Health Coverage and Farmworker Productivity

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Abstract

Farmworkers are often subject to hazardous working conditions, experience a disparity in health insurance coverage and are vulnerable to chronic health conditions and injury. Although recent health care mandates have improved access to health care, many agricultural employers still do not offer coverage for their employees. Hitherto unexplored, insurance coverage in farmworker labor markets leads to systemic inequalities, which have implications for worker productivity and operations strategy. We quantify the economic value of offering health coverage to farmworkers using a structural search, match, and bargaining model. We find that farmworkers with employer-provided health coverage are significantly more productive than those without and, on average, generate an additional \$0.78 in economic surplus for each hour worked. Employers who offer health coverage retain an additional \$0.60 of economic surplus for each hour of work performed by their employees due to a health productivity premium.

Keywords: bargaining power, farm labor, healthcare, productivity, search-and-matching
JEL Codes: J22, Q12, Q18

1 Introduction

Agricultural work is notoriously demanding, and one of the most dangerous in terms of the long-term health impacts of working in harsh conditions over long periods of time (Mobed, Gold, and Schenker 1992; Nordstrom, et al. 1995; Villarejo and Baron 1999; Hansen and Donohue 2003). While farm practices do show signs of change, there remains several important, but unanswered questions regarding the health status of agricultural workers (Boggess and Bogue 2016). For example, relative to other workers, do farmworkers have equal access to healthcare through employer-provided coverage, and, if not, what is the impact of coverage on operational outcomes like productivity? In the United States (U.S.), farmworkers are a minority group hastily overlooked (Simchi-Levi 2020).

In a perfect world, farm managers would recognize the productivity gains available from ensuring (or insuring) the health of their workers, but we argue that worker health among migratory and seasonal laborers is akin to a common property resource. Because individual employers cannot capture the productivity gains from improving the health of transient workers, they underinvest to their own detriment, and to the detriment of the workers themselves (Pagell et al. 2020). Others in the operations management (Das et al. 2008; Pagell et al. 2014, 2015) and economics literatures (Dey and Flinn 2005; Fang and Gavazza 2011; Dizioli and Pinheiro 2016; Kim 2022) consider worker health and safety as a productive input akin to investments in human capital, so we adopt a similar approach in examining the returns to employer-provided healthcare coverage among agricultural workers. In this paper, we use a model of worker search, matching, and bargaining (Dey and Flinn 2005; Flinn 2006; Flinn, Gemici, and Laufer 2017) to estimate the value of healthcare coverage for farmworkers, and demonstrate the long-term value of committing to employee health.

From a general perspective of "quadruple-aim performance" (Roth & Zheng 2021), ensuring agricultural workers health and safety should be a primary consideration for the sustainability of food production (Pagell and Shevchenko 2014). According to Roth & Zheng (2021), efficiency-oriented food systems are unsustainable, as farmers' increasing reliance on government support and already-thin margins spur economically motivated adulteration (Levi et. al. 2020), as may have been the case in the 2008 Chinese infant formula scandal. A circular, closed-loop farming system would "differ significantly from its linear, conventional counterpart" (pg. 793), insofar that gains to farmer families' financial security lead to safer, more nutritious food and improved socioeconomic well-being for society. Systemic changes in the supply chain, starting with better risk sharing between farmers and buyers, should be accompanied by a natural transformation at-scale. According to Novak et. al. (2021), the resulting supply chain is more resilient, as dynamic interactions among different actors in the system lead to largely unpredictable outcomes, instead of a "return to a defined pre-shock equilibrium" (pg. 325).

From an economic perspective, farms tend to serve as the textbook example of "perfectly competitive" firms, meaning that farmers have very little financial latitude to experiment with employee benefit programs that are anything other than laser-focused on keeping costs low (Carter and Rogers 2008). If providing health and safety benefits for workers were "...not discretionary, but a requirement..." (Carter and Easton 2011, p. 49), the empirical evidence should be clear in data describing farming operations. The finding that investments in worker welfare improves economic performance, however, is not universal. For example, Pagell et al. (2020) find that organizations providing safer work environments are more likely to fail than those that are less-safe, and they conclude that reliance on market forces to ensure safety is unlikely to work. In this regard, worker safety is an externality, or a market failure that derives from the fact that firms are not made to bear the external cost of poor health outcomes. Whether firm-level investments in agricultural worker healthcare contribute to organizational sustainability, or detract from it, is therefore an important empirical and policy question, with implications for the broader food system.

Unlike most other countries, healthcare in the U.S. is associated with employment, as most (54.6%) citizens obtain healthcare coverage, either directly from their own employer or indirectly through their spouse's employer (Statista 2021). Employer-coverage raises a number of important issues, including the wage effects of coverage, the impact of coverage on job-turnover, and the effect of coverage on worker productivity (Dey and Flinn 2005, 2008). Arguably, healthcare coverage for farmworkers is more than just a job benefit, as the nature of the job leads almost inevitably to job-related injuries, and health-related reductions in productivity. Because workers select into the jobs they choose, identifying the impact of healthcare coverage on productivity requires that we control for wage and retention effects in order to isolate the independent effects of coverage on productivity outcomes. Further, as workers search optimally for new jobs, and employers seek the most productive employment matches possible (Burdett and Mortensen 1998), it is very likely that health, and the need for coverage, enters into the search-and-bargaining process (Cuhac, Postel-Vinay, and Robin 2006). In our econometric model, we frame worker health outcomes in a theoretical model of search-matching-and-bargaining between farm employees and employers.

We estimate our structural model of worker outcomes using a large, pseudo-longitudinal or repeated cross-sectional data sample from the National Agricultural Workers Survey (NAWS). NAWS has become a standard data source for studying farmworker problems, from the impact of immigration on wages (Richards 2018) to the decline in farmworker migration (Fan et al. 2015), the impact of legal status on earnings (Isé and Perloff 1995), the elasticity of labor supply (Li and Reimer 2020), and worker injury (Tonozzi and Layne 2016), to name a few. In order to focus our attention on workers who tend to do similar jobs, we study farm workers from California, who are primarily employed in the specialty crop industry. Our sample of NAWS data captures some 24,000 worker records over a 32 year sample period from 1989 through 2020. More generally, the NAWS data set is ideal for the purposes at hand as it provides annual work histories for each survey subject, which allows us to parameterize an econometric model of job search, matching, and bargaining, and it contains sufficient information on job outcomes so that we are able to estimate the relationship between worker attributes, productivity, duration, and healthcare status. Moreover, the NAWS is targeted to workers in the agricultural production sector, so our empirical model below is not confounded by comparisons across jobs and sectors that are otherwise not comparable. Where necessary, we supplement the NAWS data with industry-level worker-share-of-output data from the Quarterly Census of Employment and Wages (QCEW) in order to help identify variation in worker bargaining power over time and across industries as in Flinn (2006).

Our reduced-form analysis finds that wages, productivity, and job duration are all positively related to the incidence of healthcare coverage among agricultural workers. On average, after controlling for human capital accumulation and demographics, wages for covered workers are some 4.3% higher for covered workers relative to those who are not covered. However, these results are associative, and not causal, as we cannot be sure that we have fully controlled for selection into jobs with healthcare insurance. Our structural model of job searching, matching, and bargaining equilibrium shows that match surplus, or the amount of economic surplus generated by a covered worker (i.e., the productive value of the match relative to the implicit reservation wage), is some 20% higher for covered workers relative to those who are not covered ($4.71 per hour relative to $3.93). This is an equilibrium result, so it controls for the fact that employers and employees are endogenously matching into employment contracts in which the employer is likely to choose employees that it deems worthy of the coverage risk, and workers choose employers that they believe provide the most favorable combination of compensation and health and safety benefits. We also find that job duration rises in the likelihood that a workers is covered, meaning that workers are either more likely to stay healthy while on the job, or simply remain with an employer that provides healthcare coverage as opposed to finding another job that may lack coverage. Finally, our structural findings show that workers earn some 23% of the match value due to their exercise of bargaining power in the employment contract.

We contribute to the operations management literature in providing the first empirical estimates of the productivity, match-value, and job-duration effects of employer-provided healthcare coverage. While the notion of insurance coverage is different from the health and safety programs considered by Lo et al. (2014), Pagell et al. (2020), or Das et al. (2008), the qualitative nature of the effect is similar as they each reflect a fundamental concern for worker welfare. Namely, if the health of low-skilled workers is a public good, then employers are likely to underinvest in coverage (Pagell et al. 2020). However, to the extent that workers remain with current employers, the returns to providing healthcare coverage are likely to be manifest in higher productivity, less absenteeism, and higher overall earnings. We show that employer-provided healthcare insurance is positively associated with each of these workplace outcomes, providing evidence that improved farmworker welfare could lead to more sustainable food systems (Roth & Zheng 2021). Thus, healthcare coverage is a viable investment and worker exploitation, in this aspect, is profit-reducing. The benefit to providing care is likely greater than the cost of provision.

Second, we contribute to the labor economics literature on the wage effects of healthcare coverage by showing that covered workers in low-skill jobs earn significantly more than non-covered workers, even after controlling for a full range of observables and selection into jobs that are likely to provide healthcare benefits.

Third, we contribute to the empirical literature on search, matching, and bargaining by introducing a way to incorporate healthcare insurance into an equilibrium model by allowing healthcare coverage to affect both worker productivity on the firm side, and worker absence and job duration on the worker side of the contract. Finally, we contribute to the policy debate on agricultural worker welfare by validating the notion that human resource sustainability involves the provision of worker healthcare. In other words, healthcare coverage falls into the class of sustainable, profit-increasing strategies as described by Carter and Rogers (2008).

In the next section of the paper, we review the operations management and labor-economics literatures as a means of motivating the importance of our contribution. In the following section, we develop a theoretical model of search, matching, and bargaining that incorporates investments in personal health and health coverage as elements of human capital. As such, health becomes an argument of the match productivity. In Section 4 we derive an econometric model that we use to test the hypotheses that follow from our theoretical model of labor-market equilibrium. We explain our data sources, summarize our data, and highlight our identification strategy in Section 5. The sixth section presents the estimates from our reduced-form and structural models and provides a discussion about their relevance to our hypotheses, as well as firm practices regarding the provision of employee healthcare coverage and the promotion of worker health and safety more generally. A final section concludes and offers some suggestions for future research that builds on our findings.

2 Literature Review

In this section, we fit our work in the existing literature on labor and health economics, and discuss how employer-participation in employee health might lead to productivity benefits. However, findings are mixed. We reference the clinical health science literature to outline why empirical estimates derived from quasi-experimental studies are partly responsible for mixed findings. As it relates to health coverage, better healthcare utilization appears to result in better health outcomes. Improved health and second order income effects reduce lost productive time, especially for agricultural farmworkers who face tough financial trade-offs. We conclude by positioning our research in the healthcare operations management literature, which recently has expanded scope to include public health.

Outside of agricultural settings, there is evidence of some complementarity between providing a safe, healthy workplace for employees and financial outcomes (Das et al. 2008; Longoni et al. 2013; Pagell et al.

2015; Weingarten et al. 2021). In contrast to the traditional view that providing worker health and safety implies a sacrifice of productivity and profit, which rationalizes exploitation in the case of lower-skilled agricultural workers, this more recent perspective considers the outcome of managing employee health and productivity as part of an integrated workplace strategy.[1] In the terminology developed in this literature, agricultural workers engage in the epitome of "precarious work," as their jobs are "...associated with temporary contracts, low earnings, and limited or no employee representation..." (p. 926, Wiengarten et al. 2021). In fact, Weingarten et al. (2021) find an inverse-U relationship between the level of precarious employment, flexibility, and financial performance, so there seems to be an optimal level of precariousness that maximizes flexibility and bottom-line outcomes. In the operations literature, safer work places lead to more productive employee relationships (Das et al. 2008), and indeed exploitation is not optimal. We contribute to this literature by providing empirical estimates of the extent of complementarity between healthcare coverage as an input and firm-level production outcomes with an econometric model that is grounded in the microeconomic theory of labor markets.

Other examples of complementarity abound, suggesting that employer-participation in employee health is worthwhile. Probably the most direct involvement firms can have in employee health outcomes are corporate wellness programs, which have grown to enroll some 50.0 million employees in the U.S. (Jones, Molitor, and Reif 2019). Corporate wellness programs also provide near-ideal settings for natural field experiments because researchers can randomly enroll participants, and vary the incentives provided for participation. However, the accumulating empirical evidence from corporate wellness programs in the U.S. is mixed – while Einav, Lee, and Levin (2019) report evidence of a correlation between participation and improved health outcomes, they are not able to establish a causal relationship between enrollment and lower healthcare costs. Similar findings by Baiker et al. (2013), Jones, Molitor, and Reif (2019), and Pagell et al. (2020) cast some empirical doubt on the overall effectiveness of corporate wellness programs.

On the other hand, Gubler, Larkin, and Pierce (2018) find strong returns to a corporate wellness program, where gains come in not only reduced insurance premiums and absenteeism, but higher productivity, as well (e.g., the garment processing rate among factory workers). Their sample size, however, is very small

[1]Interestingly, the modern trend toward recognizing worker welfare as a necessary precondition for organizational sustainability arose simultaneous to the emergence of the "new personnel economics" school in the field of labor economics (Lazear and Oyer 2007).

($N = 111$), so it may not be representative of a general effect. In these studies, it may be the case that the selection effect documented in Jones, Molitor, and Reif (2019) dominates, and these programs do not appear to be incrementally beneficial simply because the participants were already generally healthy and are not the "bottom of the pyramid" workers that are the focus of the current paper. Regardless, corporate wellness programs represent the extreme of corporate concern for employee welfare that we discuss here, and the empirical literature perhaps shows the limits of what we can expect from company-provided health coverage.

The study of a workplace wellness demonstrates several econometric challenges that are likely responsible for mixed findings related to employer-participation in employee health. First, most observational and retrospective studies of health interventions fail to address group-wise selection bias, as discussed in Jones, Molitor, and Reif (2019), which may underestimate the effect of employer benefits. Second, the large variety of health status measures used complicates the direct interpretation of a clinically meaningful change. In the clinical health science literature, Kazis et al. (1998) argue for the use of effect sizes. However, effect sizes can be estimated in different ways and are still subject to considerable bias. Effect sizes are also considerably low, so larger samples are required.

Third, study designs that use quasi- or natural experiments rest on an analysis of pre- and post-treatment scores to estimate an effect. These methods cannot separate unrelated longitudinal factors, like subject maturation effects, from the estimated treatment effect and typically fail to address serial correlation (Bertrand et al. 2004). These econometric challenges may be partially resolved using a structural approach instead, and a new model of the underlying phenomena. We propose that healthcare coverage leads to productivity benefits and estimate the effect using a search-match-bargaining model of the agricultural labor market.

More than just a fringe benefit associated with a job, healthcare coverage is also a complementary input to the production process, akin to investments in human capital or physical capital that increases worker productivity (Fang and Gavazza 2011; Dizioli and Pinheiro 2016; Cole, Kim, and Krueger 2019). Alternatively, firms may invest in human capital to minimize health-related lost productive time, which stems from absenteeism and decreased productivity while actually at work (Stewart et. al. 2003). In fact, Dizioli and Pinheiro (2016) examine heath care explicitly as a productive input and use Medical Expenditure

Panel Survey (MEPS) data to find that workers who are covered miss some 76.5% fewer days than otherwise. They consider two pathways to higher productivity through healthcare: Coverage reduces the probability that a healthy worker will become sick and miss days, and it increases the likelihood (i.e., reduces the number of days) that sick workers will return to productive work. Among agricultural workers, we argue that healthcare coverage can have an alternative, more direct effect on productivity. With manual labor, healthier workers are likely to be more productive, and both earn more for themselves and a higher level of employment-surplus (in the sense of Dey and Flinn (2005) and Flinn (2006)) for their employer (Goldstein 2003; Odegaard and Roos 2014; Gubler, Larkin, and Pierce 2018). We examine this question using our repeated cross-sectional data set of workers directly engaged in agricultural production.

A different line of research examines Medicaid coverage for low-income Americans, healthcare utilization and health outcomes. A landmark event occurred in Oregon in 2008, wherein adults were randomly selected to apply for Medicaid coverage by way of lottery drawings from a waiting list. This exogenous shock was used to identify and estimate the average treatment effect of health insurance coverage. Results were again decidedly mixed. One (Finkelstein et al. 2012) and two-years after (Baicker et al. 2013) the Oregon experiment, adults with Medicaid coverage appeared to have no discernible difference in health outcomes, relative to those without coverage.[2] Overall, Medicaid coverage increased healthcare utilization, predominately via increased use of primary and preventative care. Without a discernible impact on quality, however, the question remains: is health care coverage worth it?

The Oregon experiment suggests that healthcare coverage enables a more proactive approach to managing health, which for agricultural workers, means that they remain productive. Covered agricultural farmworkers, engaged in intense manual work, should equally exploit preventative health services, stay healthy and minimize lost productive time. A growing body of work suggests that low-income workers with limited budgets must face tough financial trade-offs such as paying for food and paying for healthcare care.[3] To the extent that food and medicine act as substitutes in low-income, high-risk demographics, individuals with coverage may avoid impaired self-care due to competing demands (Seligman and Schillinger 2010).

[2]Covered individuals had better self-reported measures of health and lower out-of-pocket expenditures, according to Finkelstein et al. (2012); however, more objective biomarkers (e.g., blood pressure, cholesterol levels or glycated hemoglobin levels) showed no difference.

[3]Cost-related medication underuse or the proverbial "treat or eat" has been associated with poorer health and was found to be more prevalent among Hispanic and non-Hispanic blacks, according to Berkowitz, Seligman, and Choudhry (2014)

The healthcare operations management literature has responded in force and now recognizes that a broader healthcare ecosystem (Dai and Tayur 2019) and new patient routing patterns outside the hospitals' four walls (KC, Scholtes, and Terwiesch 2020) impacts patient health outcomes. Scholars urge that future research in this area should adopt a public health lens and explore how to keep "the population healthy for longer" (pg 69, Keskinocak and Savva 2020). Our research presents a critical first step, as we demonstrate that employer-provided healthcare coverage translates into a public health benefit in the form of increased productivity, wages, and job-stickiness. To the best of our knowledge, we are the first to provide an empirical estimate of these effects for agricultural workers.

3 Empirical Model

3.1 Conceptual Model of Employment Bargaining

We apply a model of labor market search, matching, and bargaining developed by Flinn (2006) to examine equilibrium employment and productivity outcomes among our sample of farmworkers. Job duration, unemployment, productivity, and wages are each equilibrium outcomes in the sense that firms search optimally for workers, workers search optimally for jobs, and search occurs until the point at which the marginal benefit of additional search effort is just equal to the marginal cost of doing so (Stigler 1961). When both firms and workers optimize, the "employment surplus," or the amount of value created by the worker for the firm, is at a maximum. Our framework departs from the usual "take it or leave it" assumption in the labor economics literature (Burdett and Mortensen 1998; Van den Berg and Ridder 1998; Eckstein and Van den Berg 2007) by allowing workers and firms to bargain over wage outcomes. Negotiation between firms and workers, or their representative, means that the amount of employment surplus is shared between workers and firms according to their relative bargaining power, which is exogenous to each party and is usually determined by attributes, is interpreted as negotiating "skill" (Nash 1950; Muthoo 1999), and is estimated in the data.[4]

We are not the first to use a formal model of optimal search-and-matching outcomes to explain labor market outcomes, as Flinn (2006) examines how minimum wage laws affect equilibrium wages and employment, Dey and Flinn (2005) consider how wages differ between those who have healthcare and those who do

[4]Our model belongs in the general class of "imperfectly competitive" labor market models in which both workers and firms can profit from the employment relationship. In these models, imperfection refers to the existence of search frictions, and not the usual market power relationships of monopsony hiring or monopoly labor unions (Bhaskar, Manning, and To 2002; Manning 2003; Ashenfelter, Farber, and Ransom 2010; Ransom and Oaxaca 2010; Hamilton et al. 2022).

not, and Flabbi and Moro (2012) consider gender differences in compensation. We are the first, however, to explore how wage, employment duration, and productivity outcomes for low-skilled farm workers depend on the presence of healthcare coverage and, by extension, how both firms and workers can benefit from treating workers equitably and as valuable stakeholders in otherwise competitive enterprises. In this section, we provide a brief explanation of the core of our theoretical model, and use this model to derive several testable hypotheses regarding the relationship between healthcare coverage and wages, productivity, job duration, and unemployment duration.

Following the standard approach in this literature (Pissarides 2000; Flinn 2006), our model assumes that match productivity (ϕ) is distributed across the sample of workers according to a distribution function, $f(\phi)$, which is assumed to be log-normal and is determined by the production technology used by the firm. We follow Flinn (2006) in what follows, and assume that both firms and workers observe the productive value of the match, ϕ, and that match productivity depends on whether the worker has healthcare coverage (h) or not (Dey and Flinn 2005; Aizawa and Fang 2020) so that $\phi(h) > 0$, $\phi'(h) > 0$, and $\phi''(h) < 0$. The exogenous rate of job termination for employed workers is δ, the exogenous rate of job contacts, or the rate at which jobs are created, for unemployed workers is τ, and the discount rate is $\beta > 0$. Workers negotiate with an exogenously determined amount of bargaining power, $\lambda \in (0, 1)$, which reflects the share of the match surplus they retain from the employment relationship.

Labor is considered the only factor of production, so firms earn zero profit, and derive no value from participating in the labor market if they do not employ workers. The profit from employing a worker is the difference between their productivity value and the wage, or $\phi(h) - w$, where w is the wage paid to employees. Employers and employees negotiate according to a Nash (1951) bargaining framework in which the strength of each player's bargaining position depends on the value of their next best alternative, or their "disagreement profit" in Nash bargaining terminology. From the worker's perspective, the disagreement profit is the value of staying unemployed, during which time they are assumed to continue searching for a job, so their next best alternative is the value of ongoing job search efforts, denoted by W_u. At a certain point, there is a threshold wage, the critical match value, $\phi(h)^*$, that determines whether an unemployed worker will accept a job offer. The critical match value is given by $\phi(h)^* = \beta W_u$, and determines whether labor will be supplied, as all values of $\phi(h)$ that meet or exceed $\phi(h)^*$ will result in employment while those that are lower will not. Once a worker accepts a job offer, the value of employment depends on the wage, $W_e(w)$.

With these assumptions, the value to a worker of taking a job is the present value of their wage, plus the expected present value of reverting to unemployment, or:

$$W_e = \frac{w + \delta W_u}{\beta + \delta}, \tag{1}$$

where the "effective" discount rate includes a risk premium for the possibility of becoming unemployed. At the same time, the value of unemployed search is equal to the reservation wage (or the utility of consuming leisure, R) plus the expected present value of the surplus earned from taking a job at any wage greater than the critical match value:

$$\beta W_u = R + \frac{\lambda \tau}{\beta + \delta} \int_{\beta W_u} [\phi(h) - \beta W_u] df(\phi(h)), \tag{2}$$

where the expected value is over the entire distribution of possible match values above the reservation value.

From the firm's perspective, the value of employing a worker with productivity level $\phi(h)$ is simply the present value of the amount of employment surplus, discounted at the same rate as the employee, or:

$$W_f = \frac{\phi(h) - w}{\beta + \delta}, \tag{3}$$

where the wage is assumed to include the cost of healthcare coverage implied by h.

Once a match occurs, employers and employees bargain for wages at all values of $\phi(h) \geq \phi(h)^*$, that solve the generalized Nash-bargaining problem:

$$w(\phi(h), W_u) = \arg\max_w [W_e(w) - W_u]^\lambda \left[\frac{\phi(h) - w}{\beta + \delta}\right]^{1-\lambda}, \tag{4}$$

where λ measures the share of employment surplus earned by the employee, and $(1 - \lambda)$ the share earned by the employer, recalling that the disagreement profit for the firm is zero. In the absence of any consideration for minimum wages, the wage that solves (4) is given by:

$$w(\phi(h), W_u) = \lambda \phi(h) + (1 - \lambda) \beta W_u, \tag{5}$$

where recall that $\beta W_u = \phi(h)^*$ is the threshold match value for the employee. However, minimum wages are an important feature of the low-skilled, agricultural labor market, so we follow Flinn (2006) in modifying the problem to explicitly allow for the imposition of minimum wages on market-driven wage bargaining.

Minimum wages constrain the wages employers can pay. However, because employers earn some surplus on each employee, depending on the realized values of ϕ and λ, they have the ability to give up some surplus to hire workers with ϕ greater than the minimum wage (w_m) even though the minimum wage may be greater than the equilibrium wage suggested by (5). To see this more formally, assume the value of unemployed search is now a function of the minimum wage, and solve for the threshold value of $\hat{\phi}(h)$ that holds when $w = w_m$, or

$$\hat{\phi}(w_m, W_u(w_m)) = \frac{w_m - (1-\lambda)W_u(w_m)}{\lambda},$$

so the minimum wage defines regions of the equilibrium match value that separate workers who are paid clearly above the minimum wage, those who are paid the minimum wage, and those who are not hired at all. Because minimum wages impose a discontinuity on the distribution of wages, the value of unemployed search becomes:

$$\beta W_u(w_m) = R + \frac{\tau}{\beta+\delta}\left\{\int_{w_m}^{\hat{\phi}} [w_m - \beta W_u(w_m)]df(\phi) + \lambda\int_{\hat{\phi}}^{\infty}[\phi(h) - \beta W_u(w_m)]df(\phi)\right\}, \tag{6}$$

which changes the solution for the equilibrium market wage. Substituting (6) back into the Nash bargaining problem in (4) and solving for the equilibrium wage distribution leads to:

$$g(w; W_u(w_m)) = \left\{\begin{array}{ll} [f'(\hat{\phi}(w, W_u(w_m))]/\lambda f(w_m), & w > w_m \\ [f(w_m) - f(\hat{\phi}(w, W_u(w_m)))]/f(w_m), & w = w_m \\ 0, & w < w_m \end{array}\right\}, \tag{7}$$

for workers that are paid above the minimum wage, at the minimum wage, or who are not hired, respectively. We use the equilibrium wage distribution in (7) to derive several hypotheses regarding the effect of worker healthcare coverage on worker wages, productivity, job duration, and firm profit.

Our first hypothesis concerns the link between healthcare coverage and worker productivity, which we abbreviate as the health-productivity relationship. Although the literature appears mixed on the significance and directionality of this relationship, the prevailing logic is that insurance coverage reduces the probability of missing work or illness-related absences. Conditional on getting sick, insurance coverage increases the probability of recovery and return to work. The latter pathway is important because when a worker falls ill, medical treatment and absenteeism act as substitutes, and a day off work can be more expensive than a doctor's visit (Gilleskie 1998). A reliable estimate of the health-productivity relationship comes from Dizioli and Pinheiro (2016), who estimate that a covered worker misses 76.5% fewer days than an uncovered worker. Aside from the health-related physical benefits to productivity, health insurance coverage may also have psychological benefits that drive productivity even further.

According to Das et al. (2008), workers that feel safe have greater motivation and are more committed to the goals of the organization. On the contrary, when workers' personal values are put at risk, as is the case in an unsafe workplace, workers are less motivated due to a psychological disconnect. Employees then assign mental resources to conflicting or incompatible information to resolve the disconnect. With a limited pool of mental resources (Pagell et al., 2020), workers assign resources to resolve internal conflict, which directly offsets those that would otherwise be assigned to the goals of the organization. When a firm cares for workers' health and well-being through the provision of health insurance, for example, workers gain internal alignment with workplace-mandates and likely feel safer. Less disconnect translates into increased loyalty, higher productivity and job satisfaction. This is particularly true for agricultural workers who, due to the high intensity of work, have safety concerns top-of-mind. Taken together, we hypothesize

Hypothesis 1 (H1): *Healthcare insurance increases worker productivity.*

If covered workers have greater productivity, then higher wages should also be expected. However, if health insurance coverage is considered one part of the workers' total compensation, the theory of compensating differentials means that firms offer lower wages to compensate for others benefits, conditional on the employment match. In other words, workers would be willing to sacrifice wages when moving from a job without insurance to a job with insurance. In practice, however, workers sometimes have private demand for health insurance, due to marriage or the presence of children in the household, which may result in less productive matches. Following an unemployment spell, these "high demand" workers are more likely to gain coverage, but due to less productive matches, have higher voluntary turnover in jobs and lower wages (Dey and Flinn 2006). High demand workers are also less likely to be observed in an unemployment spell, generally. Worker heterogeneity then partially explains compensating differentials. Without worker heterogeneity, Dey and Flinn (2006) find that wages are 42% higher in jobs with health insurance, relative to those without. To the extent that covered agricultural workers also have lower medical debt (Finkelstein et al. 2012), workers benefit from a second order income effect which, in turn, could drive productivity (Antonisse et al. 2018). This leads to our second hypothesis,

Hypothesis 2 (H2): *Healthcare insurance improves worker wages and income.*

Health insurance coverage enhances the productivity of the match through varied mechanisms, which are discussed above. Expanding on the health-related physical benefits of coverage, Dey and Flinn (2006) explicitly suggest that poor health leads to involuntary job separations or termination of employment contracts. In fact, these authors find that uninsured workers do have greater involuntary job separations, and regardless of wages, have shorter employment contracts. Thus, jobs with health insurance last substantially longer, than those without, and the "ratio is on order of six" (Dey and Flinn 2006, pg. 574). Therefore, the health-job longevity relationship is positive, or

Hypothesis 3 (H3): *Healthcare insurance increases job duration.*

If health is a form of general human capital, then it can be modeled as part of the production function. In a two-period model of production, higher initial levels of health and investment in health translate into higher productivity and wages—surplus is the difference between the worker's productivity, and her wages (Fang and Gavazza 2011). Using the common assumption of wage compression (Acemoglu and Pischke 1998), productivity grows faster than wages, or the longer the worker stays at her current firm, the greater the difference between the worker's productivity and her outside wage. Since covered workers have longevity or job duration effects, health insurance results in greater surplus, conditional on an employment match. Coverage may also increase employment surplus by decreasing the probability of an "adverse shock" (Fang and Gavazza 2011). Given the health-related physical benefits of coverage, workers with insurance have a lower chance of becoming sick, ending the employment relationship, obtaining an outside wage and offering zero surplus to the firm. Furthermore, health insurance coverage may result in more productive matches, which generate more positive surplus. Thus, we hypothesize:

Hypothesis 4 (H4): *Healthcare insurance generates positive surplus from an employment transaction.*

Firms tend to underinvest in workers' health because health is a form of general human capital and firms are unable to capture their returns from this investment. In other words, when workers switch firms, their health is transferable to the new firm. This trend to underinvest is most pronounced in high turnover industries, resulting in an intertemporal reversal of healthcare expenditures in an individual's life: Fang and Gavazza (2011) show that workers tend to have poor health during their prime working years, and significant expenditures in retirement. This reversal reveals an inefficient pattern in the employer-sponsored healthcare system, but one that is ubiquitous and ever-connected to firm outcomes. Driving firm-productivity, worker wages and income, employer-sponsored healthcare leads to a virtuous cycle and broad reinforcing benefits for both the employer and employee. Since firms cannot instantaneously capture higher productivity from covered workers, and covered workers stay employed longer, then we propose

Hypothesis 5 (H5): *Healthcare insurance improves firm profitability.*

In the next section, we develop an empirical approach designed to test each of these hypotheses in our worker-level survey data.

3.2 Empirical Model of Wage Determination

We estimate the model with data on observed wages (w_i) and the amount of time spent unemployed during the past year (t_i) for a repeated cross-section of some $N = 24,000$ worker-year observations for employees in the California agriculture industry. We describe our data in more detail below but find that it is sufficient to identify all of the parameters of the wage distribution above, including the Nash bargaining parameter, λ, that determines the share of employment surplus earned by employees, and by firms. In this section, we derive the log-likelihood function developed by Flinn (2006) that is used to estimate the parameters of search, matching, and bargaining models such as ours. We then explain how we test the hypotheses derived above regarding the impact of healthcare coverage on wages, productivity, and job duration.

Because minimum-wage employment is common in agriculture, we follow Flinn (2006) and break the likelihood function into three parts: (1) the probability that a worker is unemployed for a duration of t weeks, (2) the probability that a worker is employed and paid a wage that is equal to the minimum wage, and (3) the probability that a worker is employed and paid more than the minimum wage.

For the first component of the likelihood function, we have to assume a distribution for unemployment durations, in general. In this regard, like Flinn (2006), we follow common practice and assume the distribution of the population duration function is negative exponential, so we write the individual-density of job duration as the mean, or:

$$pr(t|u) = \tau f(w_m) \exp(-\tau f(w_m) t), \tag{8}$$

where the parameters and minimum wage variable are as defined above. We use the parametric rate of job destruction to infer that the probability of a worker becoming unemployed during the year is:

$$pr(u) = \frac{\delta}{\delta + \tau f(w_m)}. \tag{9}$$

Multiplying the conditional probability of observing a spell of length t, given that the worker is unemployed, by the marginal probability of becoming unemployed gives the joint probability of observing an employee becoming unemployed for a period of length t, or:

$$pr(t, u) = \frac{\delta \tau f(w_m) \exp(-\tau f(w_m) t)}{\delta + \tau f(w_m)}, \tag{10}$$

and we assume f is log-normal, with parameters μ for the mean and σ for the standard deviation.

Second, we derive the likelihood-component that captures the probability that a worker is employed and paid the minimum wage. Recall that the primary implication of a minimum wage regime is to constrain the range of equilibrium productivity values to those that lie above the minimum wage. With this in mind, the likelihood contribution from minimum-wage employees is given by:

$$pr(w = w_m, e) = \frac{\tau \left[f(w_m) - f\left(\frac{w_m - (1-\lambda)\beta W_u(w_m)}{\lambda} \right) \right]}{\delta + \tau f(w_m)}, \tag{11}$$

which represents the probability a worker is employed (e) but is paid the minimum wage, so the firm is willing to give up some surplus in order to hire a worker that still produces value greater than the level of the minimum wage.

A third segment of workers are employed and paid above the minimum wage. For these workers, the minimum wage is still relevant, however, as it remains an element of the value of unemployed search which, in turn, determines the threshold match value for employment. The probability of observing a wage w for an employed worker, therefore, is the product of the conditional probability of observing a worker being paid above the minimum wage, conditional on being employed, and the probability of observing a particular wage above the minimum. The second element of this expression, therefore, is given by:

$$pr(w|w > w_m, e) = \frac{\frac{1}{\lambda} f'\left(\frac{w - (1-\lambda)\beta W_u(w_m)}{\lambda} \right)}{f\left(\frac{w_m - (1-\lambda)\beta W_u(w_m)}{\lambda} \right)}, \tag{12}$$

as the wage has to exceed the match-minimum of $\frac{w_m-(1-\lambda)\beta W_u(w_m)}{\lambda}$. Meanwhile, the conditional probability that a worker's wage is above the minimum, conditional on employment, is:

$$pr(w > w_m|e) = \frac{f\left(\frac{w_m-(1-\lambda)\beta W_u(w_m)}{\lambda}\right)}{f(w_m)}. \tag{13}$$

Multiplying these two expressions together provides the joint probability, and likelihood contribution, of observing a wage w that is above the minimum w_m for an employed worker:

$$f(w, w > w_m, e) = \frac{\frac{\tau}{\lambda} f'\left(\frac{w-(1-\lambda)\beta W_u(w_m)}{\lambda}\right)}{\delta + \tau f(w_m)}. \tag{14}$$

Combining all three elements, taking logs, and summing over all individuals in the data set provides a likelihood function that recovers all of the parameters of interest:

$$\begin{aligned} LLF = {} & [\ln(\tau) - \ln(\delta + \tau f(w_m))] + d_U[\ln(\delta) + \ln f(w_m)] - \\ & \tau f(w_m) d_U t_i + d_M \ln\left(f(w_m) - f\left(\frac{w_m - (1-\lambda)\phi^*}{\lambda}\right)\right) - \\ & d_H \ln(\lambda) + d_H \ln\left(f'\left(\frac{w_i - (1-\lambda)\phi^*}{\lambda}\right)\right), \end{aligned} \tag{15}$$

where d_U is a binary indicator of whether the worker is unemployed ($d_u = 1$) or employed ($d_u = 0$), d_M is a binary indicator that the worker is paid above the minimum wage, and d_H is a binary indicator that the worker is paid above the minimum wage. With this likelihood function, we estimate the implicit minimum wage as $\phi^* = \beta W_u(w_m)$, and capture the fact that productivity is a function of healthcare coverage by allowing the distribution f to be a linear function of a binary healthcare indicator (h) that takes a value of one when the worker has healthcare coverage and zero when they do not. In the application below, we also allow the rates of job creation (τ) and destruction (δ) to depend on the healthcare variable as an extension to our base model in (15). In the next section, we provide more detail on the data we use to estimate this model and provide some model-free evidence of the impact of healthcare coverage on worker productivity and longevity.

4 Data and Identification

California is the largest producer of labor-intensive agricultural products in the U.S., so we focus our analysis on employees on farms in the state of California. We use employee-level data from the National Agricultural

Workers Survey (NAWS; DOL 2022), which is a nationally- and regionally-representative sample of non-H-2A crop farmworkers.[5] Although the NAWS can be used to generate representative statistics for 10 separate multi-state survey regions, representative statistics can also be generated for the state of California, making it an ideal data source for our purposes.[6] The NAWS contains data on each farmworker's wage, their duration of unemployment during the previous 52 weeks, the duration of employment with their current employer, the crop they were working in at the time of the survey, their job task (e.g., harvest, semi-skilled, supervisor, etc.), and a host of demographic variables, including age, gender, educational attainment, the number of years they have been engaged in farm work, foreign-born and legal status, and a variable that identifies if their employer provides health coverage.

The health coverage variable is the primary focus of our study, and we use the other variables as controls in our statistical analysis. We use the NAWS variable D22 for our measure of health coverage, which is a binary variable that equals one if the answer is yes (and zero if the answer is no) to the question "If you are injured at work or get sick as a result of your work, does your employer provide health insurance or provide or pay for your health care?" Figure 1 shows the share of California's farm workforce that had access to health coverage between 1988 and 2020. As shown in the figure, health coverage increased significantly during the 1990's but has fluctuated around the 80% mark ever since. Using data from the National Health Interview Survey, Figure 2 shows how health coverage status across the entire US economy compares to the average farmworker between 2010 and 2020, revealing a a significant disparity.

[Figure 1 in here]

[Figure 2 in here]

Table 1 displays a set of summary statistics from our sample of California farmworkers. Roughly 20% of the workers were female. About half of the NAWS respondents were undocumented, and the average worker had about 14 years of farm work experience, 7 years of education, was 36 years old, and was unemployed for about 8 weeks during the previous year.

While male and female workers have similar levels of health coverage, undocumented workers are about

[5] The H-2A program is a non-immigrant guestworker program established under the 1986 Immigration Reform and Control Act (IRCA). Unlike the H-1B and H-2B programs that apply to workers in the technology and hospitality industries, respectively, it is not subject to an annual cap, but employers must follow regulations on worker safety, health and sanitation, transport, shelter, and wages (U.S. Department of Labor, 2022).

[6] See https://www.dol.gov/sites/dolgov/files/ETA/naws/pdfs/Map_of_NAWS_12_Sampling_Regions.pdf for a map of the 12 NAWS survey regions.

three percentage points less likely to receive coverage, revealing a disparity due to a lack of legal status. Similarly, workers with less than 12 years of schooling are three percentage points less likely to have access to health coverage. Importantly, in our reduced-form and structural analyses, we control for these individual characteristics to help mitigate bias that may arise from self-selection or human capital accumulation. In the next section, we present model-free evidence to investigate the link between employer-provided health coverage and the wages, health care use, and duration of employment and unemployment.

[Table 1 in here]

Econometrically identifying the bargaining parameter (λ) – the parameter that divides the amount of employment surplus between the employee and the employer – is notoriously difficult in data that includes only unemployment duration and hourly wages. Fundamentally, worker-based data like our NAWS sample represents observations from only the supply-side (worker side) of the employer-employee equilibrium. Variation in wages and unemployment duration is able to capture workers' threat point, or disagreement profit in the Nash (1951) framework, but not the employers'. Others remedy this weakness in worker-level survey data by using matched employee-employer data (Cahuc et al. 2006), but there are no similar data sets for U.S. agricultural workers. Therefore, we follow Flinn (2006) in using data that captures the "demand side," or employer side of the equilibrium to help identify worker bargaining power.[7]

In our application, we use data on the variability of labor's share of revenue, by industry, to estimate a flexible bargaining-power function that is more likely to be identified than if we were to use the worker-only information in the NAWS.[8] Specifically, we use data on the labor-share of revenue for workers in the agricultural production industry to help measure employers' bargaining power. Our revenue and labor-compensation data are defined as total gross receipts for all firms and total compensation for production workers, respectively, and are from USDA-NASS for NAICS codes 111 - 115 (USDA-NASS). Over the sample period, the average labor-share is 21.1% of value (s.d.= 5.9%) with a minimum value of 1.8% and maximum of 32.2%. Our assumption in using these data is that the labor share of revenue captures variation in

[7]Estimates of our model without demand-side information as in Flinn (2006) show that the bargaining-power parameter appear to be well-identified using only worker-side information, but we choose to follow his approach due to both conceptual issues in identifying λ and for comparability with others in this literature. Our results below show estimates both with and without demand-side data.

[8]Flinn (2006) uses the labor-share of revenue for one large fast-food company for the year 1996 because it is a dominant employer among minimum-wage workers (18 to 24-year-olds), and because it is publicly traded so their financial data is readily available.

the marginal revenue product of workers across industries and time under the constant-returns to scale assumption in Flinn (2006).

With this data, we embed a least-squares estimator for the bargaining power parameter (λ) into the likelihood function for equilibrium wages with search-and-bargaining (15) above, where λ is a simple linear function of the labor share of revenue in each industry. We estimate both in one procedure, so the estimate of λ reflects both demand- and supply-side information as in Flinn (2006). In this way, we are able to identify the bargaining power parameter, and test the core hypotheses of our paper.

5 Results

5.1 Reduced-Form Evidence

In this section, we first present some reduced-form, or model-free, results that are intended to provide preliminary insights into patterns in our data that may suggest our hypotheses have some support. We first focus on wages of domestic workers and consider how they may be related to healthcare coverage. These results are in Table 2 below. Our estimates that control for demographics, as well as crop, job task, and year fixed effects are in column (4). The estimates from our preferred model indicate that employer-provided health insurance is associated with a 4.3% increase in real wages, holding constant all the other variables in the model. This result reveals a statistically significant positive correlation between health insurance and wage compensation, suggesting that employers who offer health coverage are able to retain a more productive workforce. Figure 3 shows the average wage of employees with and without health coverage, revealing that a wage premium exists almost uniformly across the sample period.

[Figure 3 in here]

The other parameters that identify the statistical association between human capital variables and wages are consistent with theoretical expectations. Older workers tend to earn more (up to a point), female workers tend to earn less, education leads to higher wages, undocumented workers are at a disadvantage relative to legally-authorized workers, and workers with more relevant work experience tend to earn more. While these results are suggestive of a positive impact of health insurance on productivity, and provide evidence in support of H1-H2, we do not interpret them as causal. Instead, we use this exercise to show that the relationship warrants further investigation. In the next section, we generate structural estimates of the impact of health insurance on the productivity of farmworkers using the search, match, and bargaining framework presented in Section 2.

[Table 2 in here]

There are various channels through which employee health coverage may impact productivity. The most obvious impact is through the worker's ability to receive medical care. Using our reduced-form framework, we investigate the extent to which employer-provided health coverage is associated with workers actually receiving health care (see Table 3). Our results indicate that employer-offered health coverage is associated with a five percentage point increase in the probability of receiving health care, suggesting that covered workers, who are otherwise similar to uncovered workers, are more inclined to access medical services. This table also reveals that women are much more likely (about 31 percentage points) to receive health care than men, as are more educated workers and those with more farm work experience, but undocumented workers are less likely to access health services.

[Table 3 in here]

Next we turn our attention to job tenure to examine whether the our simple regression framework provides evidence of a relationship between health coverage and the length of employment. Our reduced-form analysis indicates that, when examining similar employees, those who have access to health coverage stay employed with their employers for longer periods of time. The coefficient on the health coverage variable in column (4) of Table 4 indicates that among workers with the same demographic composition and farm work experience, those who have health insurance stay employed with their current farm employer about 33% longer than those without. A longevity benefit directly supports H3. Older workers and those who are foreign-born tend to stay with an employer longer, but undocumented workers have a slightly lower duration of employment relative to legally authorized workers.

[Table 4 in here]

When examining the relationship between health coverage for employed workers and the duration of unemployment during the previous year (Table 5), we are unable to reject the hypothesis of no statistical relationship. Although the coefficient in our preferred specification is positive, it is not statistically significant at any conventional level of significance. Thus, at a first glance, the summary evidence suggests that health coverage is not a significant factor in determining the length of unemployment.

[Table 5 in here]

5.2 Structural Estimates

The results from equation (15) are in Table 6. Model 1 does not allow the productivity distribution to be affected by health coverage status, but it allows one to generate an estimate of the average match value and economic surplus created in the labor market for each hour of work, irrespective of whether the employer offers health insurance.[9] Our parameter estimates from Model 1 suggest that, on average, employees generated $7.68 worth of match value per hour (in $2020) over our sample period and had an average critical match value of $3.19, suggesting that $4.49 of match surplus was split among employers and employees. Farmworkers retained 23% (or $1.03) of this surplus while employers retained the other 77% ($3.46). Higher employment surplus supports H4.

[Table 6 in here]

The results are very similar if we allow μ, the mean of the log-normal productivity distribution, to vary by health coverage status. The results for Model 2 reveal that health insurance creates $0.36 in value per hour worked relative to the baseline match value of $7.40 for employees without health insurance. In Model 2, workers retain the same share of the economic surplus as in Model 1, but those with health insurance retain $1.05 of match surplus, while those without retain $0.97. Therefore, keeping employers benefit constant, health insurance coverage means that workers are better off and may make more appropriate employment match decisions.

Model 3 additionally allows δ, the job destruction rate, to vary by health coverage status. In this specification, the job destruction rate is five percentage points higher for workers with employer-provided health coverage. This result could imply that employers are more careful in selecting the types of workers they employ and are more likely to terminate marginal workers while retaining only those who "make the cut."

Models 4 and 5 are our most flexible specifications. They both allow for the job creation and destruction rates (τ and δ), as well as the mean of the productivity distribution (μ) to vary by health coverage status.

[9] The mean value of the productivity distribution, which follows a log-normal distribution, characterizes the average match value and is calculated as follows: $e^{\mu+.5\sigma^2}$.

The bargaining power parameter λ in model 4 is estimated with supply side data only, while Model 5 also uses the demand side data. These models are very stable relative to the other specifications. These results indicate that health coverage is associated with a three percentage point higher job creation rate and a six percentage point increase in the job destruction rate, in addition to higher average productivity. The fact that the job destruction and creation rates are both positively impacted by health coverage status suggests that employers may be more picky about the workers they retain, but that health insurance is likely being offered as a recruiting incentive to attract a larger pool of workers. The results from Model 5, our preferred specification, indicate that workers with health coverage create \$0.78 in additional economic surplus per hour relative to the baseline of \$3.93. Workers with health coverage retain an additional \$0.18 in economic surplus (\$1.08 total) for each hour worked relative to their implicit reservation wage.

Model 5 also reveals that employers retain 77% (i.e., $1-.2290$) of the surplus from the employer-employee work relationship and gain an extra \$0.60 per hour in surplus when they offer health insurance relative to their baseline share of the surplus (\$3.03) when they do not offer such benefits. Thus, all else equal, when employers provide health coverage to their employees, they are able to retain a more productive workforce. This means higher firm profit, and supports H5.

Our findings imply that employers who do not offer their employees health coverage are missing out on a significant economic opportunity to retain a more productive workforce and increase the economic value of the employee-employer match. Thus, our analysis suggests that health coverage increases worker productivity by promoting worker health.

While prior research finds that firm-sponsored wellness programs do not increase productivity (Jones, Molitor, and Reif 2020) and that safer work environments reduce the survival rate of firms (Pagel et al. 2020), our findings suggest that when medical expenses are covered by the employer, such that when marginal workers who are on the fence about seeking medical care actually seek treatment, they become more productive and are able to generate more economic value for the firm. This finding also suggests that offering health coverage could help agricultural businesses become more sustainable in long run because it helps them meet both the social and economic criteria as described by Carter and Rogers (2008) and Carter and Easton (2011). Thus, we find that offering health insurance could help improve the firms' triple bottom line and help sustain the agricultural sector.

5.3 Simulations

In order to make our empirical estimates more concrete, and to test H2, H4 and H5 above that are not directly testable via the structural model, we conduct a series of counterfactual simulations. We carry out experiments with different levels of healthcare coverage and calculate outcomes of economic relevance to firms in the agriculture industry. Specifically, we simulate the impact of healthcare coverage on: (1) worker wages, (2) annual worker income, (3) firm profit, and (4) job duration. We describe the details of these simulations in Online Supplement A, and report our findings in Table 7 below. In general, however, each simulation involves allowing the variable h to vary over a range that involves no healthcare coverage at all ($h = 0$) to a base-case where $h = 1$ to scenario in which healthcare coverage in the agriculture industry doubles ($h = 2$).

[Table 7 in here]

In Simulations 1 and 2 in Table 7, we examine the effect of healthcare coverage on worker wages. At the observed levels of healthcare coverage, the average real wage over all workers is approximately $11.03 / hour, but the average wage falls to $9.32 / hour with no healthcare coverage, and rises to $14.75 / hour if healthcare coverage rates double from their current level. Recall that this simulation reflects an equilibrium outcome, so our experiment shows not only what the higher productivity of more healthy workers is worth to employers, but the outcome of their searching for, finding, and negotiating with workers under different healthcare coverage scenarios. In Simulation 2, we scale our wage simulations out to an annual income level, adjusting for the average number of weeks worked per employee, and the number of hours worked per week. On an annual basis, this simulation shows that workers earn $21,915 / year in real income under the base scenario, but annual income would rise to $25,849 / year if healthcare coverage rates were to double. This finding shows the potential gain in real welfare for workers in the agricultural industry from expanding healthcare coverage.[10]

In Simulations 3 and 4 we turn our attention to the implications of healthcare coverage for firm-level

[10]Note that our findings are agnostic as to whether the additional healthcare coverage comes from employer-provided coverage, government-subsidized private sources, or federal healthcare. Our data are not sufficiently detailed to differentiate between the type of healthcare coverage.

outcomes. In Simulation 3, for instance, we examine how different levels of healthcare are likely to impact the amount of surplus earned by the firm, after adjusting for the reservation match value for employees (ϕ^*), and the negotiated share earned by firms $(1 - \lambda)$. Simulation 3 shows that the firm-share of surplus in the base scenario (observed healthcare) is \$3.53 / hour for each hired worker, but falls to \$3.03 / hour with no healthcare, and rises to \$4.09 / hour if healthcare were to double. Because our equilibrium model implicitly accounts for the cost of hiring workers, this finding shows that offering healthcare insurance is still a net benefit to firms in the agriculture industry, as their share of employment surplus rises if healthcare coverage rates rise. Moreover, Simulation 4 shows that this finding extends to firm profit, even after taking into account the equilibrium effects of healthcare on increasing both the rate at which workers enter the industry, and leave (see parametric result in Table 6). After adjusting for employee movements, and aggregating over all employees, firm profit is not different from zero in the base scenario, but falls by \$901 per worker per year if no healthcare coverage is offered, and rises by \$1,203 per worker per year if current coverage rates are doubled. Our simulation results, therefore, clearly show that it is in firm's interest to offer some healthcare coverage, or to expand current coverage rates.

Our simulation findings are perhaps not surprising, given that most farm work includes manual labor and is physically taxing, but represents the first empirical estimate of the economic value of healthcare coverage to farmworkers. Successful farmers understand the value of treating employees well, and our estimates validate farmers' improving worker welfare, regardless of any policy mandate to do so.

6 Conclusion and Implications

Agriculture is a key industry in the US economy, as millions of people depend upon it for their livelihoods, while the rest of society depends upon upstream and downstream markets connected to it through the agri-food supply chain. Farmworkers are an essential part of this system because they provide a critical service that keeps our nation fed, but they are typically exposed to more health dangers than the rest of the population and tend to have less health coverage. Health coverage has important implications for farmworker welfare, and the economic value they generate for our farm economy. For the farmworkers who labor in the fields to provide food for the rest of us, health insurance is essential not only to maintain their own health, but to help sustain their productivity as workers.

In this paper, we estimate the effect of healthcare coverage on farmworker wages, productivity, and job duration using a structural model of labor-market equilibrium. Modeling labor-market outcomes in an equilibrium framework like this is necessary as we do not observe actual productivity, nor can we control for differences among workers who are paid at the minimum wage, above the minimum wage, or who are not employed at all. We estimate our model using a well-understood survey data set (NAWS) covering some 24,000 agricultural workers in labor-intensive jobs in the state of California over a 1989-2020 time period.

We find that health insurance coverage translates into several benefits in the employer-employee equilibrium. First, on the supply side, health insurance coverage results in higher worker productivity, wages and income. Second, there is a job duration or longevity benefit, whereby workers with health insurance tend to stay employed longer, most likely because covered workers are more inclined to access medical care and stay healthy. The effect on unemployment duration was inconclusive.

To capture demand-side effects, we allow key parameters to vary according to worker health coverage status and use a flexible structural specification to estimate changes in the search-and-match process. Our findings are more nuanced for employers. First, we find that the productivity benefit of covered workers translates into higher employment surplus. The employer retains 77% of this surplus. Second, we propose that employers may publicize health insurance benefits strategically to attract and retain top farmworker talent. Higher economic surplus combined with more focused attention on employee health means that employers are better suited to maintain a productive workforce. More healthy workers means higher firm profit. Taken together, our results suggest that employer-participation in employee health leads to broad reinforcing benefits for both entities, advancing a virtuous cycle of employee health and employer productivity.

Our findings are important because we show that farmers who provide healthcare benefits to their workers are better off than those who do not, in the sense that, on average, they earn a greater amount of surplus on every hour of work performed. From an employee perspective, workers are better off as healthcare coverage causes them to stay with the same employer longer, enjoy better health, and earn more for every hour they work. Rather than a public good, therefore, economic incentives suggest that worker health is a "private good" in the sense that the profit from providing healthcare insurance is appropriable by firms, so they should indeed willingly provide healthcare coverage. Although empirical findings in this regard are beyond the scope of this paper, firms will likely to attract better workers as a result.

Our findings also have implications for management practices in agriculture and food supply chains. In line with Roth & Zheng (2021) and Carter and Easton (2011), the health and well-being of agricultural farm workers engaged in intense manual work should be a central concern for firms. Employers that invest in human capital and offer benefits such as health insurance coverage are better off than those that do not. Therefore, commonplace incentives to underinvest in a transient workforce should be re-imagined, in a collective move toward supply chain wide resilience (Novak et al. 2021). New policies and incentives have far-reaching potential to first potentially reduce intentional adulteration of farmers' food (Levi et al. 2020), then address on-going issues in connected markets of the agri-food supply chain (Akkas and Gaur 2022), and finally improve the socioeconomic well-being of society (Roth & Zheng 2021).

7 Online Supplement A: Experimental Procedures

In this Online Supplement, we describe our experimental, or counterfactual simulation, procedures in more detail. For each simulation, we aim to conduct a clean experiment in which we compare outcomes with the observed level of healthcare in the data, with extreme cases in which healthcare coverage is removed, and doubled. We consider scenarios that represent intermediate steps in each direction (reducing and increasing healthcare coverage by 50%) in order to demonstrate the path of each outcome as healthcare coverage varies. Note that the healthcare variable in our model (h) is discrete, so the experimental variation we consider should be interpreted as changing the probability that a particular employee is covered.

For the first two employee-level simulations in Table 7, we simulate changes in the equilibrium wage distribution in equation (7) with varying levels of h. Healthcare coverage affects equilibrium wages in the theoretical model through the productivity-match function ($\phi(h)$) which is manifest in this model through the mean-parameter of the log-normal distribution for f, or μ. In each of the 5 simulated outcomes, we recalculate the equilibrium wage by allowing μ to vary with the level of h and then allowing each part of the distribution in (7) to change accordingly. Because this model represents a distribution of wages, we calibrate the resulting probability values to observed wages so that the observed levels of healthcare generate the observed wage values. We then change the level of healthcare by varying the value of h through a range of -100% through +100%, in 50% increments, and measure the equilibrium wages that result. For the simulated values of income, we multiply the equilibrium wage result by the number of weeks worked (i.e., 52 - t_i) and the number of hours observed for each employee. In Table 7, we report the mean and standard deviation across all N = 23,778 observations.

For the second-two, firm-level outcomes in Table 7, we report changes in equilibrium surplus, and firm profit from the theoretical model of firm surplus in equations (3) and (4) above. In Simulation 3 of Table 7, we report net surplus, which is the gross surplus ($\exp(\mu + 0.5\sigma^2)$ less the reservation productivity from employees (ϕ^*) and the allocation between employers according to the Nash bargaining power parameter (λ). For this calculation, we simply average over all observations in the data set to arrive at an average-firm level surplus from each employee, to each firm that employs them. For Simulation 4, we multiply net surplus by the number of employees drawn from unemployment due to job creation (τ) and those lost from employment due to job destruction (δ) to arrive at an estimate of the aggregate profit implications of the firm-allocation of employment surplus, and movements in and out of the labor market. We interpret the result as the aggregated profit implications for firms that employ all workers in our data set.

For each simulation, we compare the outcome relative to the base case scenario, and report both percentage differences relative to the base, and calculate t-ratios. We do not report t-ratios in the table, but note that all are statistically different from the base case at a 5% level.

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Table 1. Selected Summary Statistics

Variable	Mean	Standard Deviation
Health Coverage	0.830	0.376
Real Wage ($2020)	11.022	3.138
Real Minimum Wage ($2020)	8.999	1.227
Age	36.185	12.580
Female	0.191	0.393
Education	7.469	3.483
Foreign Born	0.947	0.224
Undocumented	0.472	0.499
Years of FW Experience	13.833	11.362
Duration of Unemployment (Weeks)	7.639	9.917
N	24,151	24,151

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and. limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. FW is an abbreviation for farmworker.

Table 2. Reduced-Form Results for Wages

	(1) ln(Hourly Wage)		(2) ln(Hourly Wage)		(3) ln(Hourly Wage)		(4) ln(Hourly Wage)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Health Coverage	0.0470***	0.0101	0.0420***	0.0071	0.0425***	0.0070	0.0432***	0.0067
Age	0.0119***	0.0012	0.0090***	0.0011	0.0091***	0.0011	0.0091***	0.0011
Age^2	-0.0001	0.0000	-0.0001	0.0000	-0.0001	0.0000	-0.0001	0.0000
Female	-0.0239	0.0107	-0.0466***	0.0071	-0.0488***	0.0072	-0.0526***	0.0068
Education	0.0110***	0.0009	0.0048***	0.0007	0.0048***	0.0007	0.0049***	0.0008
Foreign	-0.0432***	0.0149	0.0062	0.0132	0.0022	0.0132	-0.0000	0.0131
Undocumented	0.0023	0.0024	-0.0106***	0.0017	-0.0106***	0.0017	-0.0105***	0.0017
Farm Work Experience	0.0062***	0.0005	0.0038***	0.0004	0.0039***	0.0004	0.004***	0.0004
N	24,151		24,151		24,151		24,151	
Year FE	No		Yes		Yes		Yes	
Crop FE	No		No		Yes		Yes	
Task FE	No		No		No		Yes	

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. Regressions are weighted with the NAWS probability weighting variable. Standard errors in parentheses are survey design-corrected, following NAWS methodology guidelines. The outcome variable is the natural log of *WAGET1* from NAWS, which is the hourly wage of the farm job where the worker was employed at the time of the survey. This table shows a positive association between employer-provided health coverage and worker wages. *, **, *** indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

Table 3. Reduced-Form Results for Receiving Health Care

	(1) Got Health Care		(2) Got Health Care		(3) Got Health Care		(4) Got Health Care	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Health Coverage	0.0465***	0.0176	0.0519***	0.0174	0.0525***	0.0171	0.0511***	0.0174
Age	0.0070	0.0030	0.0054	0.0030	0.0053	0.0029	0.0048	0.0029
Age^2	-0.0001	0.0000	-0.0001	0.0000	-0.0001	0.0000	-0.0000	0.0000
Female	0.3185***	0.0186	0.3079***	0.0179	0.3081***	0.0177	0.3125***	0.0179
Education	0.0183***	0.0021	0.0139***	0.0020	0.0138***	0.0019	0.0132***	0.0019
Foreign	-0.0544	0.0485	-0.0282	0.0490	-0.0259	0.0450	-0.0232	0.0446
Undocumented	-0.0324***	0.0043	-0.0394***	0.0043	-0.0394***	0.0043	-0.0389***	0.0043
Farm Work Experience	0.0076***	0.0010	0.0062***	0.0010	0.0061***	0.0010	0.0060***	0.0010
N	17,696		17,696		17,696		17,696	
Year FE	No		Yes		Yes		Yes	
Crop FE	No		No		Yes		Yes	
Task FE	No		No		No		Yes	

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. Regressions are weighted with the NAWS probability weighting variable. Standard errors in parentheses are survey design-corrected, following NAWS methodology guidelines. The outcome variable is the dummy variable *NQ01X* from NAWS, which is set to 1 if the farmworker responded "Yes" (at the time of the survey) to the question: *"In the last TWO YEARS have you used any type of health care services from doctors, nurses, dentists clinics, or hospitals in the US"*? This table shows a positive association between employer-provided health coverage and workers actually receiving care. *, **, *** indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

Table 4. Reduced-Form Results for Duration of Employment

	(1) ln(Dur. Employ)		(2) ln(Dur. Employ)		(3) ln(Dur. Employ)		(4) ln(Dur. Employ)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Health Coverage	0.3176***	0.0290	0.3324***	0.0282	0.3358***	0.0284	0.3295***	0.0276
Age	0.0414***	0.0040	0.0356***	0.0040	0.0349***	0.0040	0.0331***	0.0040
Age^2	-0.0004***	0.0001	-0.0004***	0.0001	-0.0004***	0.0001	-0.0004***	0.0001
Female	0.0055	0.0352	-0.0217	0.0318	-0.0219	0.0315	-0.0226	0.0312
Education	0.0138***	0.0036	0.0056	0.0033	0.0047	0.0032	0.0027	0.0033
Foreign	0.0724	0.0503	0.1230	0.0540	0.1267	0.0533	0.1347	0.0526
Undocumented	-0.0250***	0.0061	-0.0459***	0.0068	-0.0459***	0.0068	-0.0437***	0.0065
Farm Work Experience	0.0405***	0.0015	0.0371***	0.0014	0.0371***	0.0014	0.0366***	0.0014
N	23,978		23,978		23,978		23,978	
Year FE	No		Yes		Yes		Yes	
Crop FE	No		No		Yes		Yes	
Task FE	No		No		No		Yes	

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. Regressions are weighted with the NAWS probability weighting variable. Standard errors in parentheses are survey design-corrected, following NAWS methodology guidelines. The outcome variable is the natural log of the *D27* variable from NAWS, which asks farmworkers, at the time of the survey: *"How many years have you worked for this employer"*? This table shows a positive association between employer-provided healthcare coverage and duration of employment. *, **, *** indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

Table 5. Reduced-Form Results Duration of Unemployment

	(1) ln(Dur. Unemploy)		(2) ln(Dur. Unemploy)		(3) ln(Dur. Unemploy)		(4) ln(Dur. Unemploy)	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Health Coverage	0.0862	0.0536	0.0862	0.0518	0.0651	0.0495	0.0675	0.0498
Age	-0.0490***	0.0089	-0.0406***	0.0088	-0.0383***	0.0088	-0.0383***	0.0088
Age^2	0.0005***	0.0001	0.0004***	0.0001	0.0004***	0.0001	0.0004***	0.0001
Female	1.1974***	0.0746	1.2489***	0.0671	1.2676***	0.0637	1.2452***	0.0616
Education	-0.0226***	0.0061	-0.0064	0.0063	-0.0026	0.0062	-0.0034	0.0063
Foreign	-0.2477	0.1213	-0.3789***	0.1256	-0.3590***	0.1247	-0.3607***	0.1241
Undocumented	-0.1443***	0.0141	-0.1135***	0.0130	-0.1139***	0.0126	-0.1130***	0.0126
Farm Work Experience	-0.0037	0.0029	0.0014	0.0028	0.0006	0.0026	0.0008	0.0026
N	24,151		24,151		24,151		24,151	
Year FE	No		Yes		Yes		Yes	
Crop FE	No		No		Yes		Yes	
Task FE	No		No		No		Yes	

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. Regressions are weighted with the NAWS probability weighting variable. Standard errors in parentheses are survey design-corrected, following NAWS methodology guidelines. The outcome variable is the natural log of *NWWEEKS* from NAWS, which is the number of weeks (at the time of the survey) the individual did not work (in either farm or nonfarm work) during the previous 52 weeks. This table shows no relationship between employer-provided health coverage and duration of unemployment. *, **, *** indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

Table 6. Structural Model Estimation Results

	Model 1		Model 2		Model 3		Model 4		Model 5	
Parameter	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
τ	0.1231***	0.0021	0.1237***	0.0021	0.1236***	0.0021	0.1030***	0.0031	0.1031***	0.0031
$\tau(h)$							0.0284***	0.0034	0.0286***	0.0034
δ	0.1848***	0.0042	0.1464***	0.0042	0.1464***	0.0054	0.1352***	0.0062	0.1352***	0.0062
$\delta(h)$					0.0479***	0.0056	0.0627***	0.0074	0.0628***	0.0074
μ	2.0148***	0.0068	1.9786***	0.0112	2.0004***	0.0105	1.9369***	0.0176	1.9370***	0.0177
$\mu(h)$			0.0470***	0.0106	0.0207**	0.0101	0.1036***	0.0182	0.1042***	0.0182
σ	0.2181***	0.0100	0.2166***	0.0098	0.2161***	0.0098	0.2238***	0.0098	0.2245***	0.0098
ϕ^*	3.1875***	0.0055	3.1876***	0.0055	3.1875***	0.0055	3.1876***	0.0055	3.1825***	0.0054
λ	0.2303***	0.0011	0.2304***	0.0011	0.2303***	0.0011	0.2302***	0.0011	0.229***	0.0011
Year Fixed Effects?	Yes		Yes		Yes		Yes		Yes	
Crop Fixed Effects?	Yes		Yes		Yes		Yes		Yes	
Task Fixed Effects?	Yes		Yes		Yes		Yes		Yes	
Demographics?	Yes		Yes		Yes		Yes		Yes	
Demand Side Data?	No		No		No		No		Yes	
N	24,151		24,151		24,151		24,151		24,151	
LLF	-72,587.95		72,570.53		-72,545.39		-72,516.45		-72,610.78	
AIC/N	6.016		6.014		6.012		6.010		6.018	

Note: This table uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. Regressions are weighted with the NAWS probability weighting variable. Standard errors in parentheses are survey design-corrected, following NAWS methodology guidelines. Demographic attributes include age, age squared, gender, education, foreign status, years in farm work, immigration status and whether the worker has healthcare coverage. Model 2 (resp. Model 3, resp. Models 4 and 5) match-productivity (resp. match-productivity and job destruction match-productivity and job destruction rate, resp. match- productivity and job destruction and creation rates) to depend on healthcare coverage status. Model 5 is estimated with the demand side data. All estimates with real wages and minimum wages, defined in 2020 dollars ($2020). Each of the interaction terms, $\tau(h), \delta(h)$, and $\mu(h)$ are simple linear functions of the healthcare indicator variable. This table shows the effect of employer-provided healthcare coverage on employment match value and surplus. *, **, *** indicate statistical significance at the 10%, 5%, and 1% confidence level, respectively.

Table 7. Counterfactual Simulations: Effect of Healthcare Coverage

	Sim 1: Wages			**Sim 2**: Worker Income			**Sim 3**: Surplus			**Sim 4**: Net Profit		
	Est.	Std. Dev.	% Change	Est.	Std. Dev.	% Change	Est.	Std. Dev.	% Change	Est.	Std. Dev.	% Change
Base - 100%	9.32	4.09	-15.55%	18,627	10,966	-15.00%	3.03	0.00	-14.17%	-901	4,584	3235.25%
Base - 50%	10.02	4.90	-9.21%	19,967	12,463	-8.89%	3.28	0.11	-7.27%	-505	5,943	1769.75%
Base	11.03	6.24	0.00%	21,915	14,955	0.00%	3.53	0.23	0.00%	-27	7,557	0.00%
Base + 50%	12.53	8.40	13.53%	24,771	19,069	13.03%	3.80	0.35	7.66%	540	9,429	-2098.75%
Base + 100%	14.75	11.89	33.71%	29,021	25,849	32.43%	4.09	0.48	15.73%	1,203	11,572	-4553.02%

Note: Base case for Wages and Income is observed healthcare coverage, simulations consider removing coverage (-100%) to doubling healthcare coverage (+100%). Wages are the average hourly wage over all workers, Income is the total annual income, averaged over all workers, Surplus is the average hourly surplus generated for firms by employment, and Profit is the net surplus to firms, on average, adjusted for workers either entering the laborforce (employment) or leaving the workforce (unemployed). Firm surplus is net of employee share, and critical match value that induces employees to accept offer. For all calculations, the base case is observed healthcare, and Base -100% is removal of all healthcare.

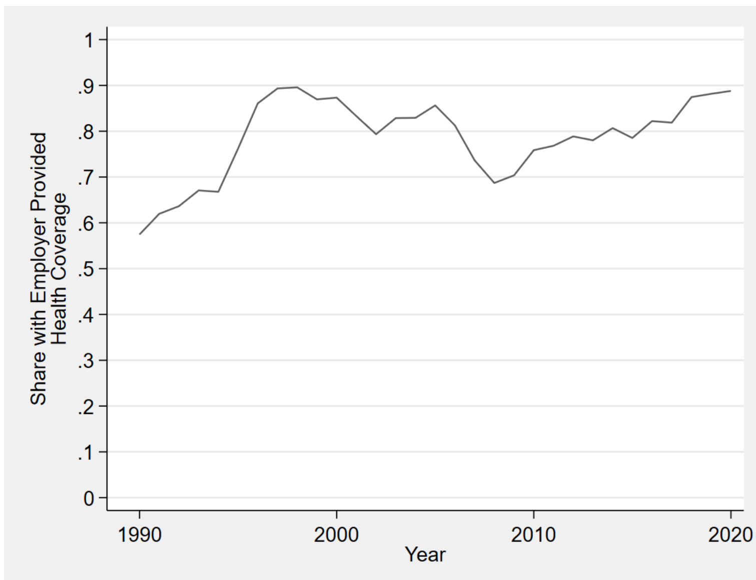

Figure 1: Percentage of workers with employer-provided healthcare coverage among California's farm workforce (1988-2020)

Note: This figure uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. The share with employer-provided health coverage is obtained from the binary NAWS variable *D22*, which is set to one if the farmworker answered "Yes" (at the of the survey) to the question "*If you are injured at work or get sick as a result of your work, does your employer provide health insurance or provide or pay for your health care*?" The share of California's farm workforce that had employer-provided healthcare coverage increased significantly from 1980-1990, but has fluctuated around 80% ever since. Figure was derived from authors' own calculations.

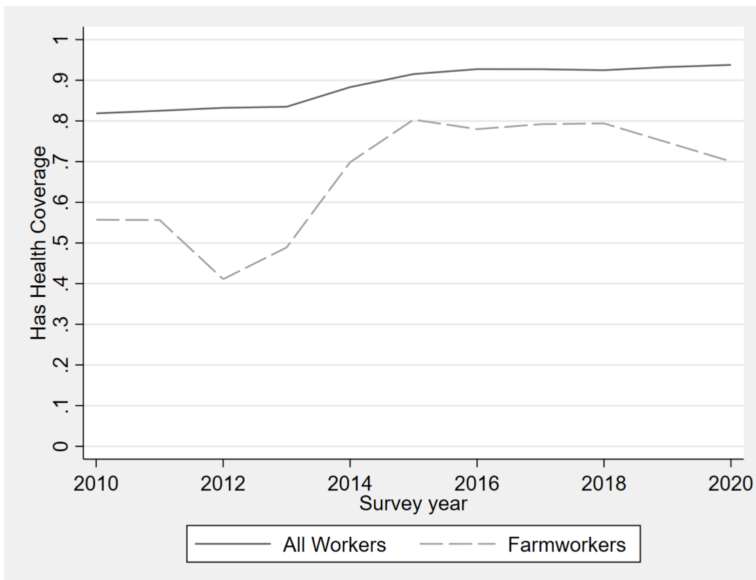

Figure 2: Workers with healthcare coverage for farmworkers, relative to all other workers in the U.S. (2010-2020)

Note: This figure uses data from the National Health Interview Survey for the years 2010 - 2020. The population is employed workers in the U.S. The solid (dashed) line shows the temporal and group-specific variation in healthcare coverage for all workers (farmworkers). Farmworkers appear to have less coverage than all other workers. This disparity was sustained across the entire 10-year period, which signifies a substantial healthcare coverage gap for U.S. farmworkers. Figure was derived from authors' own calculations.

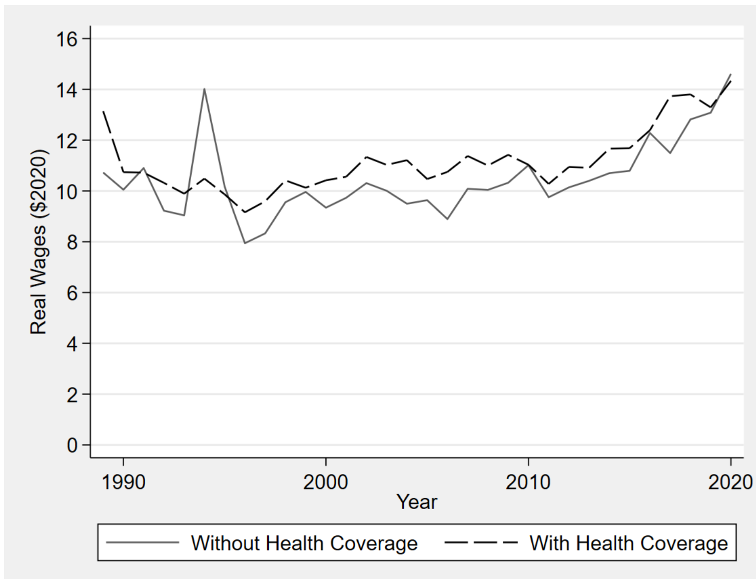

Figure 3: Wages for workers with & without employer-provided healthcare coverage among California's farm workforce (1988-2020)

Note: This figure uses data from the National Agricultural Workers Survey (NAWS), confidential version, for the years 1989 - 2020, and limited to agricultural farm workers in California, who were primarily employed in the specialty crop industry. The solid (dashed) line shows the temporal and group-specific variation in real wages ($2020 dollars), unadjusted for other factors, for workers without employer-provided healthcare coverage (with health coverage). The difference between the two lines provides evidence that a wage premium exists, and it does so almost uniformly across the sample period. Our empirical estimates (not shown) suggest that health coverage increases real wages by +4.3%, adjusted for demographics, crop, job task, and year fixed effects. Figure was derived from authors' own calculations.