Poverty, Legal Status, and Pay Basis:

The Case of U.S. Agriculture

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Abstract

U.S. farmworkers primarily are paid either on a piecerate or timerate basis. This paper studies relationships between wage contracts, legal status, and poverty using a representative survey of employed farmworkers which includes detailed information on legal status, including whether a worker is illegal. Results indicate that while piecerate workers earn more per hour on average, they work fewer hours and face greater poverty risk than their timerate counterparts. Furthermore, foreign-born workers, especially those who are illegal, are overrepresented in piecerate positions, and analysis shows that the effect of piecerate pay on poverty is positive and correlated with being foreign-born. Heterogeneity in the effect of piecerate pay on worker outcomes across demographic, employment, temporal, and regional groups also is examined.

I Introduction

This paper studies the relationship between poverty, legal status, and the wage payment methods available to farmworkers in the U.S., a group that is among the poorest in the country. The agricultural labor force in 2006 was approximately 3 million (Kandel (2008)). This includes 2.05 million self-employed farmers and unpaid family members and 1.01 million hired farmworkers. Total farm labor expenditure that year was $24.4 billion, or 10.2% of overall agricultural cash receipts (with higher percentages observed in states, such as California, with above average labor-intensive production). Hired laborers are largely immigrant, often undocumented, and crucial to labor-intensive farm activity. Furthermore, U.S. hired farmwork is characterized by high turnover and the prevalence of migrant streams following seasonal activity.

Estimates of the fraction of the agricultural population that is undocumented vary. Passel (2006), using a residual method based on Current Population Survey and Department of Homeland Security data, estimates that 24% of all workers employed in farming occupations are undocumented. Calculations based on the survey that will be used in this paper suggest that 51% of recent workers are undocumented, though the percentage may be greater than 51% if there is misreporting of legal status.

Almost 40% of U.S. farmworkers have family incomes below the poverty level, and of those in poverty, more than 85% are immigrant.[1] Agricultural wage contracts are primarily either time-based (e.g., hourly) or productivity-based (e.g., piecerate),[2] and immigrant workers (especially illegal immigrant workers) are more frequently observed in piecerate payment schemes than are U.S. born workers.

This paper explores links between payment schemes, immigration (and legal) status, and poverty outcomes. Piecerate workers are shown to earn more per hour on average but to work fewer hours per week. Weeks worked in agriculture, however, are similar across payment structures. In contrast, piecerate workers report higher numbers of weeks outside of the U.S. annually and fewer weeks in nonfarm work than do timerate workers. Together, these statistics suggest uncertainty as to whether piecerate workers face more or less poverty risk than do their timerate counterparts. Analysis of reported annual family incomes suggests that piecerate workers are more likely to fall below U.S. poverty thresholds than are hourly workers and that immigrants, especially illegal immigrants, are

more likely observed in piecerate positions all else equal. These empirical regularities suggest that payment structure may be a relevant consideration for poverty studies pertaining to agriculture and other labor markets characterized by high percentages of foreign-born workers.

The paper is organized as follows. Section II examines background literature on sorting and on incentives and productivity as related to piecerate and timerate contract structures. Section III presents a theoretical framework of contract choice and poverty outcomes in which workers sort into payment schemes based on preference, effort, ability, and risk tolerance. Section IV presents the national data source on agricultural workers exploited in this paper. Section V quantifies the effect of piecerate pay on wages and hours using these data while controlling for observable and unobservable characteristics of workers. Section VI presents results allowing for heterogeneity of the effect of piecerate pay on worker outcomes on the basis of demographic, employment-related, temporal, and regional characteristics. Section VII considers sensitivity to the definitions of piecerate and timerate. Specifically, the definition of piecerate is extended to include workers indicating combination piecerate and timerate pay, and the definition of timerate is modified to include salary workers in addition to those paid by the hour. Finally, section VIII discusses public policy implications and concludes. If piecerate workers are more likely to be observed below the poverty threshold and if they are also more likely to be immigrants, a question for welfare economics is whether this is socially desirable. Discussion focuses on whether sorting can be viewed as optimal and whether piecerate payment is a choice on the part of the worker or the result of market failure.

II Sorting, Incentives, Productivity, and Poverty

Much of the specific literature on piecerate versus timerate payment has focused on how compensation structure affects both worker sorting across firms, and incentives and productivity. Less literature has examined inequality aspects.

Sorting

Lazear (1986) presents a theoretical model of sorting such that salary workers are of lower quality and more homogeneous than are their piecerate paid counterparts. Intuitively, higher quality workers (or those who are more physically able, for example, for the purpose of fruit and vegetable

picking) would choose to be paid based on observable output in anticipation of higher productivity, whereas lower quality workers would prefer timerate work.

In the agricultural labor market literature, Rubin and Perloff (1993) model the decision by employees to work for piecerate in California. They estimate a structural probit model that controls for sample selectivity, finding that the earnings differential between piecerate and timerate workers is primarily a function of age, with prime age workers being less likely to engage in piecerate positions in comparison to those who are either younger or older.[3] The authors conclude that factors contributing to disutility of piecerate work (e.g., increased effort and income variability) outweigh benefits (e.g., increased expected pay) for prime age workers.

Foster and Rosenzweig (1996) examine possible reasons that generate the observed distributions of piecerate and timerate workers using a sample of farming households in the Philippines. They consider comparative advantage, worker and employer preferences for piecerate or timerate, and informational asymmetries. The authors find that comparative advantage is a key determinant of sorting for their case study. Newman and Jarvis (2000) present complementary evidence. They find that a theory of equalizing differences is consistent with observed wage variation in Chilean grape growing and argue that the piecerate pay method allows heterogeneous workers to sort among employers.

Recent research has suggested worker sorting based on direct measures of preference. Green and Heywood (2008), for example, use the British Household Panel Survey to estimate relationships between compensation scheme and job satisfaction. They find that piecerate pay is associated with increased overall satisfaction and satisfaction with wage and hours specifically, but decreased satisfaction with the nature of work.

Incentives and Productivity

Literature on incentives and productivity has focused on how effort translates into productivity. Using Bureau of Labor Statistics Industry Wage Surveys, Seiler (1984) establishes that piecerate earnings distributions within manufacturing are characterized by a higher mean (consistent with theoretical predictions of increased effort), but larger variance than timerate earnings distributions. This result holds both within firms and within manufacturing occupations. Seiler argues that piecerate workers receive an earnings premium and decomposes this premium into a compensating

wage differential for increased risk, and thus increased income variation under piecerate, and into an incentive-effort effect since piecerate workers would exude more effort if they were compensated for it. Risky, ambitious workers therefore would differentiate themselves under piecerate pay. Seiler measures earnings as hourly wages and finds that piecerate workers were 40% more productive than timerate workers and were paid 20% higher hourly wages. Related to incentive-effort effects, Foster and Rosenzweig (1994) show that timerate payment schemes and share-tenancy contracts reduce effort compared to piecerate payment schemes and on-farm employment for a small sample of Philippine farmers. The authors measure effort in part by calorie consumption.

Lazear (2000) presents a case study of Safelite Glass Corporation in Ohio that underwent a switch from timerate pay to piecerate pay after an ownership change. Lazear finds that this switch was associated with a 10% increase in pay and 44% increase in productivity.[4] Lazear measures earnings on a monthly basis.[5] He shows that this increase is the result of both productivity and sorting effects: both increases in current worker production and the hiring of new more productive workers was evident in his data. Similarly, Paarsch and Shearer (2000) find that piecerate workers are 22.6% more productive than are those paid timerate in a British Columbian tree-planting operation. However, this difference is only 14.3% after adjustment for decreases in quality associated with piecerate work. Shearer (2004), also using data from British Columbian tree-planting, finds that the average productivity gain from an experimental shift from timerate to piecerate would be around 20%.

In related work, Freeman and Kleiner (2005) find that piecerate compensation increases productivity in American shoe manufacturing. However, they find that this gain is at the expense of profitability. After their case study firm switched from piecerate to timerate compensation, productivity fell about 6%. However, this was offset by increased profits overall, indicating a negative relationship between profits and productivity.

Poverty

While key literature to date has established sorting by workers and positive wage differentials between piecerate and timerate work, little attention has been given to other differences (such as in hours over a pay period or weeks worked per year) that may result in lower total income for piecerate workers and therefore increased incidences of poverty. Exceptions include Neilson and Stowe (2008)

that examine how incentive-effort effects of piecerate work vary under alternate behavioral and inequality assumptions, and Lemieux, MacLeod, and Parent (2009) that find that performance pay is a mechanism that converts underlying returns to skill differences into wage inequality in high wage U.S. workers (above the eightieth percentile). While bonus pay and commissions may be more prevalent in the population studied by Lemieux, MacLeod, and Parent (2009), traditional piecerate pay may be more prevalent in low wage occupations as in the one studied here. Furthermore, Freeman and Kleiner (2005) cite evidence from the Census of Manufacturing that establishments with higher percentages of (generally low wage) production workers are more likely to pay piecerate than are establishments with lower percentages of production workers.[6]

Gisser and Dávila (1998) document wage gaps between farm and nonfarm work and find that differences decrease substantially once cost-of-living and demographic factor adjustments are made. They argue that positive selective outmigration from rural to urban sectors operates as an equilibrating force. Given their model, it is not unexpected to find significant poverty among both historical and current U.S. farmworkers.

In agriculture, the focus of the case study presented here, harvest activity is highly correlated with piecerate payment. Seasonal workers are often migratory and may not have consistent work or pay in off-seasons (either by choice or circumstance), thus contributing to poverty outcomes. A primary contribution of this paper therefore is to develop an understanding of how farmworkers under various payment schemes and their families fare in the longer term and whether equity considerations warrant public policy response.

III Theoretical Framework

Piecerate versus Timerate Pay Basis

The theoretical framework draws on Lazear (2000). Let a worker's utility be specified as $U(I, E)$ where I is income and E is effort. Utility in increasing in income and decreasing in effort. Output, Y, is a function of effort, broadly-defined ability (A), and a stochastic component (τ), and is written as $Y = f(E, A, \tau)$. The average value of the random variable τ is assumed to be known by the worker (though the realized value is discovered only ex-post to pay basis choice) and is imagined to include shocks such as weather events. Output is increasing in all arguments.[7] Therefore, high

ability workers with lower effort and lower ability workers with high effort could potentially produce equivalent output.[8]

Firms (farms) choose payment schemes based on benefit and cost calculations.[9] Benefits for hourly wages as opposed to piecerate might include advantages in terms of quality of output under an hourly compensation scheme if piecerate workers rush to maximize number of units produced. Costs for hourly wages over piecerate might include lower output levels if piecerate workers exude more effort due to sorting and incentive effects and this translates into increased output.[10] Monitoring costs also are different under piecerate and timerate schemes. On one hand, timerate schemes may have lower monitoring costs since firms can devote fewer resources to tallying output. On the other hand, monitoring costs may be higher under timerate since output may be harder to measure (especially in the case of nonproduction work).

For the case of migrant farm labor, the prevalence of performance pay relates to both relatively easy measurement of output by the employer and low "noise" in the production process. In addition, the seasonality of farmwork limits ongoing relationships between employer and employee further supporting the use of piecerate payment schemes. The starting point for the theoretical illustration and empirical exercises here abstracts from demand dynamics and focuses on the supply side. The assumption is that each firm (farm) has established a payment structure to best fit its needs given its particular benefits and costs. Farms offering hourly wages pay an equilibrium wage rate W in exchange for a minimum output level Y_0.[11] (Workers producing below Y_0 will ultimately be fired.) Minimum effort is a function of ability and is denoted $E_0(A)$. High ability workers may be hypothesized to have lower effort costs.

Farms offering piecerate payment pay an equilibrium price per unit of output p. Income to piecerate workers therefore is calculated as pY, where Y is interpreted as an expected value in the worker's problem. If both types of employment are available, agents sort into leisure (no wage income or effort), hourly work, or piecerate work according to ability level cutoffs and given their particular degrees of risk tolerance and personal preference as indicated by their utility functions. Thus, sorting into payment structure is modeled as a choice by the worker.[12] In equilibrium, hourly-equivalent wages across payment structures are set such that the marginal worker is indifferent between the two work types and pay modes.

Ability level cutoffs can be defined implicitly in terms of the parameters of the model. Workers

with ability A would be observed in the piecerate position if:

$$U(pf(E^*(A), A, \tau), E^*(A)) > U(W, E_0(A)) \tag{1}$$

and

$$U(pf(E^*(A), A, \tau), E^*(A)) > U(0, 0) \tag{2}$$

where E^* denotes the optimal piecerate effort level chosen by a worker with ability A. Therefore, workers choosing piecerate have greater expected utilities of the piecerate over the timerate position and also expect the utility associated with piecerate to be greater than the utility of choosing no employment and thus having $U(0, 0)$. Likewise, workers would be observed in the timerate employment if:

$$U(W, E_0(A)) > U(pf(E^*(A), A, \tau), E^*(A)) \tag{3}$$

and

$$U(W, E_0(A)) > U(0, 0) \tag{4}$$

Higher ability workers may derive more utility from piecerate than timerate positions given their lower effort costs to produce a given output level. Risk-loving workers, however, might choose piecerate work if they weigh higher mean income associated with piecerate work above higher variance. Assuming there is a distribution of risk tolerance in the population, individuals with higher degrees of risk aversion will choose timerate positions over piecerate work holding ability constant. Theoretically, $U(0, 0)$ can be positive or negative depending on individual attitudes.[13] Sorting into payment structures based on characteristics such as ability will form the basis of the empirical method. Namely, selection will be modeled as a function of unobservables.

Legal Status

Equilibrium parameters may vary by legal status group if, for example, illegal workers are offered lower wages than legal workers. Workers therefore sort into compensation schemes by solving:

$$\max[U(W^l, E_0(A)), U(p^l f(E^*(A), A, \tau), E^*(A)), U(0, 0)] \tag{5}$$

where the superscript l refers to the legal status group to which a worker belongs.[14] Thus, workers trade off more variable but higher expected payoff of piecerate work, where effort in endogenous, for lower variance payoff (or zero variance) of hourly work with enforced effort levels. The parameters of these tradeoffs may vary based on worker characteristics, and level cutoffs can be implicitly written as in the previous section.[15] Partitions on other demographic, employment, and regional groups also can be thought of in modifications of this framework.

Poverty

If poverty is indicated by exogenously determined threshold values (as in the case in the U.S. for assistance program eligibility and statistical purposes), workers would be defined as in poverty if:

$$W^l + p^l f(E^*(A), A) + N < T \tag{6}$$

where T is the relevant threshold value for the individual based on his or her family size, and N is additional annual income which may come from secondary employment during the year, wage earnings by family members, or nonwage income for other sources. As written, this framework easily includes combination pay workers in addition to those paid strictly on the basis of time or piece.

IV Data

Data for this paper come from the U.S. Department of Labor's National Agricultural Workers Survey (NAWS). The NAWS is a nationally representative (and regionally representative for 12 agricultural regions) survey of employed U.S. farmworkers. The NAWS is a rich source of data on illegal and legal agricultural immigrants and their earnings, as well as U.S. born farmworkers. Workers have been sampled from work sites in three seasons per year since 1989. Of the 46,566 workers represented from 1989-2006, 73% report Mexican origins and 54% of these immigrant workers admit to being of illegal status. Of the overall sample (which includes U.S. born workers), 42% report being illegal.

In terms of pay structure distribution, approximately 80% of NAWS workers are paid timerate

(either hourly or salary) and 20% are paid piecerate. Of those who are paid piecerate, 77% are paid for individual productivity and 23% are paid as part of a crew. Crews range in size from two to 150 members.[16] Immigrants in the NAWS are more likely to be paid piecerate than are natives, and of immigrants, those of illegal status are more likely paid piecerate than are legal immigrants. More than 20% of Mexican workers, for example, and almost 24% of those from other countries are paid piecerate, compared with less than 7% of U.S. born farmworkers. In terms of legal status, 21% of illegal immigrants work piecerate compared to 19% of legal immigrants. One hypothesis is that illegal immigrant workers may select into this payment structure either due to a systematic difference in risk aversion or because of decreased bargaining power with employers because of their (lack of) citizenship status. A second is that immigrants with families remaining in a source country (and therefore with higher opportunity costs associated with U.S. work) may demand piecerate jobs as part of a rational strategy to minimize time within the U.S. and therefore maximize utility.

[Figure 1 about here]

[Table 1 about here]

Summary statistics by wage payment method are presented in Table 1.[17] Hourly workers are those paid on a time-based schedule. Piecerate workers on the other hand are paid according to their productivity. "Combo" workers receive some hourly compensation and some piecerate compensation. This might take the form of a low hourly rate plus additional payment for high output. Salary workers are paid a contractual amount irregardless of specific hours worked or output produced. The columns in Table 1 indicate subsamples of the data by these payment method categories.

Of hourly workers, roughly 21% report being U.S. born as do 7% of piecerate workers. After those who are U.S. born, the naturalized citizen group may be considered the next entry along a continuum of relative permanency within the U.S. The naturalized citizen variable displays an analogous pattern to that of U.S. born workers with higher percentages in hourly as opposed to piecerate positions. Specifically, 4.5% of hourly workers report being naturalized citizens compared with only 2.2% of piecerate workers. Similar percentages are evident for green card holders, and temporary legal status groups display the opposite pattern. Of hourly workers, approximately 5% report other work authorization (e.g., temporary work permits) and 46% report being illegal. For

piecerate workers, 10% and 57% of workers report other work authorization and being an illegal immigrant respectively.

Observable differences by country of birth, age, family structure, education and experience measures, English language abilities, and crop are also evident in the summary data. Hourly workers are less likely to be immigrant, are more likely to be older and to be married, tend to have more years of education, experience, and tenure and are much more likely to speak and read English than piecerate workers. Thus, a potential general characterization is that timerate workers as a group are relatively more established within U.S. agricultural labor markets.

Combination piecerate and timerate, and salary, categories have much smaller sample sizes than the hourly and piecerate subsamples. Approximately 2% of the overall sample reports combination wages, and less than 3% of the overall sample reports being salaried. Because these two groups represent limited numbers of workers and atypical attributes, the majority of the analysis is this paper omits these observations.[18] Sensitivity analysis that incorporates combination workers into the piecerate category and salary workers into the timerate category is presented in Section VII.

Figure 1 shows the unconditional fraction of agricultural workers by pay basis over time. The fraction of the overall agricultural workforce with hourly pay shows an increasing trend over the survey years, as does the salaried worker series. The fraction of workers receiving piecerate payment demonstrates a negative trend over time: this graph suggests about a 50% decrease in workers reporting piecerate over the sample period. While this trend is beyond the scope of this paper, it can be noted that the manufacturing industry experienced a similar decline in the percentage of workers paid piecerate since the 1970s (Seiler (1984)). In that case, the pattern was attributed to the entry of new establishments with different technologies replacing old piecerate firms. Freeman and Kleiner (2005) attribute declines in piecerate pay in shoe manufacturing to labor management policies associated with piecerate that increase productivity but decrease profitability. They find that piecerate firms have higher labor costs and lower survival rates than their timerate counterparts. Furthermore, as evident in Table 1, piecerate workers are more likely observed in fruits[19] or vegetables than are their hourly paid counterparts, while the opposite is true for field crops and horticulture. Import substitution of fruits and vegetables over the sample period may contribute to the pattern.

V What is the relationship between wage contract structure and poverty?

The overall research question is what is the relationship between wage payment method and poverty, and whether this relationship is different for illegal immigrant workers than for legal immigrant and U.S. born workers.

What are the effects of compensation schemes on wages and hours?

Output-based pay rates are associated with greater variability than are time-based pay rates. Therefore, output-based pay and short-term poverty can be hypothesized to be interrelated. Negative shocks in agricultural output due to weather events, for example, may affect piecerate workers more than timerate workers. Figures 2 and 3 illustrate hourly-equivalent wages and hours per week respectively for workers under hourly and piecerate compensation schemes over time. Hourly-equivalent wages are constructed for piecerate workers based on survey questions indicating how much a worker (and his or her crew if applicable) is paid on average for each unit of output (e.g., box, bin, etc.) and how many units are produced in an average day, along with crew size information.[20]

As expected given previous literature, average wages of piecerate workers are seen in Figure 2 to be systematically higher than those of hourly workers. Also consistent with the literature, piecerate wages display larger variance. Part of this variation is likely due to smaller sample sizes by year for piecerate workers than for timerate workers. However, variation in agricultural conditions such as weather phenomena are also likely contributors to piecerate wage variability. Hours per week, as illustrated in Figure 3, suggest another element of the story. In contrast to their higher average wages per hour, piecerate workers for most of the sample period report fewer hours per week than do hourly workers.

[Figures 2-4 about here]

Figure 4 presents farm weeks worked per year.[21] While a clear pattern between piecerate and timerate workers is not observable for farm weeks per year, summary statistics in Table 1 reveal that piecerate workers on average spend fewer weeks in nonfarm work per year but more weeks abroad than do timerate workers. From Table 1, piecerate workers report four nonfarm work weeks per year and 12 weeks abroad on average while timerate workers report approximately five weeks

in nonfarm work and nine abroad.

Considering these pictures together, the relationship between total income and poverty outcomes between piecerate and hourly workers is uncertain. Since these patterns are unconditional and given that the literature stresses the role of sorting into compensation schemes, multivariate regression analysis is used for further examination. The basic regression strategy is as follows:

$$\ln w_i = X_i\beta + \delta piecerate_i + \epsilon_i \tag{7}$$

where the dependent variable lnw_i represents logarithmic hourly-equivalent wage rates. The effect of piecerate pay method on wages is represented by δ. A vector of observable characteristics, X_i, is used to control for worker features including legal status group, gender, age, education, experience, tenure, English language ability, crop, task, survey year, and region.

Maximum likelihood treatment effects regressions control for unobservable selection into documented categories so that the coefficient on $piecerate_i$ is consistently estimated and does not capture part of the effect of the omitted or mismeasured variables. The theoretical framework suggests that ability, for example, may be one of these variables. Treatment effects regressions simultaneously estimate the probability of treatment (piecerate here, estimated by probit) and $\ln w_i$ as a function of piecerate (estimated by linear regression). This is equivalent to controlling for the non-zero expectation of the outcome equation error.[22]

Piecerate pay method is modeled as an endogenous binary treatment. Specifically, piecerate status is an unobserved latent variable:

$$piecerate_i^* = z_i\gamma + u_i \tag{8}$$

The treatment decision rule then is:

$$piecerate_i = \begin{cases} 1 & if \quad piecerate_i^* > 0 \\ 0 & otherwise \end{cases} \tag{9}$$

The error terms are assumed jointly normally distributed where ρ is the correlation between these terms.

[Table 2 about here]

The treatment effects regression for hourly-equivalent wages is presented in Table 2. Although exclusion restrictions are not necessary to estimate the model, they help with identification. Rubin and Perloff (1993) hypothesize that family structures are associated with selection into piecerate work since these structures may be correlated with risk tolerance. Married workers, for example, may be able to hedge risk associated with piecerate pay if his or her spouse works for time-based wages and the presence of children may relate to both the willingness to take risk and financial need for (and therefore attractiveness of) the risk premium. Furthermore, children of piecerate workers may be more likely to work alongside adult family members than are the children of timerate workers, and therefore the choice to work piecerate may directly relate to the presence of children who can engage in this work.[23] Family structure variables therefore are used as exclusion restrictions in the wage regression.[24] The effect of piecerate compensation on the hourly-equivalent wage of agricultural workers in the sample is estimated to be 22.5% after controlling for observable and unobservable characteristics.[25] The average hourly agricultural wage rate in 2006 was $8.00, which implies a piecerate wage rate from the regression is $9.80. For the 2006 sample, the actual piecerate wage was on average $10.15.[26]

Legal status variables are relative to the omitted category of U.S. born workers. All four legal status group variables are statistically significant in the selection equation. Naturalized citizens are estimated to be 17.8% less likely to be observed in piecerate positions in comparison to U.S. born workers (the omitted category). Green card holders, those with other work authorization, and illegal workers, on the other hand, are 20 to 26% more likely to be paid piecerate. These patterns are consistent with the summary statistics in Table 1. After controlling for selection into piecerate, naturalized citizenship, green card status, and other work authorization are all associated with higher wages relative to U.S. born workers (although these coefficients are statistically insignificant). Illegal workers receive 3.1% lower wages than other immigrant and U.S. born groups all else equal. Education, experience, and tenure variables are associated with higher wages as expected.

Total earnings is a function of both hourly-equivalent wages and hours worked. If piecerate workers receive higher hourly wages but work fewer hours, then their total earnings (and ultimately their poverty outcomes) will be determined by a simultaneous determination of both of these variables. A parallel treatment effects regression for hours worked therefore is examined in Table 2.

Piecerate workers are found to work 9.5 fewer hours per week than do their timerate counterparts controlling for selection and demographic, regional, and temporal differences. Average hours for timerate in 2006 was 45.8 per week implying piecerate hours of 36.4 per work as predicted by the model and 39.7 actually in the data for that year.

Do some compensation structures expose workers to greater poverty risk?

Establishing an appropriate measure of poverty is difficult given the seasonal, transitory, and bi-national nature of the population under study. Questions of poverty and general farmworker economic outcomes are not only functions of hourly wages and weekly hours, especially in the case of seasonal work. U.S. poverty threshold values vary by family size and year. Thresholds are matched to NAWS workers by reported family sizes and year of observation. Since the presence of a spouse and/or children in the U.S. is worker specific, the measures of family size used here are those pertaining to reported *present* family members as opposed to total family size.

The fraction of NAWS respondents with self-reported family incomes under the relevant poverty threshold for their particular family sizes over the sample period are presented in Figure 5. Despite some noise in the calculation, the figure suggests that timerate workers are better off on an annual basis.[27] A lower (yet substantial) fraction is below the poverty threshold in comparison to their piecerate counterparts. The opposite picture would emerge for imputed agricultural earnings based on reported wages per hour multiplied by hours per week and then multiplied by the number of weeks that the farmworker reported working in the previous year. Agricultural workers, however, are by nature seasonal, especially those workers in piecerate paid positions. However, poverty outcomes are based on total annual outcomes which may include, for example, nonagricultural work in off-seasons and other sources of income such as that of a spouse or from public aid program participation. These reasons support the use of an annual income basis for poverty analysis.

[Figure 5 about here]

In addition to hourly wages and hours per week, NAWS workers are asked to report annual family incomes and personal incomes. Of NAWS hourly workers, approximately 35% report annual family incomes putting them below U.S. poverty thresholds for their relevant family sizes. This can be compared with 51% of piecerate paid workers, 40% of those reporting combination pay, and 14% of salary workers. The correlation between total personal annual income and total annual family

income among NAWS workers is 71.4%. The fraction of piecerate workers reporting poverty status is systematically greater than the fraction of hourly workers reporting poverty. The difference is statistically significant in most years.

[Table 3 about here]

A bivariate probit regression is estimated of the form:

$$\Pr(poverty_i) = w_i\phi + \lambda piecerate_i + \epsilon_i \tag{10}$$

where the dependent variable $\Pr(poverty_i)$ represents the probability that a worker's total annual family income is below the poverty threshold and $piecerate_i$ is modeled as an unobserved latent variable as before. The effect of piecerate pay method on poverty is represented by λ. Results are presented in Table 3. Marginal effects reported in column (4) indicate that a switch from timerate to piecerate has a positive 3.2% effect on the probability of reporting income below the poverty threshold when income is defined as self-reported family income.

U.S. agricultural workers represent a binational population and therefore measurement of poverty may be sensitive to adjustments for weeks worked. While it may be possible to deflate poverty threshold values by weeks worked, annual incomes are not expected to be approximately constant for the farmworker population given both seasonality of work and the transitory and international nature of many of these workers. Similar deflation adjustments for total income therefore would not be valid. Constructing alternative measures of poverty in the context of a binational population is a topic of ongoing work.

VI Robustness and Heterogeneity Across Farmworker Groups

Further analysis of the heterogeneous effect of piecerate compensation across worker groups is examined by partitioning the multivariate analyses. Table 4 presents these results. In general, results are robust to these subgroups through younger workers and those surveyed in the mid to late 1990s present notable differences in the overall poverty results which may be related to relative aptness by age for backbreaking agricultural piecerate work and public policy changes amidst the sample period.

[Table 4 about here]

Nativity, Legal Status, and Hispanic Self-Identification

A debate within the economics of immigration literature concerns whether legal and illegal workers are substitutes or complements in production processes. If the former is true, workers may compete in effectively different labor markets depending on their legal status. Thus, to examine heterogeneity in the effect of piecerate status on wages based on nativity and legal status, piecerate payment treatment effect estimates from regressions when the sample is restricted to native workers, legal immigrants, and illegal immigrants respectively are presented. For the wage regressions, the effect of piecerate pay is notably different in magnitude. Specifically, legal immigrants working for piecerates make 28.3% more per hour on average than to timerate workers in this group holding all else equal. Illegal immigrants working for piecerates, however, make 17.9% more than those in hourly positions. U.S. born workers present an intermediate case. For native workers, the effect of piecerate pay on wages is estimated to be 20.1%, slightly lower than the overall sample result of a 22.5% positive wage effect. Interestingly, when the sample is restricted to those from Mexico versus immigrants for other sending countries, little difference is evident relative to the overall sample estimate. Mexican immigrants in piecerate positions make 21.5% more per hour and other immigrants receive a 23.5% premium by working piecerates relative to their timerate counterparts.

Similar statements can be made pertaining to the effects of piecerate pay on hours worked per week.[28] Illegal immigrants in piecerates are estimated to work approximately 7 fewer hours than their timerate counterparts, while this difference is approximately double for those in legal immigrant and native groups. Despite these greater negative hour effects, however, illegal workers exhibit significantly higher annual poverty rates (7.1% as opposed to 3.6% for legal immigrants and only 0.5% for U.S. born workers). One difference is that U.S. born workers and some legal immigrants may qualify for public assistance as their incomes approach poverty levels, while few resources are available to illegal immigrants.[29]

An additional partition is examined which corresponds to Hispanic self-identification in the overall sample. Therefore, Hispanic Americans are classified with Hispanic immigrants, and likewise non-Hispanic Americans and immigrants are grouped together. Hispanic is self-described and includes those who identify as Mexican American, Mexican, Chicano, Puerto Rican, and other

Hispanic. Based on this alternate partition which may more closely follow cultural as opposed to nativity lines, non-Hispanic workers are found to accrue a significantly smaller wage premium for piecerate work (15.5%) than do Hispanic workers (22.4%).

Gender and Age

Partitions on demographic characteristics corresponding to gender and age also are examined for robustness. While the piecerate-timerate wage gap is notably higher for males (24.5%) than for females (12.4%), poverty outcomes are more similar. The estimated effect of piecerate pay basis on poverty among women is 2.0% and 3.6% among men. Age divisions also are notable with the effect of piecerate pay on poverty outcomes reversing for younger (less than 35 years old) workers. Younger workers may be more able do conduct strenuous piecerate work, in for example fruits and vegetable picking, at more rapid speeds and therefore would have incentive to sort into this type of work based on comparative advantage. This dynamic is illustrated in the theoretical model and is consistent with previous literature.

Crop

Fruit and vegetable picking are notably more labor intensive tasks within agriculture than are other tasks and may attract more temporary workers than permanent ones. Notably, the poverty effects of piecerate payment are greatest for these subgroups. Poverty effects for field and horticulture workers for example are close to zero in magnitude yet very positive for fruit and vegetable workers. Fruit workers in piecerate payment schemes are 10.5% more likely to have annual incomes below U.S. poverty thresholds than are similar timerate workers. Vegetable workers in piecerate are 6.3% more likey to report incomes consistent with poverty than are timerate workers in like occupations.

Time Period

The effect of piecerate pay on poverty differs across cohorts of workers with notable differences corresponding to the period corresponding to key 1996 public policy changes such as the Illegal Immigration and Immigrant Responsibility Act (IIAIRA) and the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA). PRWORA restricted both documented and undocumented immigrants' use of public aid programs, and IIRIRA increased U.S. Border Patrol

size, barred those falsely claiming citizenship from green cards, and changed eligibility factors for deportation suspension.

Poverty threshold calculations are updated each year maintain consistent methodology. Piecerate workers surveyed in this period, all else equal therefore, indicate lower poverty rates than do timerate workers which may be related to both selective outmigration of undocumented workers and compositional changes among in-migrants during this time period. Results for groups before and after this period follow overall sample results.

Region

California is the highest ranked agricultural producer among the U.S. states, represents a disproportionate share of U.S. fruit and vegetable production, and more than one-third of NAWS workers are sampled there. Therefore, separate analysis of the state is a worthwhile exercise. In comparison to the national averages presented in Table 1, both Californian piecerate and timerate workers are more likely Mexican immigrant and are less likely to report English language ability. More than 90% of both Californian hourly and piecerate workers report that they are from Mexico, and less than 15% of each of these subsamples reports English language speaking ability.

For the California subsample, the effect of piecerate pay on wages, as evident in Table 4, is 18.6%, which is smaller but qualitatively similar to the estimated effect for agricultural workers nationally. The effect of piecerate pay on hours is shown to be a negative 16.7 hours in Table 4 for the California sample. This hours effect is much larger that the 9.5 hours nationally indicating that California workers in piecerate positions work significantly fewer hours than do their timerate counterparts all else equal. Simple tabulations for hours show statistically insignificant differences between the California case and the national one. Thus, the increased hours effect comes from selection. The poverty effect (Table 4) is also greater for California than for the national case. The marginal effect of piecerate status on poverty in a California-only regression that parallels that in Table 3 is 5.0% and statistically siginificant at the 1% level.

For comparison (not shown), northwest is defined as a combination of Pacific and Mountain I and II regions as defined in Table A-1 in the Data Appendix. This represents a second region with significant fruit and vegetable production. Conclusions for the northwest region qualitatively mimic those for the rest of the country. The effects of piecerate on wages and hours are 28.3% and

7.4 hours respectively in the directions indicated in the national sample.

Regional variation may be a function of not only observable characteristics from the data such as crop and task distributions which are controlled for here, but also less tangible differences. Anecdotal evidence suggests that regional differences in human rights attitudes and treatment of agricultural workers also may lead to differences.

VII Sensitivity to Varying Piecerate and Timerate Definitions

Until this point, workers reporting combination (both piecerate and timerate) and salary schemes, were dropped from the analysis. Although these groups represent only small fractions of the overall sample, sensitivity of the results to these definitions is examined here. Namely, the piecerate pay definition is changed to reflect either those reporting piecerate or combination wages and the timerate definition is changed to include salary workers. With this modification, the effect of piecerate pay (or more specifically of piecerate or combination pay) on wages is 23.5% (compared with 22.5% as shown in Table 2 under the alternative assumption). The effect of piecerate pay on hours is 8.9 fewer hours (compared with 9.5 fewer hours in Table 2). Poverty results are also qualitatively similar. Broadly-defined piecerate workers overall are 2.8% more likely to be in poverty than are timerate workers when family income is compared with poverty thresholds. This is in contrast to 3.2% from Table 3 when the sample is restricted.

VIII Discussion and Conclusions

Wage and hour differences, in addition to those in the propensity to experience poverty are examined in this paper for piecerate and timerate workers in the U.S. agricultural workforce. Farmworkers nationally are found to receive approximately 22.5% higher hourly wages when they work for piecerate compensation as opposed to for hourly compensation. These workers, however, are also found to work 9.5 fewer hours per week. Earnings are a function of both wage rates and hours, and therefore these differences relate to the incidence of poverty in this population. Conditional correlations between piecerate pay and poverty are found to be positive for self-reported total income and negative when imputed agricultural income is used. This points to the importance of consistent employment for ultimate worker outcomes and also to the importance of differences in

family structures, secondary incomes, and sorting into pay schemes. Poverty propensity estimations accounting for selection into piecerate indicate a 3.2% difference between piecerate and timerate workers. Therefore, pay basis is shown to have a statistically and economicly significant relationship to poverty outcomes and this result is robust to several sample partitions.

Foreign-born workers, particularly illegal immigrants and more temporary legal workers, are more frequently observed in piecerate paid positions. Both the theoretical and empirical exercises in this paper assume that being paid piecerate is the result of a choice on the part of the worker. An alternative would be that pay basis is instead the result of demand side incentives or perhaps some kind of systematic discrimination. Employers of undocumented workers (or potentially undocumented workers) may prefer to pay piecerates to questionably legal workers when there is a positive probability of deportation (or other apprehension) and therefore attrition from his or her workforce. Furthermore, the existence of employer sanctions may encourage payment methods which are easy to implement more frequently and therefore that lessen farm operator attachment to individual workers.[30] Low monitoring costs associated with agricultural tasks such as fruit and vegetable picking and the seasonality of farmwork also support employer preference for this type of pay structure.

Evidence on the prevalence and characteristics of farm labor contracting also suggests that piecerate may not fully be a choice. For example, approximately 35% of piecerate workers report being employed by a farm labor contractor as opposed to directly by a grower. Only 14% of timerate workers report using farm labor contractors. Pena (2009b) finds that that wage gap between legal and illegal minimized when worker is directly hired suggesting that individual workers have more bargaining power when they represent themselves directly to a grower as opposed to via a third party (or are able to capture more of the wage surplus). If farm labor contractors sort immigrant workers (with like characteristics of those in timerate) into piecerate positions independent of their skills, then sorting may not be economically efficient and may result in adverse distributional outcomes. If this is the case, government intervention might be argued to address a market failure. Orrenius and Zavodny (2009) find that immigrants are overrepresented in risky jobs across sectors and that over representation is related to differences in average characteristics, such as immigrants' English ability and education. This suggests that improving English language and other school-learned skills may serve as one mechanism to this end.

A final question and caveat pertains to how relevant U.S. poverty measures are to a binational population that spends substantial amounts of time in a separate country of origin. Given cost of living differences, U.S. wages that put a worker below U.S. thresholds often do not put the same worker below source country thresholds. The treatment of poverty therefore in this paper may be incomplete, and conclusions should be interpreted in the context of the more precise wage and hours results if policy implications are to be drawn. Study of improved statistical measurement of poverty when a population is binational is the subject on continuing work.

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Notes

[1]Author's calculations using the National Agricultural Workers Survey, which will be exploited in this paper.

[2]A minority of workers report combination picerate/timerate payment and/or salary work. Further complexity in agricultural wage contracts comes from team structure and whether payment is based on individual or work crew productivity.

[3]The predicted probability that a worker in their sample is paid piecerate decreases until about age 34 and then increases. This age cutoff will be used in the robustness exercises.

[4]Despite these productivity increases, the Safelite Company filed for bankruptcy in 2000 (Freeman and Kleiner (2005)).

[5]Rubin and Perloff (1993), in contrast, measure pay on a daily basis. Although these alternative time units yield similar conclusions regarding short-term wage income, long-term income and poverty may differ depending on time horizon, especially in the case of seasonal employment.

[6]Piecerate pay also may be associated with higher turnover. Lazear (2000), for example, finds that the move to piecerate pay in the Safelite Corporation was associated with an increase in turnover from 3.3% per month to 3.6% per month.

[7]Lazear (2000) does not include a stochastic parameter. However, output in industries such as agriculture may depend on variables such as rainfall that are unrelated to the worker. This motivates the inclusion of a stochastic variable here.

[8]Note that $\frac{\partial E}{\partial A} = -\frac{\frac{\partial f}{\partial A}}{\frac{\partial f}{\partial E}} < 0$.

[9]See Paarsch and Shearer (2000) for modeling of the firm's decision to offer piecerate or timerate compensation.

[10]Theoretically, the minimum effort requirement under an hourly scheme could be higher than the effort chosen by piecerate workers.

[11]Although the simpler notation is used here, W, can be easily decomposed into hourly wage times hours per year and therefore incorporate variability in work hours across payment types. Y_0 can be imagined to take different values in response to various realized environmental conditions and therefore may not be constant over time.

[12]This assumption is common in agricultural labor literature (e.g., Golan, Moretti, and Perloff (1999)). The concluding section of this paper discusses alternative assumptions.

[13]The empirical analysis in this paper excludes nonworkers since this population is not represented in the survey sample. Therefore, the lower bound $U(0,0)$ while theoretically relevant will not be directly extended empirically. Instead, it is simply assumed that this bound exists.

[14]Alternatively, parameters could be indexed on the basis of being an immigrant or not, if it is believed this this is the more appropriate division. However, Pena (2009b) documents hourly wage differentials between legal and illegal workers in U.S. agriculture.

[15]Note that if one payment scheme is more risky than the other in a way that is related to legal status (for example, if workers are more likely to be cheated under piecerate than timerate), then the model could be extended by including legal status superscripts on the utility function itself.

[16]Crew size information matched to workers is only available in the confidential version of this dataset and therefore examination of crew size subsets is not an extension presented in this paper.

[17]Statistics and regressions in tables are reported using sample weights.

[18]Salary workers, for example, are more likely to be U.S. born and in supervisory positions with higher wages per hour and hours per week than are hourly and piecerate workers.

[19]The fruits category includes nuts.

[20]This construction is completed by the Department of Labor for inclusion in the public use dataset.

[21]A trend of increased hours in both types of positions in the latter part of the series is evident in the figure. Anecdotal evidence suggests that farmworker shortages characterized these years. Changes in agricultural labor markets may have resulted in fewer workers working more hours.

[22]If it can be argued that piecerate payment can be predicted strictly on observable characteristics, then propensity score matching methods may be used to estimate the effects of piecerate pay on wages and hours respectively. Results from these methods are similar. However, if selection is at least partially based on unobservable characteristics such as ability, then propensity score matching has limited applicability.

[23]If this is true, then part of the piecerate earnings premium would be attributable to the work effort of these younger workers. Of piecerate workers, 31.4% report having children under age 18 who also work the field compared with 23.1% of timerate workers.

[24]Since the existence of family members may affect a worker's total number of weekly hours, the hours regression is identified on nonlinearities from the probit functional form. While this is not ideal, alternate appropriate exclusion restrictions are not available in the data.

[25]Maximum likelihood treatment effects can be calculated with or without exclusion restrictions. In the absence of family controls in either stage of the regression, the treatment effect of piecerate pay on wages is estimated at 22.6%. With family controls in both stages, this effect is estimated at 22.5%. Spouse and children variables are jointly significant in a probit stage of the regression for piecerate pay at the 5% level.

[26]The estimated ρ parameter in Table 2 suggests negative selection into piecerate work. This is consistent with a story that piecerate is positively correlated with some omitted or unobserved factor (such as preference for short-term work or low commitment to the job) that is negatively related to wages. Selection for this full sample case, however, is not statistically significant. Furthermore, being in a piecerate paid crew is an insignificant predictor of wages and hours in this framework.

[27]A disadvantage of using annual measures is that these may not reflect transitions in or out of poverty or duration of poverty. The goal here, however, is to examine overall wellbeing over a short period of time (year) for a nationally-representative sample.

[28]One related hypothesis is that given the geographic interdependence of Mexico and the U.S., Mexican workers may exhibit increased preference for more flexible piecerate payment over timerate payment since return migration represents a cheaper outside option to this group than to immigrants whose source countries are further away. However, of Mexican workers in the NAWS sample, 27% are observed in piecerate positions which is less than the

35% of immigrants from other origins who select piecerate payment based on unconditional tabulations.

[29]This topic is explored for this community in Pena (2009a).

[30]Of piecerate workers in the NAWS, 5.2% report daily and 83.8% report weekly pay in comparison to 2.4% and 80.5% respectively for hourly workers. Greater differences are found in bi-weekly pay with 12.8% of hourly and only 2.8% of piecerate workers reporting that category.

A Data Appendix

The sampling procedure of the National Agricultural Workers Survey is based on four levels: region, crop reporting district, county, and employer with probabilities proportional to size at each level. Specifically, NAWS uses 12 geographic regions based on USDA Quarterly Agricultural Labor Survey of farm employers. The 12 regions are defined in the table below. USDA information is also used for cyclical allocation (based on the relative proportions of workers each cycle). There are 47 crop reporting districts (aggregates of counties with similar agricultural characteristics) from which sampling locations are selected. Within crop reporting district, counties are selected randomly without replacement with probabilities proportional to the county's farm labor expenses. Employer lists are from the Bureau of Labor Statistics Agricultural Soil and Conservation Service and are updated with information from county extension agencies, local employment agencies, grower organizations, and farmworker service programs. Employers are selected using probabilities proportional to the square root of the seasonal farm workforce. Once permission to interview is obtained, the maximum number of interviews per grower is determined with probabilities proportional to square root size. The number of interviews per site of a particular grower is also determined by a proportional distribution to total number of crop workers. Workers are selected and approached randomly when arriving for work, at lunch, or when leaving, and interviews are scheduled for times away from work site at locations chosen by the workers.

[Table A-1 about here]

Table 1: Summary Statistics by Wage Payment Method

	Hourly	Piecerate	Combo	Salary
Real Wage (2006 base)	7.29	9.33	10.66	11.70
Hours (per week)	41.68	35.35	40.79	48.61
Farmwork Weeks (last year)	28.59	27.04	26.85	40.23
Non-farm Work Weeks (last year)	4.77	3.85	3.41	4.72
Abroad Weeks (last year)	9.41	12.00	7.80	2.58
Poverty (%)	37.97	51.11	42.72	20.64
U.S. Born (%)	21.22	6.67	7.68	52.19
Naturalized Citizen (%)	4.48	2.15	5.33	6.20
Green Card (%)	23.25	23.68	41.41	23.71
Other Authorization (%)	5.31	10.48	5.93	3.32
Illegal (%)	45.74	57.02	39.66	14.57
Female (%)	21.91	17.58	36.07	9.11
Age (years)	32.34	30.65	32.46	38.84
Has Spouse (%)	35.37	29.68	45.10	65.18
Children (number)	0.72	0.76	1.08	1.29
Education (years)	7.20	6.13	6.82	9.15
Farm Experience (years)	9.20	8.08	9.38	17.58
Tenure (years)	3.96	2.94	3.68	9.07
Speaks English (%)	31.52	17.02	20.27	67.86
Reads English (%)	28.74	13.95	18.87	62.48
Mexican (%)	72.03	87.91	82.65	43.65
Other Immigrant (%)	1.25	2.16	7.52	2.14
Field Crops (%)	17.42	6.14	4.10	48.80
Fruit (%)	28.59	53.74	76.00	11.53
Horticulture (%)	18.83	0.80	1.53	14.86
Vegetables (%)	28.19	35.72	15.86	16.32
Misc Crops (%)	6.79	3.50	2.51	8.09
Observations	31365	6322	993	1046

Table 2: Effect of Piecerate Pay Basis on (log) Hourly-equivalent Wage and Hours per Week

	(1a) Log(wage)	(1b) Piecerate	(2a) Hours	(2b) Piecerate
Piecerate	0.225***		-9.446***	
	(0.010)		(1.21)	
Naturalized Citizen	0.0120	-0.178**	3.261***	-0.259***
	(0.011)	(0.090)	(0.78)	(0.087)
Green Card	0.0179	0.195**	5.135***	0.161**
	(0.011)	(0.085)	(0.68)	(0.082)
Other Authorization	0.0188	0.209**	5.702***	0.194*
	(0.015)	(0.10)	(0.86)	(0.10)
Illegal	-0.0306***	0.255***	3.336***	0.214**
	(0.012)	(0.089)	(0.70)	(0.086)
Female	-0.0546***	0.0263	-4.725***	0.00860
	(0.0059)	(0.040)	(0.33)	(0.039)
Age	-0.0000963	-0.00531***	-0.00964	-0.00543***
	(0.00025)	(0.0018)	(0.016)	(0.0017)
Education	0.00630***	-0.00587	0.153***	-0.00598
	(0.00078)	(0.0051)	(0.045)	(0.0050)
Farm Experience	0.00178***	0.00711***	0.0637***	0.00677***
	(0.00034)	(0.0023)	(0.022)	(0.0022)
Tenure	0.00833***	-0.0133***	0.261***	-0.0107***
	(0.00050)	(0.0034)	(0.028)	(0.0033)
Spouse		-0.0335	0.989***	-0.0259
		(0.040)	(0.34)	(0.037)
Children		0.0361**	-0.145	0.0381***
		(0.015)	(0.13)	(0.014)
From Mexico	0.00957	0.162***	-0.547	0.198***
	(0.0081)	(0.063)	(0.52)	(0.060)
Field Crops	-0.0435***	-0.220***	1.608**	-0.203***
	(0.0081)	(0.071)	(0.63)	(0.067)
Fruit Crops	-0.0687***	0.569***	-1.750***	0.517***
	(0.0086)	(0.060)	(0.57)	(0.057)
Horticulture	0.0252***	-0.912***	-0.197	-0.956***
	(0.0076)	(0.095)	(0.59)	(0.089)
Vegetables	-0.0444***	0.158***	-1.231**	0.171***
	(0.0079)	(0.061)	(0.56)	(0.058)
Preharvest	-0.0450***	0.144*	-2.157***	0.132*
	(0.0059)	(0.081)	(0.48)	(0.076)
Harvest	-0.0140**	1.436***	1.613***	1.413***
	(0.0063)	(0.069)	(0.59)	(0.065)
Postharvest	-0.00929	0.553***	0.825	0.519***
	(0.0074)	(0.083)	(0.54)	(0.078)
Semiskill	-0.0326***	0.634***	1.920***	0.554***
	(0.0062)	(0.072)	(0.48)	(0.067)
Supervisor	0.216***	0.366	2.035	0.395
	(0.036)	(0.27)	(1.61)	(0.25)
Constant	1.542***	-2.411***	39.39***	-2.229***
	(0.021)	(0.16)	(1.46)	(0.15)
atanh ρ	-0.0128		0.174***	
	(0.013)		(0.049)	
$\ln \sigma$	-1.494***		2.614***	
	(0.015)		(0.0083)	
Observations	38362		38588	

Notes: Statistically significant at: the * 0.10 level; ** 0.05 level; *** 0.01 level. Marginal effects reported. Regressions also include English language speaking and reading ability, survey year, and region dummies. Robust standard errors in parentheses. Ancillary parameters are the inverse hyperbolic tangent of ρ and $\ln \sigma$.

Table 3: Effect of Piecerate on Probability of Family Income Below the Poverty Threshold

	(1a) P(poverty)	(1b) Piecerate	MFX
Piecerate	0.960***		0.0324***
	(0.17)		(0.0040)
Naturalized Citizen	0.250***	-0.130	0.00165
	(0.074)	(0.094)	(0.0034)
Green Card	-0.0839	0.230**	0.00568
	(0.073)	(0.092)	(0.0041)
Other Authorization	-0.0946	0.206	0.00476
	(0.10)	(0.13)	(0.0059)
Illegal	0.0817	0.297***	0.0124**
	(0.076)	(0.094)	(0.0051)
Female	0.102***	-0.0638	0.000373
	(0.034)	(0.043)	(0.0015)
Age	-0.00339**	-0.00283	-0.000172*
	(0.0014)	(0.0019)	(0.00009)
Education	-0.0211***	0.00574	-0.000323
	(0.0042)	(0.0056)	(0.00021)
Farm Experience	-0.00839***	0.00510**	-0.0000387
	(0.0020)	(0.0026)	(0.00008)
Tenure	-0.0285***	-0.0154***	-0.00118***
	(0.0033)	(0.0038)	(0.00033)
Spouse		-0.123***	-0.00383***
		(0.042)	(0.0012)
Children		0.116***	0.00370***
		(0.023)	(0.00051)
From Mexico	0.00920	0.154**	0.00478*
	(0.056)	(0.069)	(0.0025)
Field Crops	0.323***	-0.230***	-0.0000122
	(0.055)	(0.076)	(0.0026)
Fruit Crops	0.209***	0.499***	0.0276***
	(0.059)	(0.064)	(0.0086)
Horticulture	-0.0839	-0.696***	-0.0150***
	(0.058)	(0.095)	(0.0052)
Vegetables	0.257***	0.152**	0.0131***
	(0.053)	(0.065)	(0.0048)
Preharvest	0.0636	0.166**	0.00789**
	(0.048)	(0.081)	(0.0037)
Harvest	-0.206***	1.380***	0.0664***
	(0.068)	(0.071)	(0.017)
Postharvest	-0.0955*	0.532***	0.0209***
	(0.055)	(0.085)	(0.0074)
Semiskill	-0.149***	0.587***	0.0195***
	(0.047)	(0.073)	(0.0063)
Supervisor	-0.403*	-0.347	-0.0107**
	(0.22)	(0.36)	(0.0045)
Constant	-0.391***	-2.334***	
	(0.13)	(0.16)	
atanh ρ	-0.559***		
	(0.13)		
Observations	29117		

Notes: Statistically significant at: the * 0.10 level; ** 0.05 level; *** 0.01 level. Marginal effects reported in column (4). Regressions also include English language speaking and reading ability, survey year, and region dummies. Robust standard errors in parentheses.

Table 4: Effects of Piecerate Pay Basis on Logwage, Hours, and Poverty, by Subgroup

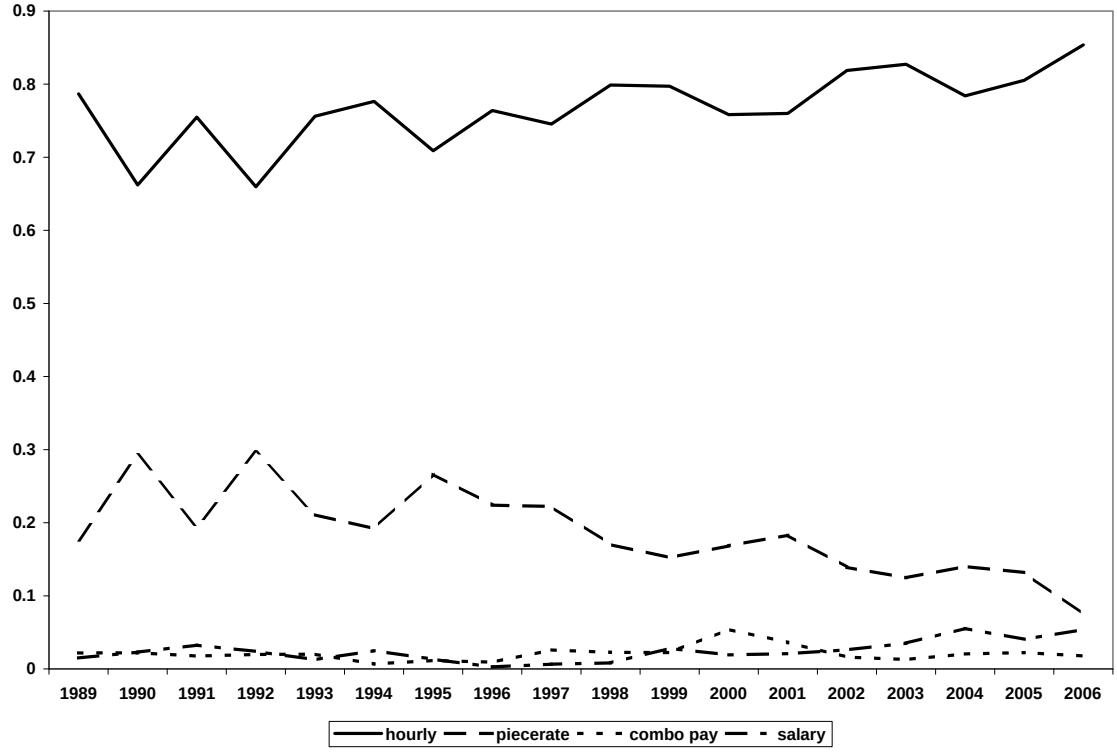
	Log(wage)	Hours	Poverty
U.S. Born	0.201***	-15.790***	0.00471***
	(0.0540)	(2.558)	(0.0013)
Legal Immigrants	0.283***	-13.217***	0.0363***
	(0.0179)	(2.730)	(0.00335)
Illegal Immigrants	0.179***	-6.958***	0.0713***
	(0.0130)	(1.384)	(0.00707)
From Mexico	0.215***	-7.396***	0.0604***
	(0.0110)	(1.214)	(0.00377)
Other Immigrant	0.235***	-8.763*	-0.00220
	(0.0304)	(4.828)	(0.00149)
Hispanic	0.224***	-9.027***	0.0530***
	(0.0105)	(1.307)	(0.00364)
Non-Hispanic	0.155***	-4.826	0.000941
	(.0443)	(3.413)	(0.00102)
Male	0.245***	-9.913***	0.0361***
	(0.0114)	(1.751)	(.00385)
Female	0.124***	-7.884***	0.0202***
	(0.0281)	(2.064)	(0.00295)
Less than 35	0.231***	-6.698***	-0.0452***
	(0.0125)	(1.501)	(0.00342)
35 or Older	0.203***	-13.55***	0.0209***
	(0.0181)	(2.068)	(0.00229)
Field Crops	0.291***	-17.297***	0.00772***
	(0.0322)	(3.115)	(0.00152)
Fruit Crops	0.159***	-12.072***	0.105***
	(0.0148)	(2.662)	(0.006)
Horticulture	0.347***	-5.036	0.0000802
	(0.0584)	(5.260)	(0.00006)
Vegetables	0.294***	-0.845	0.0631***
	(0.0205)	(2.516)	(0.00593)
Before 1996	0.263***	-10.634***	0.0629***
	(0.0213)	(2.494)	(.00644)
1996-1998	0.161***	-5.095*	-0.0429***
	(0.014)	(2.971)	(0.00421)
After 1998	0.208***	-9.679***	0.0143***
	(0.0151)	(2.229)	(0.00199)
California	0.186***	-16.74***	0.0501***
	(0.0112)	(1.154)	(0.00412)

Notes: Statistically significant at: the * 0.10 level; ** 0.05 level; *** 0.01 level. Marginal effects reported. Regressions also include regressors as in full sample models. Robust standard errors in parentheses. Ancillary parameters are the inverse hyperbolic tangent of ρ and $\ln \sigma$. Marginal effects reported for the bivariate probit poverty regressions.

Table A-1: NAWS Agricultural Regions

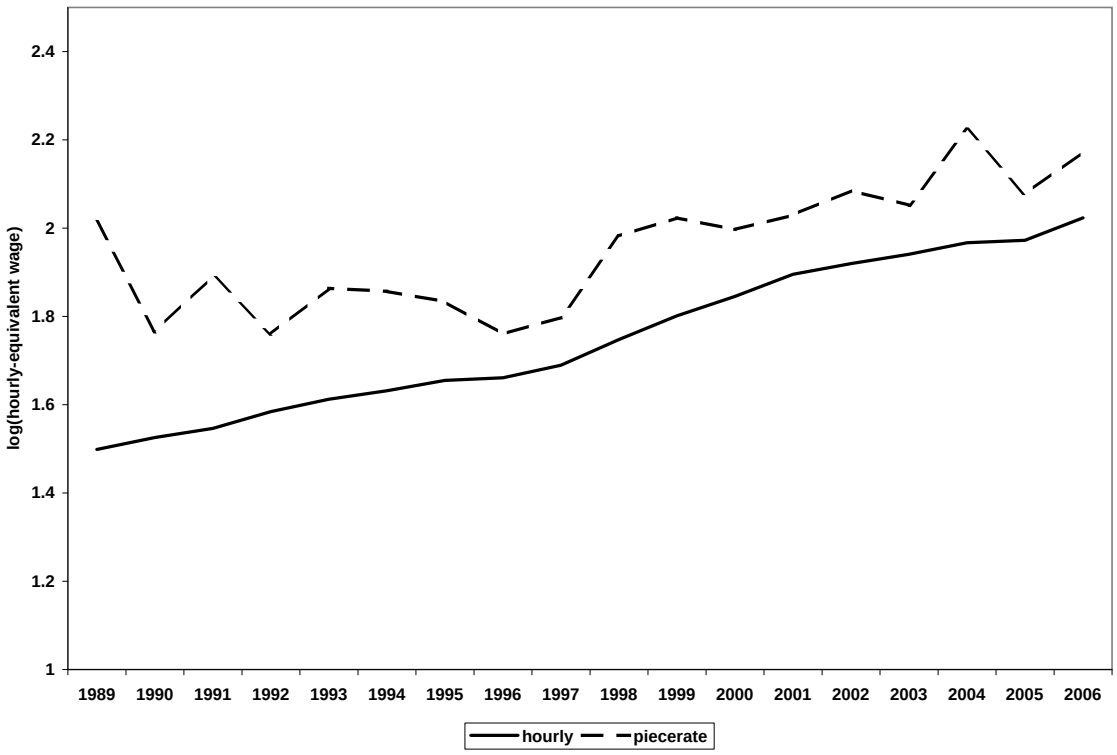
Region	States
California	CA
Southern Plains	TX, OK
Florida	FL
Mountain III	AZ, NM
Appalachia I, II	NC, VA, KY, TN, WV
Cornbelt Northern Plains	IL, IN, OH, IA, MO, KS, NE, ND, SD
Delta Southeast	AR, LA, MS, AL, GA, SC
Lake	MI, MN, WI
Mountain I, II	ID, MT, WY, CO, NV, UT
Northeast I	CT, ME, MA, NH, NY, RI, VT
Northeast II	DE, MD, NJ, PA
Pacific	OR, WA

Figure 1: Fraction of Agricultural Workers by Pay Basis



SOURCE– National Agricultural Workers Survey, pooled cross sections 1989-2006.

Figure 2: Hourly-equivalent Wage by Pay Basis



SOURCE– National Agricultural Workers Survey, pooled cross sections 1989-2006.

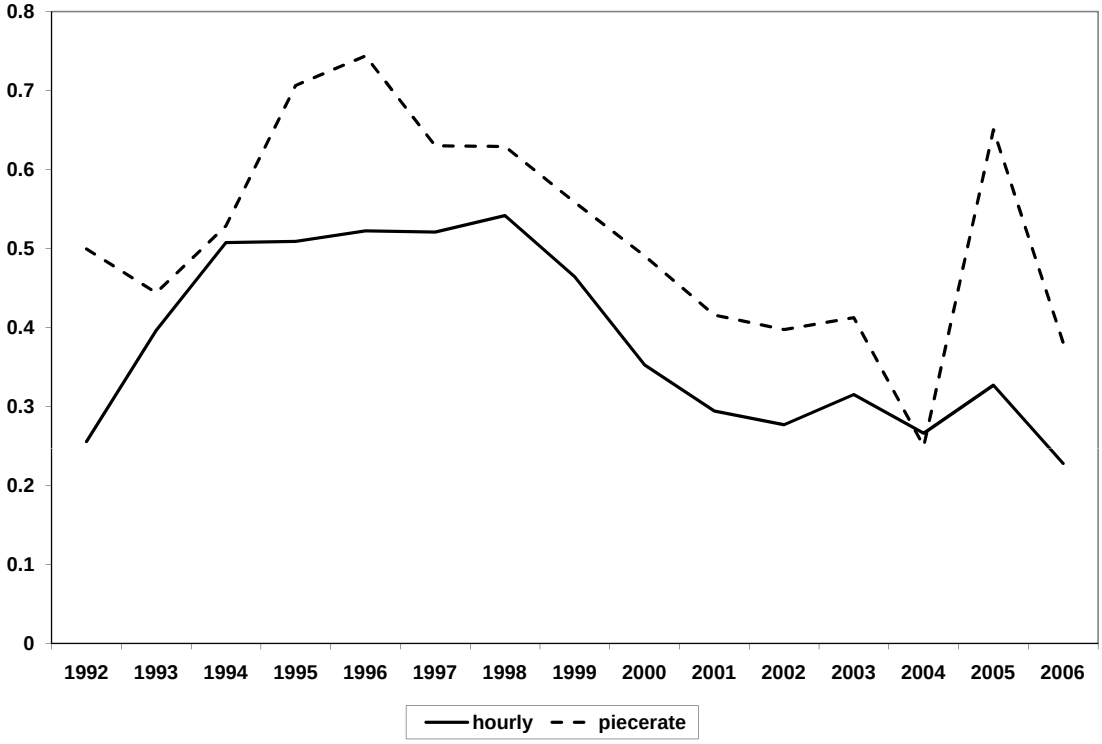
Figure 3: Hours per Week by Pay Basis

SOURCE– National Agricultural Workers Survey, pooled cross sections 1989-2006.

Figure 4: Farm Weeks per Year by Pay Basis

SOURCE– National Agricultural Workers Survey, pooled cross sections 1989-2006.

Figure 5: Fraction of Workers with Family Incomes Under U.S. Poverty Threshold



Source– National Agricultural Workers Survey, pooled cross sections 1989-2006.