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ABSTRACT

This paper examines the behavior of dual jobholders to test a simple model of wage bargaining and wage posting. We estimate the sensitivity of wages and separation rates to wage shocks in a worker's secondary job to assess the degree of bargaining versus wage posting in the labor market. We interpret the evidence within a model where workers facing hours constraints in their primary job may take a second, flexible-hours job for additional income. When a secondary job offers a sufficiently high wage, a worker either bargains with the primary employer for a wage increase or separates. The model provides a number of predictions that we test using matched employer-employee administrative data from Washington State. In the aggregate, wage bargaining appears to be a limited determinant of wage setting. The estimated wage response to improved outside options, which we interpret as bargaining, is precisely estimated, but qualitatively small. Wage posting appears to be more important than bargaining for wage determination overall, and especially in lower parts of the wage distribution. Observed wage bargaining takes place mainly among workers in the highest wage quartile. For this group, improved outside options translate to higher wages, but not higher separation rates. In contrast, for workers in the lowest wage quartile, wage increases in the secondary job lead to higher separation rates but no significant wage increase in the primary job, consistent with wage posting. We also find evidence in support of the hours-constraint model for dual jobholding. In particular, work hours in the primary job do not respond to wages in the secondary job, but hours and separations in the secondary job are sensitive to wages in the primary job due to income effects.

JEL Classification Codes: C78, J31, J33, J41

Key Words: wage bargaining, wage posting, dual jobholders, employer-employee, secondary jobs, work hours

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1 Introduction

How wages are set is central to understanding the growth of wages and earnings, worker mobility, wage inequality, and the causes of unemployment, as Hall and Krueger (2010, 2012) have described. Bargaining models and explanations based on them assume that workers have the ability to negotiate compensation and that wages incorporate information about a worker's outside option(s). With renegotiation, wages can adjust in response to new information. The alternative to bargaining is wage posting, whereby employers set wages that individual workers cannot influence and must either accept or reject.[1]

Hall and Krueger (2010, 2012) noted that the scarcity of empirical evidence on the extent of wage bargaining and wage posting in setting wages is puzzling in view of the importance of the question. To obtain such evidence, they surveyed a representative sample of newly hired U.S. workers and found that one-third reported bargaining over pay before accepting their position. Hall and Krueger's work was followed by studies using observational data: Faberman et al. (2017) found that workers who could have stayed in their job before accepting another position reported obtaining a higher wage, and Lachowska (2017) found that workers' subjective assessments of how easy it would be to find an alternative job or to be replaced in their current job are highly correlated with the wage received in their current job. Both suggest an important role for outside options in determining wages.

A more recent approach to obtaining evidence on wage bargaining and wage posting is to observe variation in a worker's outside options (or other differences in bargaining power) that are uncorrelated with labor demand or employer characteristics. Such approach has been taken by Caldwell and Harmon (2019) (CH), who examine how the wages of Danish workers are affected by changes in information about their outside opportunities. Information about those options is based on networks of past coworkers, and using this approach, CH find a role for outside options in wage setting, particularly among higher skilled workers.

[1] While wages in a posting model may respond to outside options, this would happen at the market-level—idiosyncratic changes in the outside option of a single worker should not affect wages.

Our approach is related to CH, but it does not make use of networks of past coworkers to understand the influence of outside options. Rather, we examine whether and how wages in the primary job of dual jobholders in Washington State respond to wage changes in the worker's secondary job. A key advantage of examining dual jobholders is that it gives a contemporaneous measure of changes in a worker's outside option in the form of the wage earned on another job held by that worker, whereas the CH approach relies on measuring a worker's outside option using data on past coworkers. A second advantage is that the approach can be applied to any setting where there is matched employer-employee data with dual jobholders. A disadvantage of the dual jobholder approach is the extent to which our results apply to other groups in the labor market.

We also examine whether *separations* from the primary job are related to wage changes in the secondary job. Separations provide a "revealed preference" test that helps differentiate between bargaining and posting. In a job where wages are posted, the primary margin of adjustment to better outside options is mobility. When a worker generates surplus (over their replacement) it will be in the employer's interest to respond by increasing the wage rather than allowing the worker to separate. For low-surplus or easily-replaceable workers, the employer's wage response will be limited, consistent with wage posting, and more separations will be observed. Accordingly, the model predicts an inverse relationship between the wage response and the separation response to an improved outside option when looking at different sub-groups based on job characteristics in the data.

A dual jobholder's jobs are classified as primary (job 1) and secondary jobs (job 2) based on the hours worked in each job. To implement the tests, we relate changes in the wage of coworkers in the secondary job to the worker's own wage in the primary job. Specifically, we use wage changes of coworkers in the secondary job as an instrument for wage changes in the secondary job. We can then estimate how primary-job wages, hours, and separations relate to wage changes in the secondary job while controlling for employer fixed effects of the primary job (interacted with quarter). These fixed effects flexibly control for shocks affecting all workers in the primary employer, such as labor demand shocks that might be correlated between the primary and secondary employers.

To interpret the estimates, we embed bargaining in the canonical hours-constrained model for dual jobholding (Shishko and Rostker, 1976). In the model, workers facing hours constraints in their primary job take a second, flexible-hour job for extra income. Employers can respond to a worker's improved outside option by raising the wage if the worker threatens to separate. The model has a number of predictions that are both testable and potentially different from alternative models of dual jobholding, such as the job portfolio model (Renna and Oaxaca, 2006), where workers have preferences for multiple jobs. For example, hours in the primary job should be invariant to wage changes in the secondary job, while hours in the secondary job should be inversely related to the wage rate in the primary job (due to income effects). Separation from the primary job should be positively related to the wage rate in the secondary job, and separation from the secondary job should be positively related to the wage rate in the primary job. We find support in the data for all of these predictions.

We find a statistically significant relationship between changes in the wages of coworkers in the secondary job and changes in the worker's own wage in the primary job, suggesting that bargaining does play some role in wage setting. The estimate is robust to including employer-by-quarter fixed effects and to limiting the sample to workers whose two jobs are in different industries; however, this effect, aggregated over all workers, is small.

There are differences in the importance of bargaining among different groups of workers. In particular, the bargaining effect is relatively more important among workers in the top quartile of the wage distribution. These higher-income workers do not tend to respond to better outside options by separating. However, workers in the lowest quartile of the distribution do not receive pay increases from improved outside options and instead separate from their primary job, consistent with wage posting and an absence of bargaining. Bargaining effects are more prominent with employers where wages tend to vary greatly across workers, and when workers have longer tenure in their secondary job.

Our results are consistent with the findings of Cahuc, Postel-Vinay and Robin (2006) who estimate an equilibrium model of strategic bargaining and on-the-job search and find that bargaining

plays no role for wage determination for intermediate- and lower-skilled workers in France, and only a moderate role for higher-skill workers. They find that between-firm competition for workers (wage posting) plays a much more important role. The findings are also compatible with Di Addario et al. (2021) who estimate an augmented dynamic two-way fixed effects specification that permits past jobs to influence starting wages in new jobs, as predicted by bargaining models based upon the sequential auction framework of Postel-Vinay and Robin (2002), and find very limited role of past jobs in influencing contemporaneous starting wages. The estimated magnitude of the wage responses to outside options that we find are close to those found in Jäger et al. (2020). That wage bargaining is more important for high-wage workers is consistent with the findings in Card, Cardoso and Kline (2015) as well as CH.

In addition to its relevance to the literature on wage setting, this paper is related to the literature on estimating income effects (Imbens, Rubin and Sacerdote, 2001; Cesarini et al., 2017) and to the literature on multiple jobholding and its determinants (Smith Conway and Kimmel, 1998). Multiple jobholding has gained renewed interest with the rise of the electronically mediated gig economy (Katz and Krueger, 2019; Mas and Pallais, 2020). Secondary jobs may serve to provide a source of extra income due to hours constraints in the primary job (Shishko and Rostker, 1976), to solve underemployment while searching for the optimal wage-hour job combination (Paxson and Sicherman, 1996), or to smooth consumption due to income volatility (Koustas, 2018; Tazhitdinova, 2020). We extend this line of research by using a linked employer-employee panel based on administrative records to test the predictions of the canonical hours-constraint model of multiple jobholding.

In the next section, we develop the hours-constrained model of dual jobholding with bargaining and summarize its testable predictions. Section 3 describes the data and reports summary statistics for the main sample used in estimation. (Appendix A includes additional details about construction of the samples used to estimate the models.) The econometric framework is developed in Section 4, and Section 5 describes the empirical findings. We start by examining the evidence on wage bargaining and separations, first for the full sample, then for several subgroups of workers,

including the upper and lower quartiles of the wage distribution. We then provide additional tests of hours-constraint model on work hours. The final section briefly summarizes the results and discusses their implications.

2 Conceptual Framework

We begin by incorporating bargaining into the canonical hours-constraint model of how workers choose to hold multiple jobs applied to dual jobholding (Shishko and Rostker, 1976). The model is related to Rueben Gronau's model of home production (Gronau, 1977), which Lemieux, Fortin and Fréchette (1994) apply to decisions to work in the formal versus informal sector. In this model, workers take a second job because, although their primary job offers better terms, the primary employer limits work hours. If the worker desires additional income, she will take a second (less-attractive) job, provided it offers a wage above the worker's reservation wage at the maximum hours allowed by the primary employer.

Figure 1 shows the kinked budget constraint facing such a worker, who optimizes time in the primary job, the secondary job, and leisure. The budget constraint has a slope of $-w_1$ up to the hours limit on the primary job ($\bar{H}$), then a slope of $-w_2$ thereafter.[2] In Figure 1, the worker's optimum is shown by point A, where she works the maximum allowable hours in the primary job ($\bar{H}$), works $\tilde{H} - \bar{H}$ hours in the secondary job, and spends the remaining available hours in leisure.

The employer obtains a surplus from the employment relationship, the size of which depends on the degree of heterogeneity of jobs and workers. Denote surplus $s = v - w$, where v is the value of the worker to the firm. If labor markets are not perfectly competitive employers may incur a cost when replacing an incumbent worker because the replacement worker will produce a lower surplus. Denote by λ the incumbent worker's value to the firm over her replacement: $\lambda \equiv s_{\text{incumbent}} - s_{\text{replacement}}$. That is, if a worker leaves and a firm is forced to fill the vacancy, the

[2] While the hourly wage is the only differentiator between firms, the model can be easily adapted to include differences in non-wage amenities.

firm loses λ in profits. The size of the loss will determine the employer's willingness to bargain if a worker threatens to separate.

How does the worker respond to wage changes in this model? Consider first an increase in the wage on the secondary job from w_2 to w_2'. If the change is small enough that the wage on the secondary job is still below the primary wage ($w_2' < w_1$), then a worker will continue to work the maximum allowable hours in primary job ($\bar{H}$), and any adjustments will be in hours in the secondary job. This situation is shown in Figure 2, panel (a), with equilibrium moving from point A to point B, both interior solutions in hours for the secondary job.[3] The prediction that hours in the primary job are invariant to secondary-job wages distinguishes this model from the job portfolio model outlined in Renna and Oaxaca (2006), where workers have preferences for multiple jobs. In that model there is a negative cross-elasticity of hours with respect to wages in the alternative job.

Alternatively, if the change in the secondary-job wage results in that wage exceeding the primary job wage ($w_2' > w_1$), then the outcome depends on the relationship between the worker's value over replacement in the primary job (λ) and the difference between the new secondary job wage and the primary job wage ($w_2' - w_1$). If $(w_2' - w_1) > \lambda$, the worker leaves the primary job for the secondary job. If $(w_2' - w_1) < \lambda$, the primary employer matches the new secondary-employer wage. As is apparent, when λ is small there will be a limited potential bargaining response from the primary employer, and small changes in the secondary job wage will lead to separation from the primary job to the secondary job. When λ is large there will be a bargaining response from the primary employer and a reduced tendency for the worker to separate, for a given change in the secondary-job wage. In this setup, wage posting happens when λ is small, or zero in the extreme case. A small value of λ does not necessarily mean there is little employer surplus from the employment relationship–though that would be sufficient–but rather that a worker does not have much higher surplus than their replacement.

Next, consider an increase in the primary-job wage, from w_1 to w_1'. As shown in Figure 2, panel (b), hours in the primary job remain at the upper limit ($\bar{H}$), and if leisure is a normal

[3]The figure is drawn so that secondary-job hours increase, but this prediction is ambiguous as it depends on the sign of the uncompensated labor supply elasticity.

good, secondary-job hours decline due to an income effect. We would not expect a bargaining response from the secondary employer because hours in the secondary job are unconstrained, and the secondary-job wage was previously dominated by the primary-job wage.

An increase in the primary-job wage allows us to compute the marginal propensity to reduce earnings per dollar of unearned income (Imbens, Rubin and Sacerdote 2001). An exogenous increase in the primary-job wage w_1 (with primary-job hours fixed at $\bar{H}$) increases unearned income, which in turn is predicted to decrease secondary-job hours but have no effect on secondary-job wages. If so, we can estimate, for an increase in unearned income, how workers' lower labor supply in the hours margin reduces earnings. Following Cesarini et al. (2017), we refer to this parameter as marginal propensity to consume out of unearned income (MPE). Formally, we define MPE as $MPE = \frac{w_2}{h_1}\frac{\partial h_2}{\partial w_1}$, where w denotes wage rates, h denotes hours, and subscript 1 denotes the primary job and 2 denotes the secondary job. The MPE is intrinsically interesting, and this calculation offers a way of checking the generality of our estimates; that is, whether estimates derived from the sample of dual jobholders are consistent with other samples that have been used to estimate MPE.

To summarize, this simple model produces the following predictions:

1. Primary-job wages rise with secondary-job wages (as a result of bargaining).

2. Separation rates from the primary-job to the secondary-job increase with secondary-job wages.

3. When a worker has a high value to the firm over their replacement, improved outside options will result in wage responses but relatively limited separation effects. When a worker has a low value over replacement, wage responses will be limited, and separation effects will be more pronounced. Therefore, the wage response and the separation response to an improved outside option will be inversely related.

4. Secondary-job wages do not rise with primary-job wages.

5. Primary-job hours do not respond to secondary-job wages (as a result of constraints in work hours).

6. Secondary-job hours fall and secondary-job separation rates rise with primary-job wages (as a result of income effects).

3 Data, Sample, and Summary Statistics

3.1 Data and Sample

The data used in this paper are based on quarterly administrative wage records maintained by the Employment Security Department of Washington State to administer the state's unemployment insurance (UI) system: quarterly earnings records from all UI-covered employers in Washington from 2001:1 through 2014:4.[4] Each UI-covered employer in Washington is required to report each worker's earnings and work hours each quarter. A record appears for each quarter-worker-employer combination, so we are able to construct an hourly wage rate for each job in each quarter for the great majority of workers in Washington's formal labor market. Lachowska, Mas and Woodbury (2021) examine the reliability of the Washington hours data and conclude that they are of high quality.

For each worker in a given quarter, we rank her employers using work hours.[5] We flag the employer with whom the worker had the most work hours in the quarter and refer to that employer/job as the "primary job/employer." We restrict this sample of primary employers to "full" quarters of employment—quarters in which a worker's employment with the primary employer is both preceded and followed by a quarter of employment with that same employer. Specifically, for worker-quarter to be included in the sample, the worker must work for the same primary employer

[4]The only employers not required to report quarterly earnings and hours are so-called reimbursable employers—government agencies, private non-profits, and federally recognized Indian tribes who elect to reimburse the UI agency for benefits paid to their laid off workers. Also, self-employed workers do not make quarterly reports, and underground earnings are not reported.

[5]We have also ranked employer using hourly wage rates. The two rankings agree in over 90 percent of observations. As a robustness, we dropped observations where the hours-based and wage-based rankings disagreed and the results turned out to be very similar.

in quarters $t-1$, t, and $t+1$. We do this to avoid counting a worker who transitions between two jobs within a quarter as a dual jobholder; see Appendix A for further discussion.

If a worker had more than one employer in a quarter, we flag the employer with whom the worker had the second-most work hours in the quarter and refer to that employer/job as the "secondary job/employer." We also require that secondary jobs to be observed in "full" quarters.

Finally, we drop observations with three or more jobs in a quarter. This procedure results in about 60.7 million full-quarter observations identifying a single jobholder, and an additional 2.2 million quarterly observations that include a secondary job identifying a dual jobholder.[6]

3.2 Summary Statistics

Table 1 reports summary statistics (sample means with standard deviations) for the roughly 60.7 million quarters of single jobholding (column 1) and for the roughly 2.2 million quarters of dual jobholding (column 2 for the primary job, and column 3 for the secondary job).[7] The picture that emerges from the table is that dual jobholders tend to be lower-wage workers who experience more turnover, and who have lower earnings, despite working relatively long hours. For example, the mean hourly wage rate of jobs held by single jobholders is substantially higher ($25.80) than the mean wage rate of either the primary or secondary job of dual jobholders ($17.97 and $17.40). Mean work hours of jobs held by single jobholders are greater that the hours of the primary jobs of dual jobholders (469 vs. 438), but total quarterly hours worked by dual jobholders (438 + 129 = 567) are substantially higher overall than hours worked by single jobholders. The higher wage rates of jobs held by single jobholders outweigh their lower hours, so quarterly earnings of single jobholders ($12,163) tend to be substantially higher than total quarterly earnings of dual jobholders

[6] We drop any worker-quarter whose *primary* job was in NAICS sectors 61 (education) or 92 (government). We exclude primary jobs in education because an unusually large number of these workers (about 30 percent) in education had a second job also in education, perhaps reflecting teachers moonlighting in the different school districts; see García and Weiss (2019) for an overview of the extent of moonlighting among teachers. Dual jobholding among education workers tends to be more common in the first quarter of the year, possibly because of teachers work then as substitutes for sick teachers. We also exclude primary jobs in the public sector because bargaining at the worker level is unlikely to take place in that industry.

[7] Table B1 in Appendix B reports summary statistics for the subsample of individuals for whom we observe demographic characteristics.

($9,848 = $7,915 + $1,933). On average, the earnings obtained from the secondary job amount to about 20 percent of a dual jobholder's total pay.[8] Finally, separation rates from jobs held by single jobholders tend to be somewhat lower than from the primary jobs of dual jobholders, and substantially lower than from the secondary jobs of dual jobholders.

Dual jobholding seems to be concentrated among specific types of employers and jobs. In particular, only 5 percent of single jobholders' coworkers are dual jobholders, whereas 9 percent of dual jobholders' coworkers on the primary job are also dual jobholders. This is consistent with the hours constraint explanation of dual jobholding—that is, dual jobholders will tend to be concentrated in firms with hours constraints. Note also 48 percent of dual jobholders' coworkers on their secondary job are also dual jobholders, which suggests that some firms employ a "cluster" of workers for whom the job is secondary. Finally, the average employer of single jobholders is somewhat bigger (116 workers) than employers of either the primary or secondary job of dual jobholders (91 and 110 workers).[9] Figure 3 shows the distribution of industries by whether the observation is a single jobholder, or a dual jobholder (and by whether the job is a primary or secondary job). The sample is limited to industries included in the primary job holder sample, which excludes government and education sectors. For single jobholders, the most common industry is manufacturing, followed by retail and health care. For dual jobholders—both for the primary and secondary job—the most common industry is the health care sector, followed by accommodation and food services and retail.

[8] We observe a similar pattern among employed respondents in Washington State in the March Current Population Survey over the 2001-2014 period. In that sample the mean quarterly earnings of single job holders is $10,684 as compare to the average earnings (across all jobs) of $9,214 for workers with more than one job.

[9] About 14 percent of all the observed employer-quarters appear in our data only as secondary-job spells; that is, the associated employer in that quarter is no worker's primary job. More than half of the time, these observations are found in the health care sector.

4 Econometric Framework

Our baseline econometric specification has the following form:

$$\Delta y_{it}^{j_1} = \alpha + \theta_D Dual_{it} + \theta(Dual_{it} \times \Delta \bar{w}_{-it}^{j_2}) + \psi_{j_1(i,t),t} + r_{it}^{j_1}, \tag{1}$$

where i indexes workers and t the quarters. The superscripts j_1 and j_2 indicate whether a variable pertains to the primary job (j_1) or the secondary job (j_2). The function $j_1(i,t)$ indexes primary-job employer of worker i in quarter t so that $\psi_{j_1(i,t),t}$ captures primary employer by quarter effects. The variable $Dual_{it}$ is an indicator whether worker i has a secondary job in quarter t. The term $\Delta \bar{w}_{-it}^{j_2}$ measures the change in the outside option of a dual jobholder. Specifically, $\Delta \bar{w}_{-it}^{j_2}$ is the average change in the log wage w between t and $t+1$ of the secondary-job coworkers of worker i (excluding the worker, denoted as $-i$) in quarter t.[10] Standard errors are two-way clustered at the worker and primary-employer level.

We are interested in using equation (1) to estimate whether a worker's wage responds to an outside option, measured as an average wage change of coworkers in another firm. In this case, $\Delta y_{it}^{j_1}$ represents the quarter t to quarter $t+1$ change in the log of primary wage for worker i. Therefore, the θ-coefficient compares changes in log primary wages of dual jobholders *to all other workers* in a firm j_1 and quarter t as a function of wage shocks in a worker's second job. This specification is similar to CH's; we, however, measure the outside option as the average wage change of current coworkers' wages in a dual jobholder's other job, whereas CH measure outside option as the average wage change of past coworkers' wages. In other specifications, we also use log hours and separations as $\Delta y_{it}^{j_1}$.

Because, as explained in the previous section, our analysis sample is restricted to "full" quarters with either the primary employer or the secondary employer, when estimating the effects of wage shocks from the secondary job on either primary-job wages or hours, we necessarily condition the analysis on stayers. Conditioning on stayers allows us to test whether incumbent primary

[10] For single jobholders, $\Delta \bar{w}_{-it}^{j_2}$ is set to zero. Appendix C shows results for a sample restricted to only dual jobholders.

employers are "bargaining" employers who respond to a change of the outside option of the worker by raising her wage (Cahuc, Postel-Vinay and Robin, 2006; Manning, 2011).[11] Note that because of the full quarter restriction, in order to define separations, we need to look past quarter $t+1$, to quarter $t+2$. Accordingly, following the prediction of the theoretical framework, in model (1) we define separation as an indicator equal to one if a worker's secondary employer in quarter t becomes the primary employer in quarter $t+2$.[12]

We can reverse the analysis in (1) to estimate how hours, wages, and separations measured on the secondary job respond to a wage shock on the primary job. The associated empirical model reads as follows:

$$\Delta y_{it}^{j_2} = \alpha + \phi \Delta \bar{w}_{-it}^{j_1} + \psi_{j_2(i,t),t} + r_{it}^{j_2}, \tag{2}$$

where the variable $Dual_{it}$ is omitted because we are focusing on secondary-job outcomes as a function of primary-job wage shocks and so all the workers must be dual jobholders. In this model, $\psi_{j_2(i,t),t}$ captures secondary-job employer fixed effects by quarter. The ϕ-coefficient in equation (2) estimates the response of secondary-job outcomes to a change in the primary job coworkers' wages after controlling for firm-by-quarter shocks.

Note that when the outcome variable is log hours, the ϕ-coefficient measures how hours in the secondary job change in response to a wage shock from the primary job. Following the framework presented in Figure 2, panel (b), we expect the ϕ-coefficient for hours to be negative. The ϕ-coefficient allows us to derive an estimate of the marginal propensity to consume out of unearned income due to reduced hours in the second job: $MPE = \frac{w_2}{h_1}\frac{\partial h_2}{\partial w_1}$ (Cesarini et al., 2017).

To assess the presence of heterogeneous effects, we estimate augmented models of the form:

[11] Conditioning on stayers also allows us to avoid mismeasurement issues in earnings and hours that might incur in our data during "partial" quarters where the individual is switching employers and might receive as a result extra severance payments.

[12] For single jobholders, this variable is set to zero.

$$\Delta y_{it}^{j_1} = \alpha + \theta_D Dual_{it} + \gamma_C Char_{it} + \gamma(Char_{it} \times Dual_{it}) + \\ + \theta(Dual_{it} \times \Delta \bar{w}_{-it}^{j_2}) + \beta(Dual_{it} \times Char_{it} \times \Delta \bar{w}_{-it}^{j_2}) + \psi_{j_1(i,t),t} + r_{it}^{j_1}, \tag{3}$$

where $Char_{it}$ is some characteristics of either the worker or of her primary/secondary job. We report both the β and θ coefficients.

5 Results

We begin by testing predictions of a wage bargaining and wage posting model. Specifically, if there is wage bargaining, we should see wages in the primary job respond to changes in the wage in the second job. If there is wage posting, we should see separations responding to the outside option. Both responses are possible at once as there may be heterogeneity across jobs in the extent of bargaining versus posting. Accordingly, we will examine this heterogeneity by looking at the bargaining versus separation response as a function of different job and employer characteristics. In sub-groups where bargaining dominates, we should see a wage response to changes in the outside option while in sub-groups where posting dominates, we expect to see a separation response.

After testing and characterizing bargaining and posting, we provide evidence in support of the hours constraint model of dual jobholding. We do this by testing for the asymmetrical response in hours of a job to the primary and secondary job wage. When the reference job is primary we expect no relationship, whereas when the reference job is secondary we expect to estimate a negative relationship from income effects.

5.1 Primary-Job Wage and Separation Responses to Secondary-Job Wage Changes

Table 2 shows estimates from equation (1), where the outcomes are the job 1 change in log wages (columns 1 and 2), and an indicator if the worker separates from her primary job in quarter t and her secondary job becomes her primary job in quarter $t+2$ (columns 3 and 4). The right-hand

side variable is the change in coworker average log wage in job 2. For each of these outcomes, we present a model that restricts the analysis to cases where the primary-job sector is different from the secondary-job sector. Dropping such observations eliminates cases where the outside option may reflect market-wide changes as opposed to an idiosyncratic change to the outside option of a given worker.

We find evidence of a limited bargaining response to improved outside options for workers when aggregating across workers. When the mean wage of coworkers in the second job increases, so does the wage in the primary job. Specifically, for wages as an outcome, we find a positive and statistically significant relationship in the baseline specification in column 1. The inclusion of firm-by-quarter fixed effects means that within-firm, changes in the wage of a dual jobholder, relative to their primary-job coworkers, is affected by wage changes in their secondary job. We also see similar magnitude effects when the primary and secondary job are in different sectors (column 2). Though statistically significant, the magnitude of this average bargaining effect is small. Dividing the intent-to-treat coefficient in column 1 (0.0077) by the corresponding first-stage coefficient in column 1 of Table C1 (0.59) yields an elasticity of 0.013. Hence, a 1 percent increase in own wage in the secondary job, results in a 0.013 percent increase in the primary job. The estimate is close to the corresponding estimates in Jäger et al. (2020) who find that a one dollar increase in UI—their measure of outside option—translates to a 0.01 dollar increase in wages.[13]

Separations from primary to secondary job are also significantly and positively related to changes in the secondary-job wage in the baseline model, though we lose a little precision when imposing that job 1 and job 2 are in different industries. This finding suggests that when the second job becomes more attractive, some workers leave their main job and make their secondary job primary, instead of obtaining a higher wage with their previous primary employer. This kind of response might occur if wages in the primary job were non-negotiable, as in a wage posting situation.

[13]The CH estimate is not directly comparable to ours since in the CH specification, workers may not hear about or receive all job offers occurring in their social network.

Column 5 of Table 2 shows a "placebo" estimate of the effect of the outside option on the probability of leaving the primary job for any *other* job than the secondary job. There is no detectable relationship between secondary job wage and workers leaving their primary job for a third employer suggesting that the effect we are estimating does not reflect a general tendency to move, but rather a specific shift between the worker's two jobs.

Table 3 presents estimates of the reverse bargaining relationship: changes in coworker wages in job 1 on changes in wages in job 2. According to the framework outlined in Section 2, we should expect no relationship because job 1 already dominates job 2, so there should be no departure threat to which the secondary employer has to respond. Indeed, we see no detectable relationship in either specification. The asymmetry in wage responses to coworker wages in the alternative job alleviates a possible concern that the covariance is picking up an unobserved factor, like occupation, that is common to both jobs.

In Table 4, we explore heterogeneity in the wage and separations results. In the first panel the outcome is log wages in the primary job and in the second panel the outcome is whether the secondary job becomes the primary job. Each point estimate corresponds to either the estimate of β or θ in equation (3). The first column of Table 4 shows the baseline results from Table 2. In column 2, we begin by examining the response by a worker's position in the wage-rate distribution. We find that, in the top panel of Table 4, the bargaining response for workers in the bottom-quartile of wage rates is statistically indistinguishable from zero. However, for workers in the top-quartile, the bargaining response is positive and statistically significant with an elasticity of 0.0225 (column 3). Hence, the results by quartiles of wages are consistent with bottom-quartile workers having limited surplus with which to bargain, while top-quartile workers having surplus that gives employers scope to increase pay. It follows that high-wage workers are more likely to engage in wage bargaining in response to improved outside options, while low-wage workers face posted wages and are therefore more likely to separate.

In Table 4, column 5, we analyze estimate heterogeneity based on whether the primary employer is more likely to be a "bargaining" or a "posting" employer. To do so, we assume that

posting employers have a low degree of variability in within-firm wage changes. In contrast, bargaining employers are expected to have a large degree of variability; this variability will depend on the heterogeneity in outside options among its workers; see also Manning (2011). Accordingly, a bargaining employer is an employer that is in the fourth quartile of the standard deviation of within-firm changes in log wages among stayers. This measure is strongly associated (elasticity equal to 0.0373) with a positive wage response from the primary employer when the wage of the secondary employer increases. This finding provides further assurance that we are detecting a bargaining response.

In the last two columns of Table 4, we examine heterogeneity with respect a worker's tenure with the primary employer and with a secondary employer. We expect the bargaining response to increase in both these measures of match-specific capital. We find that wage response is positive and statistically significant for workers with a longer tenure and that separation responses are negative and statistically not different from zero.

Looking at separations in the bottom panel, there is a clear inverse relationship between estimated wage response to outside options (which we interpret as suggesting wage bargaining) and the estimated separation response to outside options (which is we interpret as suggesting wage posting). The estimates show that low wage workers—those in the bottom quartile of the primary job wage distribution—have separation rates that are highly sensitive to the secondary-job outside option. We find that separation responses are particularly pronounced for workers for whom a significant amount of their total earnings comes from their secondary job. These workers, following an improvement in their outside option, are also likely to make their secondary job their primary job. Separation responses are undetectable in jobs with more variability in within-firm wage changes and for workers with higher job tenure. The results suggest that when employers do not respond to improved outside options with higher wages, workers separate.

We next turn to visualizing the relationship between wage and separation responses for each primary-job sector of the worker. Figure 4 shows this relationship in a scatterplot of estimated

wage and separation responses. Each response is estimated using equation (3) for each primary-job sector. There is only a slight inverse relationship (t-statistic = -0.67) between the two responses.

In summary, we find evidence of both wage bargaining and wage posting in the labor market, with wage bargaining more pronounced at the top of the wage distribution and wage posting being the norm at the bottom.

5.2 Evaluating the hours-constraint model of dual jobholding

In the previous section, we have confirmed several predictions from the hours-constraint model outlined in Section 2. We now turn to testing the remaining labor supply predictions. The model predicts that work hours in the primary job should be invariant to wage changes in the second job due to constraints. However, hours in the second (flexible) job should be inversely related to wages in the primary job due to income effects. Relatedly, income effects should lead to a positive relationship between separations in the secondary job as a function of wages in the primary job.

We test the first of these predictions in Table 5. The table shows estimates from equation (1), where the outcome variable is the job-1 change in log hours and the right-hand side variable is the change in coworker average log wage in job 2. Consistent with the model's prediction, the coefficient in the baseline specification is close to zero and insignificant. Primary-job hours are not responsive to secondary-job wages. This lack of an effect holds also in column 2, which restricts the analysis to cases where the primary-job sector is different from the secondary-job sector. In summary, the data support the conclusion that primary-job hours are fixed.

Table 6 tests the income effects prediction: secondary-job hours decline and separations increase in the primary-job wage. In the top panel, we regress the change in log hours in job 2 on the coworker average of the change of log wages in job 1. In the baseline model the coefficient is negative (-0.0291) and highly significant, consistent with hours in the secondary job being at least somewhat flexible and there being an income effect. Using this estimate, we can compute the marginal propensity to consume out of unearned income due to reduced hours in the second job: $MPE = \frac{w_2 \partial h_2}{h_1 \partial w_1}$. The denominator of this expression represents the change in unearned income from

the change in job-1 wage, and the numerator is the change in earnings from the change in labor supply in job 2.

To compute MPE, we need to scale the hours elasticity in Table 6 by the baseline first-stage estimate from the bottom panel of Table C1, $\frac{-0.0291}{0.64} = \frac{w_1}{h_2}\frac{\partial h_2}{\partial w_1}$. Therefore, using means from Table 1, we compute $MPE = \frac{-0.0291}{0.64}\frac{h_2}{w_1}\frac{w_2}{h_1} = \frac{-0.0291}{0.64}\frac{129.08}{17.97}\frac{17.40}{437.88} = -0.013$. This estimate implies that, for every dollar of unearned income, workers lower work hours reduce earnings by about 1.3 cents. This estimate is in line with income effect estimates from lottery studies, such as Cesarini et al. (2017).

The bottom panel of Table 6 shows the analogous relationship for any separation from job 2. These separations may also occur due to income effects as workers leave their second job entirely to reduce hours. There is also a statistically meaningful response to the primary-job wage change for this measure. Overall, the estimates strongly support the predictions of the hours-constraint model for dual jobholding.

6 Conclusion

We have examined the market for dual jobholders both to obtain evidence on the reasons for dual jobholding and to test for the extent of wage bargaining in the labor market. The empirical evidence suggests three main conclusions. First, wage bargaining is an observable feature of the labor market, although for dual jobholders in aggregate, the importance of bargaining is limited. That is, wages do respond to an outside option—in this case, a wage increase at the secondary job—but for dual jobholders, the overall magnitude of the response is small. Second, wage bargaining is more pronounced among workers in the top quartile of the wage distribution. In terms of the model we outline, highly skilled workers generate a relatively large surplus for the employer, and are not easily replaceable, which creates an incentive for the employer to raise a worker's wage rather than accept a separation. In contrast, wage bargaining appears nonexistent among workers in the lowest quartile of the wage distribution, where we observe separations in response to improved outside

options. This is consistent with low-wage workers being easily replaceable, which in turn leads to wage posting. Third, the results suggest that work hours are constrained in the primary job, which influences workers' decisions about taking a second job.

The paper adds to the literature by showing that wage posting is a relevant feature of the labor market and that separation is a primary response to improved outside options, particularly at the lower part of the wage distribution. This finding has implications for understanding aggregate job separation rates and wage growth. For example, in a Burdett and Mortensen (1998) wage posting framework, Moscarini and Postel-Vinay (2016a) connect employer-to-employer (EE) job transitions to wage growth in the economy. These are linked both through the standard process by which workers receive better wage offers and quit jobs, and employers who raise wages for their entire workforce to retain workers when quits are elevated. This positive correlation between EE transitions and wage growth has been empirically verified by Faberman, Justiniano et al. (2015) and Moscarini and Postel-Vinay (2016b). Our paper adds to the literature establishing the wage posting feature underpinning of this process. Our finding has additional implications for, among other things, modeling racial discrimination in hiring and wage setting (Card, Cardoso and Kline, 2015, Lang, Manove and Dickens, 2005), and job search in the labor market. On this last point, it adds to the weight of evidence that Nash bargaining may not be a realistic way to model wage formation, except, perhaps when considering higher-skilled workers.

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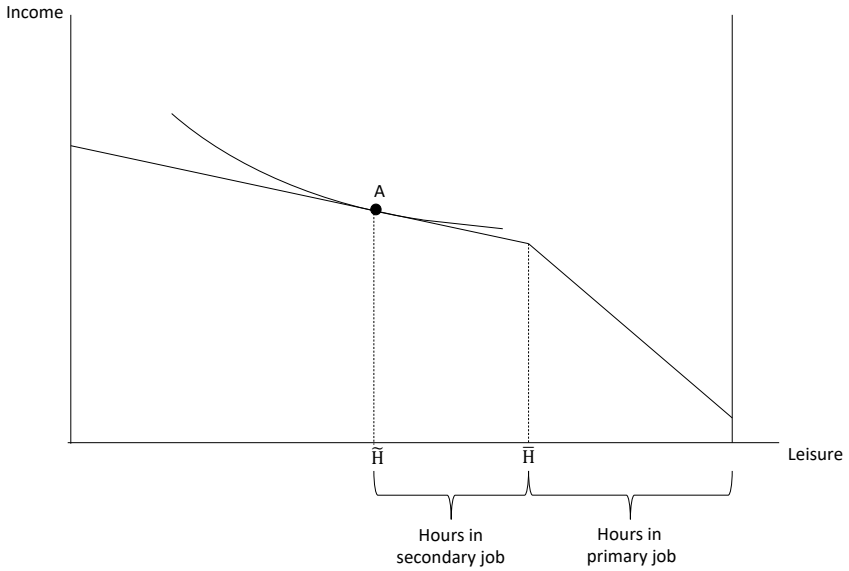
Figures and Tables

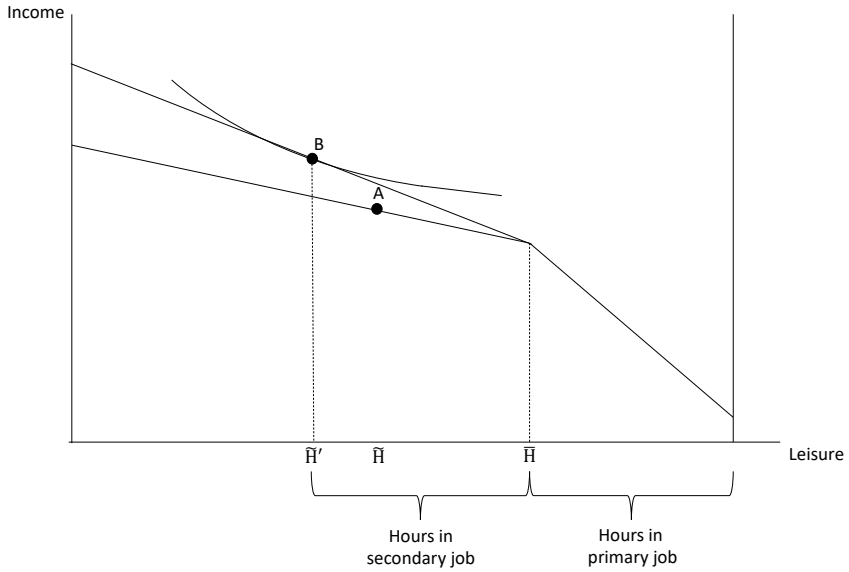
Figure 1: Labor Supply Decision with Two Jobs



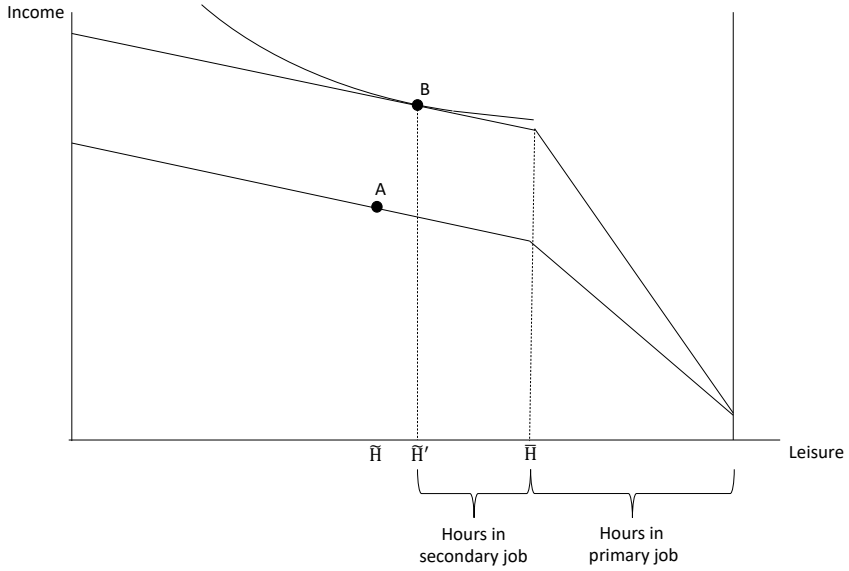
Note: This figure shows a situation where a worker optimizes between time in the primary job, the secondary job, and leisure. The worker first chooses hours worked in the primary job, and once she reaches the limit in hours at $\bar{H}$, additional $\tilde{H} - \bar{H}$ hours are supplied at a lower wage in the secondary job. This lower wage produces a kink in the budget constraint.

Figure 2: Change in Wage

(a) Increase in the Wage of the Secondary Job

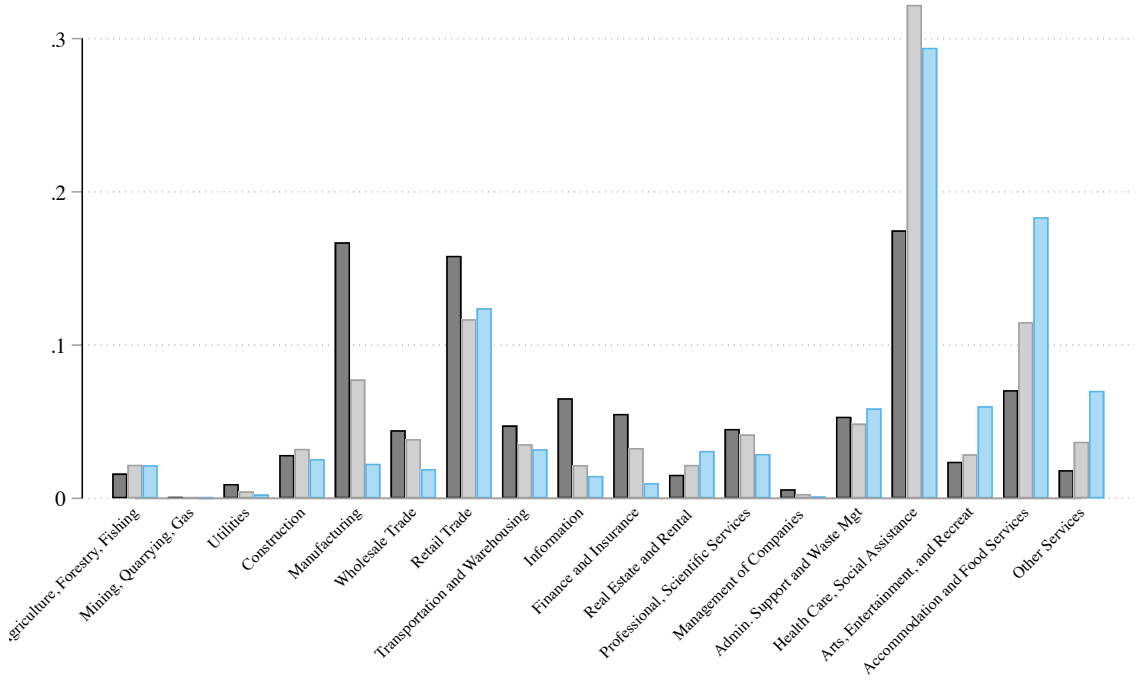


(b) Increase in the Wage of the Primary Job



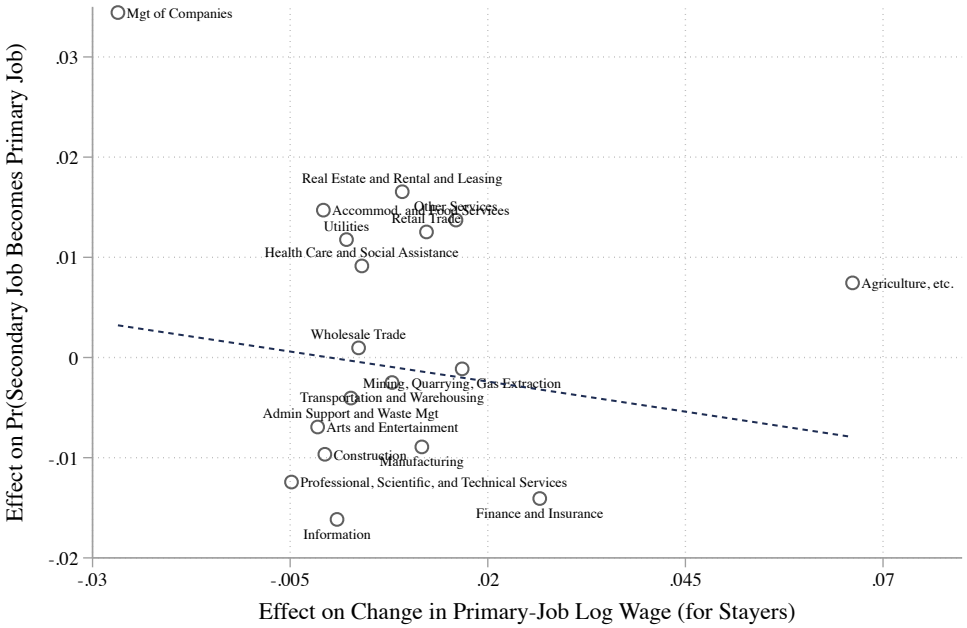
Note: This figure shows the hours response for a potential change in the wage of the secondary job (Panel a) and for a change in the wage in the primary job (Panel b).

Figure 3: What Sectors Do Single Jobholders and Dual Jobholders Work in?



Note: The figure shows the distribution of single jobholders and dual jobholders by sector of primary-job employment. The dark bars denote single jobholders, the light grey bars denote dual jobholders' primary jobs, and the light blue bars denote the dual jobholders' secondary jobs. Observations of single jobholders and of primary jobs of dual jobholders that are in the educational services, public administration, and missing are omitted.

Figure 4: Wage and Separation Responses by Sector



Note: The figure shows a scatterplot of $(\theta + \beta)$-estimates from equation (3), where the variable "Char" is set to the primary-job sector. For each sector, two models are estimated. One using the probability of separation from the primary job in period t to the secondary job in period t+2 as the outcome variable and the second one using the change in log wage in the primary job as the outcome. The vertical axis reports the impact of outside options on separation rates. The horizontal axis reports the impact of outside options on the change in log wages (of job stayers) in the primary job between. All regressions control for primary-employer by quarter fixed effects; see Table B3 for point estimates and standard errors. The fitted line's constant is zero with a slope equal to $-.12$. The t-statistic of the slope is -0.67 and the R-squared of the relationship equals .03.

Table 1: Summary Statistics

	Single Jobholders	*Dual Jobholders*	
	(1)	(2)	(3)
		Primary Job	Secondary Job
Hourly Wage ($/hours)	25.80	17.97	17.40
	(21.29)	(11.92)	(16.55)
Work Hours per Quarter	469.00	437.88	129.08
	(135.56)	(146.45)	(119.05)
Earnings ($)	12,162.63	7,914.61	1,932.71
	(10019.31)	(5823.89)	(2197.23)
Separation to Another Job or to Non-employment	0.08	0.13	0.26
Job-to-Job Separation	0.04	0.07	0.06
Secondary Job Becomes Primary Job	0.00	0.06	0.00
Tenure (in Quarters)	13.94	11.75	7.42
	(12.55)	(11.17)	(7.80)
Δ Log Wage	0.01	0.01	0.00
	(0.28)	(0.17)	(0.28)
Δ Log Hours	-0.01	0.00	-0.03
	(0.37)	(0.26)	(0.66)
Firm Size	116.19	91.02	110.44
	(828.70)	(733.47)	(866.81)
Δ Coworkers' Log Wage	0.01	0.01	0.01
	(0.15)	(0.13)	(0.13)
Share of Coworkers who are Dual Jobholders	0.05	0.09	0.48
	(0.08)	(0.17)	(0.43)
Share of Total Earnings from Secondary Job	0.00	0.20	0.20
	(0.00)	(0.16)	(0.16)
Number of Workers	4,040,287	450,395	450,395
Number of Employers	86,505	120,031	100,118
Number of Worker-Quarter Observations	60,752,695	2,224,233	2,224,233

Note: the first column, we show summary statistics for worker-quarter observations who are single jobholders. In the second column, we show summary statistics for worker-quarter observations where the worker has two jobs. We report mean and standard deviation (in parentheses) separately for the primary job and the secondary job. All statistics are worker-quarter weighted except for firm size, which is weighted by employer-quarter observations.

Table 2: Estimated Primary Wage and Separation Responses to Secondary-Wage Changes

	(1)	(2)	(3)	(4)	(5)
Outcome:	***Δ Primary-Job Log Wage***		***Secondary Job Becomes Primary Job***		***Separation to any Job except the Secondary Job***
Δ Secondary-Job Coworkers' Wage	0.0077***	0.0075***	0.0040*	0.0034	-0.0008
	(0.0021)	(0.0018)	(0.0018)	(0.0019)	(0.0007)
Mean Dependent Variable	.0092	.0093	.0018	.0012	.0378
Observations	56151431	55632983	59950564	59357883	59950564
Sample	Baseline	Job 1 and Job 2 in Different Sectors	Baseline	Job 1 and Job 2 in Different Sectors	Baseline

Note: This table reports estimates from equation (1) for various outcome variables. In columns 1 and 2, the outcome is the quarter-to-quarter change in primary-job log wages, conditional on being a job stayer. In columns 3 and 4, the outcome is an indicator for whether the secondary job in the current period (quarter t) becomes the primary job in the next period (t+2). In column 5, the outcome is an indicator equal to 1 if the worker separates to any job other than the secondary job. "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of secondary-job coworkers. This variable is set to zero if a worker is a single jobholder in a given quarter. Columns 1, 3, and 5 estimate the model on the baseline sample of single jobholders and dual jobholders; columns 2 and 4 restrict this sample so that job 1 and job 2 are in different sectors. The regressions controls for primary employer by quarter fixed effects. Standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) are reported in parentheses and are two-way clustered at the worker and primary-employer level.

Table 3: Estimated Secondary-Wage Responses to Primary-Wage Changes

	Baseline	Job 1 and Job 2 in Different Sectors
	(1)	(2)
Outcome: Δ Secondary-Job Log Wage (for Job Stayers And Dual Jobholders Only)		
Δ Primary-Job Coworkers' Wage	0.0022	0.0049
	(0.0032)	(0.0037)
Mean Dependent Variable	0.0038	0.00386
Observations	1005573	625923

Note: This table reports estimates from equation (2). The outcome variable is the quarter-to-quarter change in secondary-job log wages, conditional on being a job stayer and on having two jobs. "Δ Primary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of primary-job coworkers. Column 1 estimates the model for dual jobholders. Column 2 restricts this sample so that job 1 and job 2 are in different sectors. The regressions control for secondary employer by quarter fixed effects and for primary sector by secondary sector by year effects. Standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) are reported in parentheses and are two-way clustered at the worker and secondary-employer level.

Table 4: Estimated Primary Wage and Separation Responses to Secondary-Wage Changes, by Job Characteristics

	Baseline (No Interactions)	Bottom-Quartile Wage, Job 1	Top-Quartile Wage, Job 1	Above-Median Share in Earnings, Job 2	Q4 of Sd of Within-Firm-Within-Worker Variation in ΔWage	Tenure with Primary Employer	Tenure with Secondary Employer
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome: Δ Primary-Job Log Wage (for Job Stayers)							
Δ Secondary-Job Coworkers' Wage	0.0077***	0.0078***	0.0048*	0.0078**	0.0011	0.0028	0.0033
	(0.0021)	(0.0022)	(0.0019)	(0.0028)	(0.0011)	(0.0025)	(0.0022)
Δ Secondary-Job Coworkers' Wage x Job Char		-0.0006	0.0225**	-0.0006	0.0373***	0.0003*	0.0005*
		(0.0035)	(0.0076)	(0.0033)	(0.0100)	(0.0002)	(0.0002)
Mean Dependent Variable	.0092	.0092	.0092	.0092	.0092	.0086	.0086
Observations	56151431	56151431	56151431	56151431	56151431	42203030	42203030
Outcome: Outcome: Secondary Job Becomes Primary Job							
Δ Secondary-Job Coworkers' Wage	0.0040*	-0.0004	0.0042*	-0.0054**	0.0038*	0.0029	0.0028
	(0.0018)	(0.0019)	(0.0019)	(0.0018)	(0.0019)	(0.0030)	(0.0026)
Δ Secondary-Job Coworkers' Wage x Job Char		0.0100**	-0.0043	0.0136***	0.0011	-0.0000	-0.0001
		(0.0038)	(0.0041)	(0.0034)	(0.0046)	(0.0002)	(0.0002)
Mean Dependent Variable	.0018	.0018	.0018	.0018	.0018	.0018	.0018
Observations	59950564	59950564	59950564	59950564	59950564	44674296	44674296

Note: This table reports estimates from equation (3). In the top panel, the outcome variable is quarter-to-quarter change in the log wage from the primary job, conditional on being a job stayer. In the bottom panel, the outcome variable is an indicator if the secondary job in the current period (t) becomes the primary job in the next period (t+2). "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of secondary-job coworkers. "Δ Secondary-Job Coworkers' Wage x Job Char" interacts this variable with a characteristic listed at top of each column. "Above-Median Share" is a dummy equal to 1 if the share of an individual's earnings coming from the secondary job is above the corresponding sample median for dual jobholders. "Q4 of Sd of Within-Firm-Within-Worker Variation in ΔWage" is constructed as follows: we start by computing the within-firm standard deviation of wage changes among its dual jobholder stayers. We then construct quartiles of this standard deviation across firms. Q4 means the top quartile of this measure, hence firms in Q4 have the highest variability in wages changes among its employees. The last two columns interact the independent variable of interest with tenure on either the primary or secondary job. To minimize issues due to left censoring, tenure is measured starting from 2005. All regressions control for primary employer by quarter fixed effects and a dummy for dual jobholders. The model is estimated on the baseline sample of single jobholders and dual jobholders. Standard errors (*** p<0.01, ** p<0.05, * p<0.1) are reported in parentheses and are two-way clustered at the worker and primary-employer level.

Table 5: Estimated Primary Hours Responses to Secondary-Wage Changes

	Baseline	Job 1 and Job 2 in Different Sectors
	(1)	(2)
Outcome: Δ Primary-Job Log Hours (for Job Stayers)		
Δ Secondary-Job Coworkers' Wage	-0.0011	0.0015
	(0.0024)	(0.0024)
Mean Dependent Variable	-.005	-.0051
Observations	56151431	55632983

Note: This table reports estimates from equation (1). The outcome variable is the quarter-to-quarter change in the log hours in the primary job, conditional on being a job stayer. "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of the secondary-job coworkers. This variable is set to zero if a worker in a given quarter is a single jobholder. Column 1 estimate the model on the baseline sample of single jobholders and dual jobholders. Column 2 restricts this sample so that job 1 and job 2 are in different sectors. The regressions control for primary employer by quarter fixed effects and a dummy for dual jobholding. Standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) are reported in parentheses and are two-way clustered at the worker and primary-employer level**.**

Table 6: Estimated Secondary Hours and Separation Responses to Primary-Wage Changes

	Baseline (1)	Job 1 and Job 2 in Different Sectors (2)
Outcome: Δ Secondary-Job Log Hours (for Job Stayers)		
Δ Primary-Job Coworkers' Wage	-0.0291***	-0.0283***
	(0.0079)	(0.0092)
Mean Dependent Variable	-0.0331	-0.0330
Observations	1005573	625923
Outcome: Separation from Secondary Job		
Δ Primary-Job Coworkers' Wage	0.0135***	0.0133***
	(0.0042)	(0.0046)
Mean Dependent Variable	0.258	0.258
Observations	1392999	870771

Note: This table reports estimates from equation (2). In the top panel, the outcome variable is quarter-to-quarter change in the log hours from the secondary job, conditional on being job stayer. In the bottom panel, the outcome variable is a dummy equal to 1 if we observe any separation from the secondary job between quarter t and quarter t+2. "Δ Primary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of the primary-job coworkers. Column 1 estimates the model only for dual jobholders. Column 2 restricts this sample so that job 1 and job 2 are in different sectors. All regressions control for secondary employer by quarter fixed effects and for primary sector by secondary sector by year effects. Standard errors (*** p<0.01, ** p<0.05, * p<0.1) are reported in parentheses and are two-way clustered at the worker and secondary-employer level**.**

A Data Appendix

This appendix first describes the data used in the analysis. It then describes the sample restrictions imposed on the estimation sample.

A.1 Further Description of the Data

The data used in this paper are based on quarterly administrative wage records maintained by the Employment Security Department (ESD) of Washington State to administer the state's unemployment insurance (UI) system. The available quarterly data provide information on earnings and work hours of all workers employed by UI-covered employers in the state between 2001–2014. Workers who drop out of the labor force, become self-employed, work in the underground economy, or move out of state will not appear in the records. This is because self-employed workers are not covered by UI, underground earnings are not reported, and out-of-state earnings will be picked up in the earnings records of another state.

UI-covered employers in Washington are required to report each worker's quarterly earnings and work hours, which allows us to construct an hourly wage rate in each quarter for most workers in Washington's formal labor market; in the analysis, earnings and wage rates are CPI-adjusted using the year 2005 as the base. Each worker's quarterly record also includes an employer identifier and the employer's four-digit North American Industry Classification System (NAICS) code, making it possible to construct employment at both the employer and industry level; see also Lachowska, Mas and Woodbury (2020) for further discussion of Washington administrative wage records.

A.2 Construction of the Estimation Sample

We build the estimation sample using the following steps. We begin by using all the available UI wage records from 2001–2014. Using these data, for every worker in a given quarter, we rank a worker's employer by the number of quarterly work hours (we have also ranked employers by

earnings; the coefficient of correlation between the hours- and earning-based rank is 0.95). Using this ranking, we define a worker's primary employer as the employer with whom she worked the highest number of hours in that quarter. A secondary employer is then defined as the employer with whom the worker worked had the next-highest number of hours in that quarter, and so forth.

In the raw data, 87 percent of jobs are jobs with primary employers (that is, primary jobs), 10 percent are secondary jobs, about 1 percent are tertiary jobs, and less than 0.5 percent are quaternary jobs. We compute several variables using the raw data, for example, a firm's size is the number of all employees in a firm in a quarter. We also compute the number of employers a worker had in each quarter. In the raw data, about 20 percent of workers appear to have more than one employer. However, many such observations are workers transitioning between employers mid-quarter rather than having more than one job for longer than a quarter. Accordingly, in the analysis, we exclude such "partial" quarters of employment; see the sections below. Next, we create two subsamples: a subsample of primary jobs and a subsample of secondary jobs that we merge together to a dataset of dual jobholders.

A.2.1 Primary-Job Subsample

We first set up a panel where, for each worker and quarter, there is one primary employer (as mentioned above, a primary employer is the employer with whom a worker worked the highest number of hours in that quarter). We define full-quarter job spells; that is, quarters of employment bookended with the same primary employer. We do this to avoid including "partial" quarters of employment, which might lead us to believe that a worker holds more than one job in a quarter, when she is transitioning between employers mid-quarter. About 70 percent of all worker-quarter observations are full-quarter spells with a primary employer. Note that once we restrict this sample to only include full quarters, this automatically restricts the sample to only job stayers. Note also that, the full quarter restriction implies for a quarter t to be included in the analysis sample, that the worker must be employed with the same primary employer in $t-1$, t, and $t+1$. Therefore, in order to define any transition (for example from one employer to another employer or to non-

employment), we need to look out to quarter $t+2$. We drop observations employed in the Public Sector (Education Services and Public Administration), as well as observations with a missing sector.

A.2.2 Secondary-Job Subsample

To create a dataset of secondary jobs, we set up a panel where, for every worker and quarter, there is one secondary employer. As previously, we restrict this dataset to job spells are full quarters. For secondary jobs, about 20 percent of worker-quarter observations are full quarters. This shows that often what appears to be dual jobholding is actually a worker transitioning between employers mid-quarter.

A.2.3 Leave-Self-Out Averages of Wage Changes

Using the primary job dataset for each worker in each quarter, we compute firm-by-quarter leave-self-out averages of changes in log wages. We winsorize average firm-by-quarter log wage changes at -1 and $+1$ log points. We then merge these leave-self-out averages of wage changes to each employer in the secondary job stayer dataset.

A.2.4 Main Analysis Dataset

Finally, we merge secondary job dataset to the primary job dataset. This merged dataset includes single jobholders (whose single job is by definition their primary job) or dual jobholders (workers with a primary and a secondary job). Note that, for workers who do not have a second job, the outside option (measured as the firm-average change in wages in the secondary job) is set to zero. Once we drop observations where in a given firm-quarter there is no dual jobholder, the estimation sample consists of about 60.7 million observations (depending on what outcome is studied) of whom about 2.2 million are observations of dual jobholders.

A.2.5 Demographic Information

State employment security agencies typically record workers' characteristics only when they claim UI. Accordingly, we observe demographic characteristics (year of birth, gender, race, and education) only for workers who claimed UI benefits at least once during 2001–2014. For gender and race, we assign an indicator with a constant, modal value over this period. We assign the age of a worker in each quarter based on the worker's year of birth. For education, we assign a constant level if we observe the worker only once (that is, if he or she claimed UI only once); however, if a worker claimed UI more than once, we assign the first observed value of education for all quarters until the quarter in which we observe a change. We observe demographics for about 30 percent of the sample.

B Other Results

This appendix presents summary statistics for the sample with worker demographics as well as the main estimation using this selected sample. The last table shows the estimated wage and separation response, separately for each primary-job industry.

Table B1: Summary Statistics (Workers with Available Demographic Characteristics)

	Single Jobholders	*Dual Jobholders*	
	(1)	(2)	(3)
		Primary Job	Secondary Job
Hourly Wage ($/hours)	20.57	16.15	15.25
	(13.52)	(8.88)	(12.08)
Work Hours per Quarter	477.76	445.74	121.59
	(130.92)	(139.69)	(110.58)
Earnings ($)	9,890.40	7,239.18	1,617.78
	(6835.70)	(4560.34)	(1631.04)
Separation to Another Job or to Non-employment	0.11	0.16	0.30
Job-to-Job Separation	0.06	0.09	0.06
Secondary Job Becomes Primary Job	0.00	0.07	0.00
Tenure (in Quarters)	11.11	9.55	6.36
	(10.35)	(9.25)	(6.74)
Δ Log Wage	0.01	0.01	0.00
	(0.26)	(0.17)	(0.28)
Δ Log Hours	-0.01	0.00	-0.03
	(0.40)	(0.27)	(0.71)
Firm Size	134.49	169.97	193.45
	(895.47)	(1126.43)	(1235.61)
Δ Coworkers' Log Wage	0.01	0.01	0.01
	(0.14)	(0.13)	(0.13)
Share of Coworkers who are Dual Jobholders	0.05	0.09	0.48
	(0.09)	(0.17)	(0.44)
Share of Total Earnings from Secondary Job	0.00	0.19	0.19
	(0.00)	(0.15)	(0.15)
Female	0.454	0.544	0.544
Age	40.37	40.91	40.91
	(12.29)	(12.20)	(12.20)
College Degree	0.195	0.195	0.195
White	0.724	0.674	0.674
Number of Workers	1,338,011	160,806	160,806
Number of Employers	71,527	65,000	55,672
Number of Worker-Quarter Observations	20,429,904	685,921	685,921

Note: This table provides summary statistics for the subsample of individuals who at some point claimed UI benefits in the Washington State UI system and so for whom we observe demographics. The first column shows summary statistics for worker-quarter observations who are single jobholders. The second and third column show summary statistics for worker-quarter observations where the worker has two jobs: a primary and a secondary. We report mean and standard deviation (in parenthesis) separately for the primary job and the secondary job. All statistics are worker-quarter weighted except for firm size, which is weighted by employer-quarter observations.

Table B2: Estimated Primary Wage and Separation Responses to Secondary-Wage Changes, by Demographics

	Sample with Demographics (All)	Female	White	Young (Age<30)	Old (Age>40)	College
Outcome: Secondary Job Becomes Primary Job						
Δ Secondary-Job Coworkers' Wage	-0.0032	-0.0045	-0.0034	-0.0024	-0.0000	0.0007
	(0.0030)	(0.0042)	(0.0057)	(0.0034)	(0.0038)	(0.0035)
Δ Secondary-Job Coworkers' Wage x Demographic		0.0024	0.0003	-0.0048	-0.0076	-0.0148*
		(0.0060)	(0.0067)	(0.0077)	(0.0060)	(0.0067)
Mean Dependent Variable	.0017	.0017	.0017	.0017	.0017	.0017
Observations	20141125	20141125	20141125	20141125	20141125	20141125
Outcome: Δ Primary-Job Log Wage (for Job Stayers)						
Δ Secondary-Job Coworkers' Wage	0.0061	0.0072	0.0111	0.0076*	0.0040	0.0072
	(0.0031)	(0.0052)	(0.0082)	(0.0035)	(0.0034)	(0.0037)
Δ Secondary-Job Coworkers' Wage x Demographic		-0.0019	-0.0069	-0.0083	0.0048	-0.0041
		(0.0062)	(0.0084)	(0.0063)	(0.0053)	(0.0066)
Mean Dependent Variable	.0101	.0101	.0101	.0101	.0101	.0101
Observations	18287019	18287019	18287019	18287019	18287019	18287019

Note: This table reports estimates from of our heterogeneity specification displayed in equation (3), estimated on the subsample sample of individuals for whom we observe demographic characteristics. In the top panel, the outcome variable is an indicator if the secondary job in the current period (t) becomes the primary job in the next period (t+2). In the bottom panel, the outcome variable is quarter-to-quarter change in the log wage from the primary job, conditional on being a job stayer. "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of secondary-job coworkers. "Δ Secondary-Job Coworkers' Wage x Demographic" interacts this variable with a demographic characteristic listed at top of each column. All regressions control for primary employer by quarter fixed effects, a dummy for dual jobholder, a dummy for the characteristic listed in each column, an interaction between that characteristic and the dual-job indicator. Standard errors (*** p<0.01, ** p<0.05, * p<0.1) are reported in parentheses and are two-way clustered at the worker and primary-employer level.

Table B3: Estimated Primary Wage and Separation Responses to Secondary-Wage Changes, by Sector

	Effect on Probability that a Secondary Job Becomes Primary Job	Effect on Δ Primary-Job Log Wage Change (Stayers Only)
	(1)	(2)
Agriculture	0.0074	0.0661
	(0.0149)	(0.0554)
Mining, Quarrying, and Oil and Gas Extraction	-0.0011	0.0168
	(0.0566)	(0.0158)
Utilities	0.0118	0.0021
	(0.0124)	(0.0107)
Construction	-0.0097	-0.0006
	(0.0085)	(0.0116)
Manufacturing	-0.0089	0.0117
	(0.0065)	(0.0060)
Wholesale Trade	0.0010	0.0037
	(0.0075)	(0.0089)
Retail Trade	0.0125	0.0122
	(0.0040)	(0.0042)
Transportation and Warehousing	-0.0025	0.0079
	(0.0070)	(0.0061)
Information	-0.0162	0.0009
	(0.0077)	(0.0057)
Finance and Insurance	-0.0141	0.0266
	(0.0055)	(0.0134)
Real Estate and Rental and Leasing	0.0165	0.0092
	(0.0139)	(0.0149)
Professional, Scientific, and Technical Services	-0.0124	-0.0048
	(0.0072)	(0.0081)
Management of Companies and Enterprises	0.0344	-0.0268
	(0.0355)	(0.0287)
Administrative Support and Waste Management	-0.0040	0.0027
	(0.0080)	(0.0060)
Health Care and Social Assistance	0.0091	0.0041
	(0.0037)	(0.0022)
Arts, Entertainment, and Recreation	-0.0069	-0.0015
	(0.0101)	(0.0079)
Accommodation and Food Services	0.0147	-0.0008
	(0.0065)	(0.0035)
Other Services (except Public Administration)	0.0137	0.0160
	(0.0086)	(0.0119)

Note: This table reports estimates from equation (3), where the variable *Char* is a primary-job sector. Column 1 reports estimates of the effect of a change in the wage of secondary-job coworkers on an indicator for whether the secondary job in the current period (t) becomes the primary job in the next period (t+2). Column 2 reports estimates of quarter-to-quarter change in the average leave-out wage of secondary-job coworkers on the quarter-to-quarter change in log wage among job stayers. All regression controls for primary-employer by quarter fixed effects. Standard errors are reported in parentheses and are two-way clustered at the worker and primary-employer level.

C Results for Dual Jobholders Only

In this appendix, we restrict the analysis to only dual jobholders. The advantage of analyzing this subsample is that it allows us to estimate the first-stage effect of a change in the wages of coworkers in one job on the wage in that worker's job. For consistency, we also present the main results for the subsample consisting of only dual jobholders.

C.1 First-Stage Estimates

The first-stage effect can be estimated as follows:

$$\Delta w_{it}^{j_2} = \alpha + \theta_{FS} \Delta \bar{w}_{-it}^{j_2} + r_{it}^{j_2}. \tag{4}$$

This model compares the change in workers' wages in a secondary employer j_2 as a function of the change in average coworker (leave-self-out) wage from the same secondary employer, j_2.[14] The model also controls for primary employer by quarter effects and for the primary sector by secondary sector by year effect.

To estimate first-stage effects, we use the change in average job 2 coworker log wage as an instrument for an worker's secondary-job wage. The top panel of Table C1 shows the first-stage estimate from using the change in average job 2 coworker log wage as independent variable for the change in a worker's secondary-job wage. The estimates range from 0.55 to 0.59 and are highly significant. Note that an estimate of 0.6 implies that a 1 percent increase in the average wage of coworkers corresponds to a 0.6 percent increase in a worker's wage. The bottom panel of Table C1 shows the shows the first-stage estimates from regressing a change in worker's wage in job 1 on the average wage of coworkers in job 1. The first-stage estimates for primary jobs range from 0.64 to 0.65 and are again highly significant.[15]

[14]The model can be reversed to study the change in workers' wages in a primary employer as a function of the change in average coworker (leave-self-out) wage from the same primary employer.

[15]The primary-job first-stage estimates are larger than secondary-job first-stage estimates. The reason for this is difference lies the industry composition differences between primary and secondary jobs. Once secondary jobs in the top panel are reweighed so that the distribution of secondary-job sector employment mimics the distribution of

C.2 Hours, Separation, and Wage Responses

Note that by restricting the analysis to only dual jobholders, the model in (1) simplifies to

$$\Delta y_{it}^{j_1} = \alpha + \theta \Delta \bar{w}_{-it}^{j_2} + r_{it}^{j_1}. \tag{5}$$

The estimate of θ in model (5) compares changes in outcomes of dual jobholders *only to other dual jobholders* in a primary employer j_1 and quarter t as a function of shocks in a worker's second job.[16] Therefore, restricting the sample to dual jobholders alters the comparison group and is also expected to reduce statistical power. Note that about 20 percent of the firms have only one dual jobholder in a given quarter. As in the baseline model, we control for primary employer by quarter effects and (additionally for this dual jobholder sample) for the primary sector by secondary sector by year effect.

Below, we show the results from estimating equation (5) for hours, separation rates, and wages. For this subsample, the hours response is positive and statistically different from zero; this also holds if this sample is restricted to the two jobs being in different industries. However, when the comparison group is narrowed to only other dual jobholders in the primary job, primary-job hours increase in the secondary-job wage.[17] As in the main text, the wage response is positive and statistically different from zero.

primary-job sector employment, the first-stage estimate corresponding to column (1) in the top panel, 0.59 becomes 0.63.

[16] For consistency, as in equation (1), we cluster the standard errors in equation (5) on the worker and the primary employer. However, the specification in equation (5) allows us to cluster on worker and secondary employer. In practice, clustering on primary or secondary employer leads to very similar results.

[17] Additional analysis revealed that this response is concentrated among primary jobs in the manufacturing and retail sectors.

Table C1: First-Stage Estimates

	Only Dual Jobholders	Only Dual Jobholders, Job 1 and Job 2 are in Different Sectors
	(1)	(2)
Outcome: Δ Secondary-Job Log Wage (for Job Stayers)		
Δ Secondary-Job Coworkers' Wage	0.5888***	0.5552***
	(0.0171)	(0.0133)
Mean Dependent Variable	0.00363	0.00365
Observations	920965	560245
Outcome: Δ Primary-Job Log Wage (for Job Stayers)		
Δ Primary-Job Coworkers' Wage	0.6384***	0.6490***
	(0.0121)	(0.0108)
Mean Dependent Variable	0.00877	0.00911
Observations	1218755	766087

Note: This table reports estimates from the "first-stage" regression. The top panel shows estimates from equation (4), where the outcome variable is the quarter-to-quarter change in secondary-job log wages, defined for job stayers. "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of secondary-job coworkers. The models in the top panel control for primary employer by quarter fixed effects and for primary sector by secondary sector by year effects. In the bottom panel, the outcome is quarter-to-quarter change in the log wage in the primary job, defined for job stayers. "Δ Primary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of primary-job coworkers. The model in the bottom panel control for quarter-secondary employer fixed effects. Column 1 estimates both panels on sample of dual jobholders. Column 2 restricts this sample so that job 1 and job 2 are in different sectors. Standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$) are reported in parentheses and are two-way clustered at the worker and employer level.

Table C2: Estimated Primary Hours, Separation, and Wage Responses to Secondary-Wage Changes

	Only Dual Jobholders	Only Dual Jobholders, Job 1 and Job 2 are in Different Sectors
	(1)	(2)
Outcome: Δ Primary-Job Log Hours (for Job Stayers)		
Δ Secondary-Job Coworkers' Wage	0.0063**	0.0081**
	(0.0027)	(0.0032)
Mean Dependent Variable	0.00180	0.00148
Observations	1107456	682310
Outcome: Secondary Job Becomes Primary Job		
Δ Secondary-Job Coworkers' Wage	0.0017	0.0010
	(0.0021)	(0.0025)
Mean Dependent Variable	0.0573	0.0532
Observations	1268654	776644
Outcome: Δ Primary-Job Log Wage (for Job Stayers)		
Δ Secondary-Job Coworkers' Wage	0.0055***	0.0066***
	(0.0019)	(0.0023)
Mean Dependent Variable	0.00915	0.00963
Observations	1107456	682310

Note: This table reports estimates from equation (5). In the top panel, the outcome variable is the quarter-to-quarter change in primary-job log hours, conditional on being a job stayer. In the middle panel, the outcome variable is an indicator if the secondary job in the current period (t) becomes the primary job in the next period (t+2). In the bottom panel, the outcome variable is the quarter-to-quarter change in primary-job log wages, conditional on being a job stayer. "Δ Secondary-Job Coworkers' Wage" is the quarter-to-quarter leave-out average change in the wage of the secondary-job coworkers. Column 1 estimates the model on the sample of dual jobholders. Column 2 restricts this sample so that job 1 and job 2 are in different sectors. All regressions control for primary employer by quarter fixed effects and for primary sector by secondary sector by year effects. Standard errors (*** p<0.01, ** p<0.05, * p<0.1) are reported in parentheses and are two-way clustered at the worker and primary-employer level.