little scope for significantly increasing the demand for labor in the region without, perhaps, resorting to extreme policies such as taxation of tractor services. Given Mexico's desire to increase agricultural production so that it may better compete in world markets, such a policy would be out of the question.

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