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JOB CHARACTERISTICS AND HOURS OF WORK

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ABSTRACT

This paper provides evidence that hours of work are heavily influenced by the particular job which a person holds. The empirical work consists of a comparison of the variance in the change in work hours across time intervals containing a job change with the variance in the change in hours across time periods when the job remains the same. To the extent that workers choose hours and these hours choices are influenced by shifts in individual preferences and resources, the variance in the time change of hours should not depend upon whether the worker has switched jobs. The desire to reduce or increase hours could be acted upon in the current job. On the other hand, if hours are influenced by employer preferences or if job specific characteristics dominate the labor supply decision, then hours changes should be larger when persons change jobs than when they do not. Using the Panel Study of Income Dynamics and the Quality of Employment Survey, we find that hours changes are typically two to four times more variable across jobs than within jobs. This result holds for both men and women and for both quits and layoffs, is obtained for weeks per year, hours per week, and annual hours, and is not sensitive to the use of controls for a set of job characteristics (including the wage) which might influence the level of hours persons wish to supply. The findings are also inconsistent with the view that workers may costlessly adjust hours by changing jobs.

The finding that the job has a large influence on work hours suggests that much greater emphasis should be given to demand factors and to job specific labor supply factors in future research on hours of work. The overwhelming emphasis upon the wage and personal characteristics in conventional labor supply analyses of work hours may in part be misplaced.

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1. Introduction

Most empirical studies of hours of work, and virtually all based upon micro data, have assumed that observed hours represent the labor supply decisions of workers. In a conventional labor supply framework work hours are determined as the quantity of labor the worker chooses to sell given preferences, wages, and non-labor income in current and future periods. The focus upon the labor supply model is due in part to intense interest in the responsiveness of hours to wages and taxes and to lack of micro data on firm characteristics. Many refinements of the basic labor supply model and improvements in econometric techniques have been made during the past fifteen years. But despite these advances, the recent surveys by Ashenfelter (1984) and Pencavel (1984) conclude that (1) there is considerable variation across studies in estimates of the response of hours to wages, nonlabor income, and demographic characteristics emphasized in the studies and (2) existing labor supply models explain little of the variation in hours across workers and very little of the variation in hours over time for a given worker.[1]

One obvious response to the current shortcomings of the literature is to continue to refine labor supply models and estimation techniques and, perhaps most importantly, to obtain more comprehensive and reliable data on hours, budget parameters, and personal characteristics. A second response, complementary to the first, is to explore the possibility that non-wage characteristics associated with specific jobs, such as working conditions, commuting time, and job hazards, are key determinants of labor supply preferences. In this view, empirical labor supply studies are basically on the right track but have emphasized the wrong set of variables. A third response, which is attracting growing support among labor economists, is to conclude that the labor supply model is fundamentally inadequate as a model of hours determination, and to emphasize the role of employer preferences in the determination of hours. The second and third responses are very different, but both involve a shift in emphasis from worker characteristics to job specific characteristics as the key determinants of work hours. This paper examines the extent to which hours are in fact influenced by (non-wage) characteristics of the job which affect the labor supply preferences of the worker and/or are influenced by employer preferences for hours.

To set the stage for the analysis, a brief discussion of existing studies of the importance of job specific labor supply and labor demand considerations in hours determination is in order. The comprehensive surveys by Killingsworth (1983) and Pencavel (1984) cite few studies which have examined the influence on hours of job characteristics (other than wages and fringe benefits such as pensions) which might be expected to affect labor supply. Atrostic (1982) shows that an index of job attributes plays a significant role in a demand system for work hours, job attributes, and nonlabor income.[2] Her results suggest that job attributes do affect the form of the labor supply function and consequently influence the hours chosen given the level of nonlabor income and the wage. However, Atrostic does not examine whether the job attributes have much explanatory power. A number of cross section studies have added occupation or industry variables to standard labor supply models as partial controls for job attributes. These variables play a significant role, although they are subject to demand as well as supply interpretations and may capture the effects of omitted personal characteristics which happen to be associated with occupation or industry.

Casual empiricism suggests that firms have strong preferences about employee hours. These preferences arise in part from technological considerations such as hiring and training costs which are fixed per employee and the costs of coordinating the activities of workers who work different numbers of hours.[3] Also, due to start-up costs and fatigue, productivity per hour may be low both for employees who only work a few hours a week and for employees who work a large number of hours. Furthermore, fringe benefits and government mandated payroll taxes which are assessed on a per worker basis introduce nonlinearity in the relationship between hours and compensation. If the preferences of employees and/or the hours required by employers vary over time, and if mobility costs prevent workers from quickly moving to firms which offer the hours level workers prefer, then observed hours do not represent points on a labor supply function and consequently may be difficult to explain with a labor supply model.

The implications of employer preferences for the analysis of labor supply and hours of work have been explored in a number of recent empirical studies. Rosen (1976), Moffit (1983), and Lundberg (1984) are among a handful of papers which have estimated labor supply models in which the worker faces a nonlinear schedule relating the wage rate to hours of work. Abowd and Ashenfelter (1981) and a subsequent study by Topel (1983) examine the idea that firms offer workers hours-wage packages in the context of studies of compensating differentials for unemployment risk. Ehrenberg and Schumann (1984) use a similar framework to investigate compensating differentials for mandatory overtime. Ashenfelter (1980), Ham (1982, 1986) and a number of other recent studies have examined whether unemployment is best interpreted as a constraint on choice of hours.[4] Finally, hours-wage packages have been the subject of much theoretical speculation in the implicit contracts literature.[5]

While an important beginning has been made, research on the empirical implications of hours-wage packages is in an early stage of development. It is unclear whether employer preferences for hours determinants play a quantitatively significant role in hours determination. Even less is known about the importance of job related labor supply determinants, aside from the effect of the wage rate and fringe benefits such as pensions. To guide research on structural labor supply, labor demand, and contracts models of hours, it would be useful to provide an empirical assessment of whether or not job characteristics are a dominant influence on hours.

We shed light on the issue by establishing the following fact about the structure of hours: a large fraction of the variance of work hours is associated with jobs.[6] Specifically, we compare the variance of the change in hours across time periods when people switch jobs with the variance in the change in hours across time periods when the job does not change. Shifts in job specific hours requirements will be larger when the job changes than when it does not. Shifts in job specific labor supply characteristics are also likely to be larger when the job changes than when it does not. For these reasons, one would expect hours to be more variable across jobs than within jobs if hours requirements and/or job specific labor supply determinants are important. On the other hand, if workers may freely vary hours on a given job and labor supply depends largely on personal characteristics rather than job characteristics, then the magnitude of observed hours shifts (controlling for the effects of wage changes) should not be sensitive to whether or not the job changes.

Using data from the Panel Study of Income Dynamics (PSID) and the Quality of Employment Survey (QES), we find that the variance of the hours change is between two and four times as large for those who have switched jobs as for those who are in the same job. This result holds for both men and women, is obtained for weeks per year, hours per week, and annual hours, and is not sensitive to the use of controls for a detailed set of job characteristics which might influence the worker's desired hours. Furthermore, the results do not appear to arise from heterogeneity in the underlying variance in desired hours for workers who change jobs frequently relative to workers who do not.

We also investigate whether the findings are consistent with a model in which hours in a given job are determined by employer preferences, but each worker may cheaply locate and move to firms which offer hours equal to the desired hours level. In such a model, hours choices would still reflect the preferences of workers, who would simply change jobs when they wish to make large adjustments in hours. By analyzing quits and layoffs separately, we are able to reject such a model.

Our results show that characteristics of jobs play a very important role in the determination of hours. We wish to emphasize, however, that they do not establish whether the job characteristics represent constraints on hours imposed by the firm, unobserved job characteristics which influence hours desired by the worker, or a combination of the two. There is of course a big gap between the data analysis in the paper and a satisfactory structural analysis of hours determination. However, our finding that the job has a large influence on work hours suggests that structural models of hours of work should give much more emphasis to demand factors and to job specific supply factors.

The paper procedes as follows. Section 2 provides motivation for the empirical work by discussing the implications of alternative models of hours determination for the variance in hours within and across jobs. Section 3 discusses the data used in the analysis and a variety of econometric issues. Section 4 presents the empirical results. The paper concludes with a brief summary of the findings and their implication for future research on hours of work.

2. Implications of Models of Hours Determination for the Variance of Hours Changes within and Across Jobs

Let ΔH_{ijt} denote the change in the log of hours between period t and t-k for individual i when the same job was held in both periods. Let $\Delta H'_{ijt}$ denote the hours change for individual i if a job change occurred. Let Var(.) denote the variance function. The empirical work in the paper focuses primarily on comparisons $Var(\Delta H_{ijt})$ with $Var(\Delta H'_{ijt})$.

Although the paper focusses on comparison of hours changes within and across jobs, no formal model of mobility is presented. The implicit view underlying our work is that workers weigh many job attributes in making mobility decisions, including wages, promotion possibilities, working conditions, fringe benefits, and locational preferences. To the extent that hours cannot be chosen on the job, the shifts in hours requirements of a job relative to individual labor supply preferences may play a key role in job mobility. The extent of mobility and the ability of heterogenous workers to locate job packages which are most suitable to them along all dimensions is influenced by search costs and mobility costs. Finally, a substantial fraction of mobility arises exogenously through layoffs and is not related to hours preferences of the worker.

In the remainder of this section , we discuss four alternative models of hours determination, and derive their implications for the difference in the variances of hours changes across and within jobs. We refer to the models as LS-PC, LS-JC, LD-IM, and LD-PM.

Model LS-PC is a conventional labor supply model in which employers permit workers to freely choose work hours at a parametric wage and *personal characteristics* are key labor supply determinants. Model LS-JC is a conventional *labor supply* model in which workers may choose hours but hours preferences are heavily influenced by *job-specific characteristics*, in addition to personal characteristics. Model LD-IM is a "*labor demand-imperfect mobility*" model in which hours on a given job are determined by employer preferences, and mobility costs and imperfect information prevent workers from avoiding hours constraints through costless job mobility. Model LD-PM is a "*labor demand-perfect job mobility*" model in which hours in a given job are determined by employer preferences, but workers may costlessly locate and move to firms offering hours which are equal to the desired hours level.

Suppose that workers are free to choose hours within jobs, and hours choices are influenced primarily by the wage rate, individual (i.e. non-job-related) preferences and resources, as in model LS-PC. Then the variance of the change in hours should depend on whether or not the job has changed *only* to the extent that the wage varies more across jobs than within jobs. To take the simplest example, suppose an individual faces the same wage in all jobs. Then, since individuals may freely choose hours, the desire to reduce or increase hours could always be acted on within the current job. Conversely, a change of job, all preferences being equal, would result in *no* change of hours. Of course, there is evidence (Cline (1979), and Freeman (1980)) that wages do vary across jobs, and that the variance of the wage change is higher when the job changes than when it does not. This implies that the variance of hours changes will be higher across jobs than within jobs. However, under LS-PC, the component of the desired supply of hours which is not related to the wage should have the same variance within and across jobs. In sum, if LS-PC is correct, and if one first adjusts hours to account for the effect of the wage rate on labor supply, then $Var(\Delta H'_{ijt})$ should be similar to $Var(\Delta H_{ijt})$.

On the other hand, both LS-JC and LD-IM imply that $Var(\Delta H'_{ijt})$ will exceed $Var(\Delta H_{ijt})$, even when the wage is controlled for. However, LS-JC and LD-IM involve very different sources of the underlying variance of hours. If LD-IM is correct, differences across firms in the demand for hours will cause the variability of hours to be greater when the job changes than when it does not. If LS-JC is correct, differences across firms in characteristics affecting labor supply may cause $Var(\Delta H'_{ijt})$ to exceed $Var(\Delta H_{ijt})$. This would be the case if many non-wage labor supply determinants, such as working conditions and travel time, vary more when the job changes than when it does not. Thus, to distinguish between LS-JC and LD-IM one must first adjust hours measures for the effects of job-related labor-supply determinants and then compare the variances of these adjusted measures within and across jobs.

Model LD-PM also implies that $Var(\Delta H'_{ijt})$ will exceed $Var(\Delta H_{ijt})$. Model LD-PM is a demand model in the sense that observed hours are always in accord with the employer's preferences. However, the assumption that mobility costs are low and information about job openings is very rich implies that workers simply change jobs when they wish to change work hours. In the LD-PM model employer preferences for hours influences job selection but not work hours. For purposes of conducting labor supply analysis, LD-PM is similar to LS-PC (although LD-PM has very different implications for mobility).[7] However, under LD-PM the fact that workers must change jobs to change hours implies that $Var(\Delta H'_{ijt})$ will exceed $Var(\Delta H_{ijt})$ even if hours are determined entirely by worker preferences.

In sum, a finding that $Var(\Delta H'_{ijt})$ exceeds $Var(\Delta H_{ijt})$ (after controlling for the effects of wages on hours) would provide evidence against LS-PC. However, the finding would not permit one to distinguish among the other three models. It could be that job-specific labor supply preferences, employer preferences, or even, in the case of LD-PM, individual specific labor supply preferences are the underlying source of the higher cross job variance of hours changes. In Section 2.1 we provide a more formal discussion of the issues involved in discriminating between LS-JC and LD-IM, under the assumption that LD-PM is not correct. In Section 2.2, we suggest a method for testing whether LD-PM is a reasonable explanation for the excess variance of hours across jobs.

2.1. Distinguishing between the Labor Supply-Job Characteristics and Labor Demand-Imperfect Mobility Models.

Assume that mobility and search costs are substantial, so that LD-PM is incorrect. Models LS-JC and LD-IM may be tested by adjusting for the effects of job-specific labor supply determinants. If LS-JC is correct, then the variance of hours changes after controlling for the effects of job-specific labor supply determinants should not depend on whether or not the job has changed. A finding that the variance of hours changes across jobs exceeds the variance of hours changes within jobs even after adjusting hours for job-specific labor supply determinants provides evidence in favor of LD-IM.

The importance of using adjusted hours measures when drawing inferences about LS-JC and LD-IM from $\mathrm{Var}(\Delta H'_{ijt})$ and $\mathrm{Var}(\Delta H_{ijt})$, and the appropriate adjustment to hours may be demonstrated using the following simple model of hours determination. The model is general in nature, and is little more than a framework for measurement. By imposing restrictions on the coefficients of the model, one can obtain a model in which hours are supply determined, demand determined, or some combination of both. Since in this paper we do not attempt to estimate structural models of hours determination, there is little point in presenting the underlying optimizations (on the part of firms and workers) which would yield such models of hours determination. However, in Appendix 1, we work through a specific example and show that the model in the text nests intertemporal labor supply models similar to those used by MaCurdy (1981) and Altonji (1986) and others, demand models such as those discussed by Lewis (1971) and Rosen (1969), and contracts models of hours determination of the type discussed by Rosen (1985) and Abowd and Card (1985a,b).

The equation for the supply of hours is

$$H^s_{ijt} = \Phi Z_{ijt} + bw_{ijt} \quad . \tag{1}$$

In (1), H^s_{ijt} is the log of the number of hours individual i wishes to work in job j at time t. To simplify the presentation only one dimension of hours is considered in the model, although the empirical work is conducted using hours/week, weeks/year, and hours/year.[8] The vector Z_{ijt} is a set of labor supply determinants, which may be partitioned as $Z_{ijt} = \{z_i, z_{it}, z_{ij}, z_{ijt}\}$. The subvector z_i contains variables which are constant over time and affect labor supply to all jobs. This vector includes fixed determinants of current and future wages and labor supply preferences in all jobs, such as education and race. The subvector z_{it} contains time-varying variables which affect wages and labor supply preferences on all jobs, and includes variables such as marital status, number of children, and non-labor income. The vector z_{ij} contains variables which are fixed over time and affect the supply of labor to job j, such as travel time and work environment. The vector z_{ijt} consists of job-specific time-varying supply determinants, such as transitory aspects of the work environment. The variable w_{ijt} is the log of the real wage, which for ease of presentation we assume does not vary with hours of work.[9]

The demand for hours per worker by firm j is

(2) $H^d_{ijt} = Bw_{ijt} + D_{jt}$,

where D_{jt} is a vector of factors affecting labor demand. D_{jt} is partitioned into $D_{jt} = \{d_j, d_{jt}\}$, . The subvector d_j is a set of variables which are fixed over time for job j and characterize aspects of the firm's technology and/or compensation system (such as set up costs and firm-specific training per worker and payroll taxes and fringe benefits) which affect desired hours per worker. The subvector d_{jt} consists of time varying determinants of employer preferences for hours, such as productivity shocks, shifts in product demand, or changes in the stock of workers due to random changes in quits and hiring success.

How is the log of hours (H_{ijt}) actually determined? A simple rule which allows for various alternatives is that H_{ijt} is a linear function of the determinants of both labor supply and labor demand, as in (3).

(3) $H_{ijt} = \mu Z_{ijt} + \beta D_{jt} + \gamma w_{ijt}$

The vector of parameters μ and β can be partitioned conformably with Z_{ijt} and D_{jt} such that $\mu = \{\mu_1, \mu_2, \mu_3, \mu_4\}$ and $\beta = \{\beta_1, \beta_2\}$.

For a variety of econometric reasons, it is convenient to work with the changes in hours rather than the levels. (In practice, we discuss results for both.) From (3) we have:

(4a) $\Delta H_{ijt} = \mu_2[z_{it} - z_{it-k}] + \mu_4[z_{ijt} - z_{ijt-k}] + \beta_2[d_{jt} - d_{jt-k}] + \gamma[w_{ijt} - w_{ijt-k}$

(4b) $\Delta H'_{ijt} = \mu_2[z_{it} - z_{it-k}] + \mu_3[z_{ij} - z_{ij'}] + \mu_4[z_{ijt} - z_{ij't-k}]$
$+ \beta_1[d_j - d_{j'}] + \beta_2[d_{jt} - d_{j't-k}] + \gamma[w_{ijt} - w_{ij't-k}]$.

A "prime" on the job subscript in t-k (i.e., j') signifies that the job has changed between t and t-k. Note that if hours are demand determined, as in LD-IM, $\mu=0$ and $\gamma=B$. If hours are supply determined as in LS-JC, then $\beta=0$ and $\gamma=b$. For model LS-PC, $\beta=0$, $\mu_3=0$, $\mu_4=0$, and $\gamma=b$. Of course, it is possible that hours are determined both by employer and employee preferences. For example, an implicit contracts model in which the marginal utility of income is equated with the marginal product of labor will result in hours which are determined by a weighted average of firm and worker preferences. (See the Appendix.)

Given that the wage rate, job related labor supply determinants, and labor demand determinants in (4b) are all likely to vary more when the job changes than when it does not, LS-JC, LD-IM, and even LS-PC (because of the wage rate in the case LS-PC) are potentially consistent with an excess of $var(\Delta H'_{ijt})$ over $var(\Delta H_{ijt})$. Suppose, however, that we adjust the changes in hours measures to take into account the effects of the wage rate and job related labor supply determinants. Assume, for the moment, that w_{ijt} and all elements of Z_{ijt} are observed. Then, define Δh_{ijt} and $\Delta h'_{ijt}$, the adjusted hours measures, to be:

$$\Delta h_{ijt} = \Delta H_{ijt} - \mu_4[z_{ijt} - z_{ijt-k}] - \gamma[w_{ijt} - w_{ijt-k}]$$
$$\Delta h'_{ijt} = \Delta H'_{ijt} - \mu_3[z_{ij} - z_{ij'}] - \mu_4[z_{ijt} - z_{ij't-k}] - \gamma[w_{ijt} - w_{ij't-k}]$$

implying that:

$$\text{(5a)}\quad \Delta h_{ijt} = \mu_2[z_{it} - z_{it-k}] + \beta_2[d_{jt} - d_{jt-k}]$$
$$\text{(5b)}\quad \Delta h'_{ijt} = \mu_2[z_{it} - z_{it-k}] + \beta_1[d_j - d_{j'}] + \beta_2[d_{jt} - d_{j't-k}]\ .$$

Thus, under the null hypothesis that hours are determined by workers (either

LS-PC or LS-JC, with $\beta=0$), $\Delta h_{ijt} = \Delta h'_{ijt}$, and $var(\Delta h'_{ijt}) - var(\Delta h_{ijt}) = 0$.

Assume that the fixed demand components d_j and $d_{j'}$ are unrelated to the time varying demand components. Then under the alternative hypothesis that hours are employer determined:

$$(6)\ var(\Delta h'_{ijt}) - var(\Delta h_{ijt}) = 2\beta_1^{\,2}[var(d_j) - cov(d_j, d_{j'})] + 2\beta_2^{\,2}[cov(d_{jt}, d_{jt-k}) - cov(d_{jt}, d_{j't-k})] .$$

It is reasonable to assume that the autocovariance of time varying demand determinants is larger within the same job than across jobs, in which case $cov(d_{jt}, d_{jt-k}) - cov(d_{jt}, d_{j't-k})$ is positive. Furthermore, $var(d_j) - cov(d_j, d_{j'})$ is necessarily positive, which follows from the Cauchy Schwartz inequality since $var(d_j)$ and $var(d_{j'})$ are the same. This leads to the conclusion that if hours are employer determined, the difference between the variances of adjusted hours changes within and across jobs should be positive, whereas if hours are employee determined this difference should be equal to 0. Thus, by adjusting hours measures one may in principle isolate the importance of employer preferences in hours variation.

We have assumed, so far, that all elements of Z_{ijt} are observed. Although our data sets contain several personal and job related labor supply determinants, they provide little information on expectations of wages and nonlabor income in future periods, the work environment, travel time, job security, and other personal and job related non-wage factors which influence labor supply. To account for the fact that many labor supply determinants are <u>not</u> observed, we modify equation (3) in the following way. Partition Z_{ijt} into $\{X_{ijt}, S_{ijt}\}$, where $X_{ijt}=\{x_i, x_{it}, x_{ij}, x_{ijt}\}$ contains only <u>observed</u> labor supply determinants, and $S_{ijt} = \{s_i, s_{it}, s_{ij}, s_{ijt}\}$ are the unobserved counterparts to $\{x_i, x_{it}, x_{ij}, x_{ijt}\}$. Also partion μ into $\{\alpha,\delta\}$, where $\alpha=\{\alpha_1,\alpha_2,\alpha_3,\alpha_4\}$ corresponds to the elements of X_{ijt} and $\delta=\{\delta_1,\delta_2,\delta_3,\delta_4\}$ corresponds to the elements of S_{ijt}. Then

$$(7)\ H_{ijt} = \alpha[X_{ijt}] + \delta[S_{ijt}] + \beta[D_{jt}] + \gamma w_{ijt}.$$

Proceeding as above, one may take the first difference of (7) and adjust ΔH_{ijt} and $\Delta H'_{ijt}$ for all observed job-related labor supply determinants. This yields the following expressions for Δh_{ijt} and $\Delta h'_{ijt}$:

$$\Delta h_{ijt} = \alpha_2[x_{it} - x_{it-k}] + \delta_2[s_{it} - s_{it-k}] + \delta_4[s_{ijt} - s_{ijt-k}] + \beta_2[d_{jt} - d_{jt-k}]$$

$$\Delta h'_{ijt} = \alpha_2[x_{it} - x_{it-k}] + \delta_2[s_{it} - s_{it-k}] + \delta_3[s_{ij} - s_{ij'}] + \delta_4[s_{ijt} - s_{ij't-k}] + \beta_1[d_j - d_{j'}] + \beta_2[d_{jt} - d_{j't-k}] .$$

Under the null hypothesis LS-PC, $\delta_4=\beta_2=\delta_3=\beta_1=0$ and $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ equals 0, but under the null hypothesis LS-JC,

$$\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt}) = 2\delta_3^{\,2}[\mathrm{var}(s_{ij}) - \mathrm{cov}\ (s_{ij}, s_{ij'})] + 2\delta_4^{\,2}[\mathrm{cov}(s_{ijt}, s_{ijt-k}) - \mathrm{cov}(s_{ijt}, s_{ij't-k})]$$

where we have assumed that the fixed job specific supply components s_{ij} and $s_{ij'}$ are unrelated to the time varying components s_{ijt} and $s_{ij't}$ in all periods. That is, the difference in the variance of hours changes across and within jobs may be positive if there are unobserved job-related factors affecting labor supply. The difference would arise in part from the variance across jobs in the unobserved permanent determinants of labor supply to a particular job, and in part from the fact that the autocovariance of time-varying job specific labor supply determinants is likely to be larger within jobs than across jobs.

The implications of the above model for the empirical analysis below may be summarized as follows. First, if LS-PC is correct (hours are supply determined and non-wage job characteristics have little effect on labor supply), then the difference between the variance of adjusted hours changes across and within jobs should still be 0 despite the presence of unobserved personal characteristics. Thus, a finding that $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ is substantially larger than 0 is evidence against this simplest model of hours.[10] Second, if LS-JC is correct, $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ may be positive if unobserved job-related labor supply determinants are important. Thus, the finding that the variance of hours changes is much larger across jobs than within jobs provides evidence in favor LD-IM over LS-JC only insofar as we have been able to control for all relevant labor supply determinants. A final interpretation of our results will await development and estimation of structural hours models incorporating both job specific labor supply determinants and labor demand determinants.

2.2. Testing the Labor Demand-Perfect Job Mobility Model

The LD-PM ("labor demand-perfect job mobility") model is a fourth possible model of hours determination. In this model, hours worked in a particular job are dictated by the firm in accordance with (2), but workers may costlessly exercise their labor supply preferences by moving across jobs even though they cannot vary hours within jobs. Given no search or mobility costs the worker will change jobs when $H_{ijt} \neq H^s_{ijt}$, and so the worker will almost always be in a firm with D_{jt} such that $H^d_{ijt} = H^s_{ijt}$. Even though hours are determined by the demand equation (2), the characteristics D_{jt} of the job chosen by the worker will implicitly depend upon the worker's labor supply preferences. The term var($\Delta H'_{ijt}$) is likely to be larger than var(ΔH_{ijt}), since workers must change jobs to change hours. However, labor supply preferences, rather than firm preferences, would underlie the difference between var($\Delta H'_{ijt}$) and var(ΔH_{ijt}). Furthermore, the excess of var($\Delta H'_{ijt}$) over var(ΔH_{ijt}) would arise even if labor supply preferences were not affected by job characteristics.

Of course, if mobility and information costs are literally 0, then from the worker's point of view there is no meaningful distinction between varying hours within a firm and varying hours across firms. In fact, the substantial length of time workers spend on jobs, the evidence of substantial dispersion in wages across jobs offering similar characteristics, and the significant amount of time workers spend in job search suggests that mobility costs and information costs are substantial. In this situation observed hours-wage combinations will not necessarily lie on the labor supply function. Workers will choose the best combination of hours, wage income, and other job characteristics available at a particular time, and employer preferences will have an independent influence on work hours. In summary, LD-PM is not plausible as a full explanation for a large difference between var($\Delta H'_{ijt}$) and var(ΔH_{ijt}). However, it may be a partial explanation.

To help discriminate the LD-PM model from LD-IM and LS-JC, we compare Var($\Delta H'_{ijt}$) for the subset of job changes resulting from layoffs with Var(ΔH_{ijt}). In making this comparison we assume that the occurrence of layoffs are not correlated with changes in labor supply preferences. If this assumption is correct and LD-PM is correct, then workers who experience a layoff will pick new jobs offering an hours level similar to their old job, and so Var($\Delta H'_{ijt}$) should be similar to Var(ΔH_{ijt}). (Hours are measured such that hours of unemployment directly associated with layoffs should not affect the hours change measures.) If LD-IM is correct, then the best new job that the worker is able to find after a layoff may require an hours level different from hours on the previous job, in which case $\mathrm{Var}(\Delta H'_{ijt})$ will exceed $\mathrm{Var}(\Delta H_{ijt})$. If mobility and search are costly and LS-JC are correct, then the wage and non-wage characteristics of the laid off worker's best offer may induce a change in the worker's supply of hours. As a result, $\mathrm{Var}(\Delta H'_{ijt})$ will also exceed $\mathrm{Var}(\Delta H_{ijt})$.

3. Data and Econometric Issues

3.1 Data

The major data source is the first fourteen waves (1968-1981) of the Panel Study of Income Dynamics (PSID, Survey Research Center (1982)). Observations for a particular year were included only if the individual was between the ages of 18 and 60, inclusive, was not retired, and worked positive hours in that year. Observations were excluded from the sample if total annual hours worked on all jobs exceeded 5,000. The sample sizes for the procedures are reported in the tables below. They vary considerably due to differences in the availability of data for men, unmarried women, and married women, which we analyze separately, and due to missing data on particular variables.

The second data source, the Quality of Employment Survey (QES, Quinn and Staines (1979)), consists of two waves (1973 and 1977). After exclusions due to missing data our QES sample contains 280 white males between the ages of 17 and 64. The QES contains more information on characteristics of the job which may affect labor supply than does the PSID, although the small size of the QES sample is a disadvantage.

Most of the variables used are self-explanatory and are listed in Table

1. The PSID measures of annual work hours on the main job, weeks/year worked on the main job, and hours/week on the main job require discussion. Since we wish to distinguish between changes in hours worked which occur within and between jobs, it is important that the hours measures used pertain to one main job only. All hours variables refer to the full calendar year prior to the survey. Consequently, if a separation occurred in the calendar year prior to the survey, the hours measures represent a mixture of hours worked on two sequential jobs. For the PSID, this problem is compounded by the fact that the separation variable indicates whether a job change occurred in the year prior to the survey date (typically March) rather than the previous calendar year.[11]

As a result of this inconsistency in timing of the hours and separation variables, to obtain change in hours measures which are unambiguously either "within job" or "between job", one must use the hours change over a three year gap. That is, we base the hour change measures on $H_{ijt} - H_{iJt-3}$, where J is the job index in t-k. (J=j if the job has not changed and equals j′ if the job has changed). We also must exclude observations if the individual indicates a change of job in survey time periods t, t-1, t-3, t-4.[12] We determine whether $H_{ijt}-H_{iJt-3}$ is "within" or "between" jobs by examining whether a separation occurred in time t-2 and set ΔH_{ijt} or $\Delta H'_{ijt}$ equal to $H_{ijt}-H_{iJt-3}$ accordingly.

This method of computing the hours change has two disadvantages. The first is that many observations are eliminated; the maximum possible number of observations per individual falls from 13 to 9, since $H_{ijt}-H_{iJt-3}$ cannot be computed if $t \leq 1971$. The second and more serious problem is that the sample becomes biased towards individuals who do not change jobs frequently: if an individual changes jobs in year t and again in year t+2, then the values of

$h_{ijt}-h_{iJt-3}$ will be set to missing for the time periods t through t+3, because none of these hours measures are truly "clean". Since there is no clear-cut answer to this problem we present results from the PSID using both one and three year changes in hours.

We also present results when ΔH_{ijt} and $\Delta H'_{ijt}$ are based on $H_{ijt} - H_{iJt-5}$. In this case we set $H_{ijt} - H_{iJt-5}$ to missing if a job change is reported for times t, t-1, t-5 or t-6. The change in hours is coded as a "between job" change if a separation occurred in t-2, t-3, and/or t-4. Thus, multiple separations are possible.

For unmarried women, the change in hours is also computed over one, three and five year gaps. Observations were set to missing if the woman was married in any of the years used to compute the change in hours. The PSID data for married women contain information on separations from employer only in 1976, 1979, 1980 and 1981. Because of these data limitations, we work with $H_{ijt} - H_{iJt-1}$.

For the QES, ΔH_{ijt} and $\Delta H'_{ijt}$ are based on hours in 1977 minus hours in 1973. Only one hours measure, average hours per week, is available. The effective QES sample sizes for unmarried and married women are too small to support an analysis.

3.2 Adjustment of the Hours Change Measures for Job-related Determinants of Labor Supply.

As was mentioned earlier, to the extent that job-related variables which might be related to labor supply can be controlled for, $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ will provide a better indication of the importance of firm preferences for hours. The hours adjustment is based upon estimates of the following equation for the unadjusted change in H_{ijt}:

$$(8) \quad H_{ijt} - H_{iJt-k} = a_0 + a_0' \text{ [SEPN]} + a_1 x_i + a_2 \Delta w_{ijt} + a_2' \text{ [SEPN] } \Delta w_{ijt} + a_3 \Delta x_{it} + a_4 \, \Delta x_{ijt} + a_4' \text{ [SEPN] } \Delta x_{ijt} + u_{ijt} + \Delta\varepsilon_{ijt}.$$

SEPN is a separation indicator, and equals 1 if the employer changed between t and t-k and is 0 otherwise. The variable u_{ijt} is a composite error component for omitted variables. The model of hours changes implies that the variance of u_{ijt} depends upon whether or not a separation has occurred. The error component $\Delta\varepsilon_{ijt}$ is measurement error in the hours change variable. We assume $\Delta\varepsilon_{ijt}$ has mean 0 and a variance which does not depend on whether or not a separation has occurred. In this case the presence of the measurement error $\Delta\varepsilon_{ijt}$ adds an extra term to var($\Delta H'_{ijt}$) and var(ΔH_{ijt}) but does not affect the difference between them. To examine the effects of measurement error on the unadjusted hours measures we use the covariances of two independent measures of the change in annual hours to provide alternative estimates of var($\Delta H'_{ijt}$) and var(ΔH_{ijt}). These estimates should be less affected by measurement error. We do in fact find that both variances decline substantially and that the difference between them rises relative to var(ΔH_{ijt}).

For the PSID, x_i includes variables for age, race, and years of education. These are included because they may affect the average change in hours. The variable Δx_{it} includes changes in marital status, number of children, a dummy variable indicating the presence of pre-school aged children, health status, and non-labor income (which includes a spouse's labor income, if any). The variable Δx_{ijt} includes changes in union membership and changes in 1 digit occupation indicators. Since we are looking at changes in hours with and without changes in employer rather than position, it is possible that occupation changes when no separation occurs. The changes in the level and in the square of annual hours of unemployment are also included in Δx_{ijt}.

The equation for the QES contains basically the same variables, with the following exceptions. First, w_{ijt} is the log of annual earnings. Second, data on changes in non-labor income were not available. Third, seventeen additional variables pertaining to changes in the characteristics of jobs were added. These variables include items such change in commuting time, required work effort, vacation pay, training possibilities, and job security.[13]

Under the null hypothesis that hours are supply determined, (8) is similar to the first difference labor supply equations estimated by MaCurdy (1981), Altonji (1984) and others, although none of the previous intertemporal labor studies distinguish between changes in hours with and without job changes. Those familiar with the intertemporal labor supply literature will note that the coefficients a_2, a_3, a_2' and a_3' each contain a component which measures the direct effect of the variable on the change in hours, and a component which measures the indirect effect through the marginal utility of income. However, unlike the studies cited above, we do not attempt to distinguish between the two effects when estimating the change in hours equations, since only the total effect of Δw_{ijt} and Δx_{ijt} is required to adjust the hours data. If all the personal and job related determinants of labor supply (including expectational variables) were observed, then aside from approximation error associated with log linear specification of (8), the coefficients would not depend on whether or not a separation occurs. We allow the coefficients to depend on SEPN because the association of the observed job related variables (eg., the wage change) with unobserved variables (eg., the change in expectations of future wages) may depend upon whether or not a separation has occurred.

We estimate (8) by weighted least squares for the QES, and weighted two stage least squares for the PSID.[14] Two stage least squares is used for the PSID to minimize estimation bias which arises from the fact that the principal wage measure in the PSID is annual earnings divided by annual hours worked. The change in the reported hourly wage, as well as all other variables in equations (8) are used as instrumental variables for Δw_{ijt}.[15] It should be emphasized that noise in wages and the other variables limits our ability to control even for "observed" determinants of labor supply. When estimating (8) with the QES data, we constrain the coefficients on job-related variables to be the same for observations with and without job changes. Given the large number of job-related variables included in Δx_{ijt} and the fact that the QES contains only 67 observations on job changes, this measure is necessary to conserve degrees of freedom.

We use the parameter estimates from (11) to compute Δh_{ijt} and $\Delta h'_{ijt}$ as follows:

(12a) $\Delta h_{ijt} = \Delta H_{ijt} - \hat{a}_2 \Delta w_{ijt} - \hat{a}_4 \Delta x_{ijt}$

(12b) $\Delta h'_{ijt} = \Delta H_{ij't} - \{\hat{a}_2 + \hat{a}'_2\} \Delta w_{ijt} - \{\hat{a}_4 + \hat{a}'_4\} \Delta x_{ijt}$.

For one set of estimates we also adjust for the change in annual hours of unemployment. The estimates of a few of the equations used to perform the adjustments are reported in Tables A1 and A2 and discussed in a footnote.[16]

The use of two-stage least squares reduces the problem of measurement error bias in the estimation of $\hat{a}_2$ and $\hat{a}_2'$. But because the wage measure is earnings divided by hours, measurement error in hours affects $\Delta h'_{ijt}$ and Δh_{ijt} both directly and through the adjustment for the wage change. Consequently, it may produce biases in the estimates of var(Δh_{ijt}), var($\Delta h'_{ijt}$) and the difference between the two. Measurement error in earnings which is independent of measurement error in hours may also affect the variances of the adjusted hours measures. In a footnote we show that measurement error in hours and in earnings are likely to increase the variance of adjusted hours both within and across jobs.[17] Furthermore, unless $\hat{a}_2'$ is equal to 0, these additional variance components will not cancel out when computing the difference between the cross job and within job variances. Depending on the values of $\hat{a}_2$ and $\hat{a}_2'$, measurement error could cause the difference between the cross job and within job variances to be either upward or downward biased. Given the estimates of $\hat{a}_2$ and $\hat{a}_2'$ which we obtain, these issues are important only for married females, and are discussed in footnote 27 below.

4. Results

4.1 Results for Men

Estimates of the variances of the unadjusted hours changes ΔH_{ijt} and $\Delta H'_{ijt}$ are presented in the left panel of Table 2. The numbers in parentheses are the standard errors of the variance estimates.[18] The results indicate that the variance in hours changes when the job has changed are much larger than when it has not changed, although the specific estimates depend upon the time gap chosen. For hours/week when the time gap (k) is one year, $\text{var}(\Delta H_{ijt})$ is $\underset{(.002)}{.0361}$ and $\text{var}(\Delta H'_{ijt}) - \text{var}(\Delta H_{ijt})$ is $\underset{(.005)}{.0397}$. That is, the variance in the change in hours per week associated with different jobs is more than double the variance within a job. These estimates of the difference are downward biased due to the fact that the hours/week measure may reflect a mixture of hours on the new and old jobs. When k=3, observations for which H_{ijt} or $H_{ij't-3}$ might reflect a mixture of hours/week on the new and old jobs have been removed from the sample, and $\text{var}(\Delta H'_{ijt})$, $\text{var}(\Delta H_{ijt})$ and $\text{var}(\Delta H'_{ijt}) - \text{var}(\Delta H_{ijt})$ are $\underset{(.015)}{.1064}$, $\underset{(.002)}{.0360}$ and $\underset{(.015)}{.0704}$ respectively. In this case, hours are three times more variable when the job changes than when it does not. The estimates for k=5 are qualitatively similar to these, while the results for

QES show that $var(\Delta H'_{ijt})$ is 2.2 times as large as $var(\Delta H_{ijt})$.

The findings for weeks per year and hours per year also show that there are important job specific components to the variance of hours. For weeks per year, $var(\Delta H'_{ijt})$ and $var(\Delta H_{ijt})$ are $\underset{(.010)}{.1916}$ and $\underset{(.003)}{.0564}$ when k=1, $\underset{(.026)}{.1496}$ and $\underset{(.003)}{.0372}$ when k=3, and $\underset{(.012)}{.1227}$ and $\underset{(.004)}{.0666}$ when k=5.[19] The figures for annual hours are similar.

Other studies have found evidence that measurement error in the hours level is important in PSID. (See Duncan and Hill (1984)). As mentioned earlier, this is likely to inflate both $var(\Delta H_{ijt})$ and $var(\Delta H'_{ijt})$ but should not have much effect on the difference between them. If measurement error is important, the estimates in the table may substantially understate the value of $var(\Delta H'_{ijt}) - var(\Delta H_{ijt})$ relative to $var(\Delta H_{ijt})$. Consequently, our results probably understate the importance of job specific factors in hours changes.

We have obtained some evidence on the importance of measurement error using the following procedure. Workers who are paid by the hour are asked to report their straight time hourly wage. By dividing labor earnings by the straight time wage, one may obtain an alternative measure of annual hours. This alternative measure is not based upon the questions about hours per week and weeks worked which are used to construct the direct measure of annual hours. Thus, there is some basis for assuming that the measurement errors in the two annual hours measures are independent, at least for hourly workers. In this case, the covariance of the changes in the two hours measures over intervals with a job change and without a job change will provide estimates of $Var(\Delta H'_{ijt})$ and $Var(\Delta H_{ijt})$ which are not affected by measurement error.

The table below reports estimates of $Var(\Delta H'_{ijt})$, $Var(\Delta H_{ijt})$ and $Var(\Delta H'_{ijt}) - Var(\Delta H_{ijt})$ for a sample of workers who were paid by the hour in both t and t-3. The sample sizes for the variances across and within jobs are

164 and 3878 respectively. The results using the imputed measure of annual hours and the direct measure are similar and correspond reasonably closely to the results for the full sample in Table 2. The last column reports estimates based on the covariances of the two alternative measures of the hours change. The estimates of $Var(\Delta H'_{ijt})$ and $Var(\Delta H_{ijt})$ fall to .235 and .037. Comparison of the middle and last columns suggests that almost half of the within job variance in the direct measure of hours is measurement error. These findings indicate that for annual hours $Var(\Delta H'_{ijt})$ is 6.3 times as large as $Var(\Delta H_{ijt})$. This ratio is considerably larger than the values of 3.3 and 4.3 based upon columns 1 and 2 respectively. This evidence suggests that measurement error in hours does in fact lead to an understatement of the relative importance of job specific factors in hours changes. The results also provide evidence against the possibility that our findings could be explained through a mechanism in which the variance in the measurement error term $\Delta\varepsilon_{ijt}$ is larger when the job has changed than when it has not.

	Estimates Based on Variances of Imputed Measure of Annual Hours (Earnings/Hourly Wage)	**Estimates based on Variances of the Direct Measure of Annual Hours**	**Estimates Based on the Covariances of the Imputed and Direct Measures of Annual Hours**
$Var(\Delta H'_{ijt})$	.326 (.093)	.298 (.130)	.235 (.087)
$Var(\Delta H_{ijt})$	.100 (.006)	.069 (.008)	.037 (.005)
$Var(\Delta H'_{ijt}) - Var(\Delta H_{ijt})$	.226 (.093)	.230 (.130)	.198 (.087)

In summary, the results for all three hours measures indicate that jobs play a very important role in hours determination.

Results Using the Adjusted Hours Measures

The second and third panels of Table 2 report the results for var($\Delta h'_{ijt}$) and var(Δh_{ijt}), where $\Delta h'_{ijt}$ and Δh_{ijt} are the across job and within job changes after adjustment for job specific labor supply determinants by the method described in Section 3.2.

The middle panel of Table 2 contains the results using hours measures which have been adjusted for observed job specific determinants of hours, but have not been adjusted for hours of unemployment. The results for the PSID data are very similar to those based on the unadjusted hours measures. They indicate that hours responses to wage changes, changes in union membership, and shifts in 1-digit occupation do not explain the much larger hours variance across jobs than within jobs.[20] However, for the QES sample var($\Delta H'_{ijt}$) - var(ΔH_{ijt}) is $\underset{(.010)}{.0417}$, whereas var($\Delta h'_{ijt}$) - var(Δh_{ijt}) is $\underset{(.011)}{.0218}$. Taken at face value, this finding for the QES sample is consistent with the view that the 17 job characteristics used to adjust hours are important labor supply determinants and are responsible for the larger difference in variances obtained for the unadjusted hours measures. In fact, after adjustment for downward bias in the estimate of var($\Delta h'_{ijt}$) associated with degrees of freedom which are lost in hours adjustment process and the small sample size of the QES, there is little evidence that adjusting hours for the observed job characteristics in the QES reduces the difference in variances within and across jobs.[21]

The last three columns of Table 2 report results in which the hours changes incorporate adjustments for hours of unemployment. This adjustment makes little difference for hours/week. However, for weeks/year var($\Delta H'_{ijt}$) - var(ΔH_{ijt}) is reduced from .14 to .035 when k=1. The reduction is much smaller for k=3 and k=5. The larger impact when k=1 reflects the fact that occurrence of unemployment is often associated with a job shift, and for this time interval the separation might have occurred during the year in which H_{ijt-1} is measured, whereas for k=3 and k=5, the observations in which a separation occurs are removed from the sample. Thus, unemployment associated with job separations should not directly influence $H_{ijt} - H'_{ijt-3}$ or $H_{ijt} - H'_{ijt-5}$.

Controlling for Individual Heterogeneity in the Variance of Hours

In this section we provide estimates of $\text{var}(\Delta h'_{ijt}) - \text{var}(\Delta h_{ijt})$ which have been corrected for the likelihood that people who change jobs frequently have more variable preferences for hours. There are a variety of reasons for believing that this might be the case. The possibility is particularly worrisome in light of Abowd and Card's (1985b) results for both the PSID and the National Longitudinal Survey indicating that the variance of the change in the log of annual hours is larger for those who have worked for more than one employer during the years covered by these surveys than for those who have worked for only one employer, although Abowd and Card note that much of the difference appears to be due to excess variance in the years surrounding a job change (see their footnote 23).

Let $\text{var}_i(\Delta h'_{ijt})$ and $\text{var}_i(\Delta h_{ijt})$ denote the variance for person i of Δh_{ijt} and Δh_{ijt} around the population mean for $\Delta h'_{ijt}$ and Δh_{ijt}. Let y denote the true difference in $\text{var}_i(\Delta h'_{ijt})$ and $\text{var}_i(\Delta h_{ijt})$, which (as in the analysis above) we assume to be the same for all individuals. If $\text{var}_i(\Delta h'_{ijt})$ and $\text{var}_i(\Delta h_{ijt})$ also depend on an individual specific fixed effect σ_i^2, then

(10a) $\text{var}_i(\Delta h_{ijt}) = \text{var}(\Delta h_{ijt}) + \sigma_i^2$

(10b) $\text{var}_i(\Delta h'_{ijt}) = \text{var}(\Delta h_{ijt}) + y + \sigma_i^2$,

The fixed effect $\sigma^2{}_i$ will arise if (1) the variances and covariances of the labor supply determinants have individual specific components, and (2) all the variances and covariances among the demand components as well as cross covariances of the labor supply and demand components are the same for all individuals. We make the assumption that heterogeneity in the variances is individual specific (as opposed to job specific) because we are most interested in checking whether consideration of heterogeneity of individual specific labor supply preferences (eg., heterogeneity in the variance in individual specific labor characteristics such as s_{it}) can reconcile the large value of $var(\Delta h'_{ijt}) - var(\Delta h_{ijt})$ with LS-PC.[22]

Let $\hat{var}_i(\Delta h'_{ijt})$ and $\hat{var}_i(\Delta h_{ijt})$ denote the sample variance of $\Delta h'_{ijt}$ and Δh_{ijt} for person i around the sample means over all persons and time periods of $\Delta h'_{ijt}$ and Δh_{ijt}. Then,

$$\hat{var}_i(\Delta h'_{ijt}) - \hat{var}_i(\Delta h_{ijt}) = var_i(\Delta h'_{ijt}) - var_i(\Delta h_{ijt}) + v_i \quad , \qquad \text{or:}$$

$$(13) \qquad \hat{var}_i(\Delta h'_{ijt}) - \hat{var}_i(\Delta h_{ijt}) = y + v_i \quad ,$$

where v_i is a sampling error with mean 0 and variance σ^2_{vi}. A consistent estimate of y can be obtained by taking the mean of $[\hat{var}_i(\Delta h'_{ijt}) - \hat{var}_i(\Delta h_{ijt})]$ over the subsample of individuals for whom there is at least one observation on Δh_{ijt} and at least one on $\Delta h'_{ijt}$:

$$(14) \qquad \hat{y} = \frac{1}{I} \sum_{i=1}^{I} \hat{var}_i(\Delta h'_{ijt}) - \hat{var}_i(\Delta h_{ijt}),$$

where I is the number of persons in the subsample.

The estimates of y, presented in Table 3, are similar to the results for k=3 which were presented in Table 2. It is also noteworthy that the estimates of $\frac{1}{I} \sum_{i=1}^{I} \hat{var}_i(\Delta h'_{ijt})$ and $\frac{1}{I} \sum_{i=1}^{I} \hat{var}_i(\Delta h_{ijt})$ are similar to the estimates of $var(\Delta h'_{ijt})$ and $var(\Delta h_{ijt})$ reported in Table 2. We conclude that heterogeneity bias is not responsible for the earlier finding that the variance of the hours change is significantly larger when the job changes than when it does not.

Evaluating the Labor Demand-Perfect Mobility Model: The Distinction Between Quits and Layoffs

To provide evidence on the Labor Demand-Perfect Mobility model (LD-PM) of hours discussed in Section 2, we have computed $\mathrm{var}(\Delta H'_{ijt})$ separately for job changes resulting from quits and for job changes resulting from layoffs. (Layoffs are about 40 % of job changes for our PSID sample of males.) These results are in Table 4. The values of $\mathrm{var}(\Delta H'_{ijt})$ for the two subgroups are very similar for hours/week and are considerably in excess of the $\mathrm{var}(\Delta H_{ijt})$. For weeks/year, $\mathrm{var}(\Delta H'_{ijt})$ is considerably larger for the layoff sample than for the quit sample, (.275 versus .072 when k=3), and a similar finding is obtained for annual hours. For these dimensions of hours, the difference between $\mathrm{var}(\Delta H'_{ijt})$ for layoffs and quits is reduced considerably when hours are adjusted for unemployment, and is reduced even further if one restricts the sample to individuals who were employed at the survey date prior to the calendar year in which hours are measured. However, it remains positive. As was explained in Section 2, the fact that the variance in hours are if anything larger for job changes arising from layoffs rather than quits is strong evidence against the view that the large values for $\mathrm{var}(\Delta H'_{ijt})$-$\mathrm{var}(\Delta H_{ijt})$ and $\mathrm{var}(\Delta h'_{ijt})$-$\mathrm{var}(\Delta h_{ijt})$ may be explained with the LD-PM model.[23]

Alternative Measures of the Variability of Hours Within and Across Jobs

We use the variance as our principal measure of dispersion because additivity of the variances of the sums of independent random variables simplifies the algebra of Section 2 and the Appendix and because the variance is the most commonly used dispersion measure. However, we also report results using the mean absolute change in the hours measures as the measure of dispersion in Appendix Table A4[24]. (Table A4 also presents results for unmarried and married women.) This measure may be less sensitive to the presence of a few outliers and perhaps provides a better feeling for the typical change in hours. The mean absolute change in hours/week, weeks/year, and annual hours are more than twice as large when the job changes as when it does not.

Much work on labor supply has been conducted using actual hours rather than the log of hours. For this reason, Table A5 and Table A6 report estimates of the variances and mean absolute values of the within and across job changes in actual hours $\Delta \underline{H}_{ijt}$ and $\Delta \underline{H}'_{ijt}$, where $\underline{H}_{ijt}$ denotes the actual value of the various hours measures and is equal to $\exp(H_{ijt})$. The changes are computed over a three year interval. The results are basically consistent with the results for the log values. The mean absolute value of the time change in hours/week is about 5 hours larger when the job changes than when it does not.[25]

As an alternative means of summarizing the data, we have performed an analysis of the autocorrelations over time of the levels (as opposed to first differences) of the actual (non log) hours measure $\underline{H}_{ijt}$. (Results not reported.) We find that the correlation of $\underline{H}_{ijt}$ with its value for person i in t-k is much smaller when the job has changed than when it has not. For example, using hours/week and k=3, the correlation is .23 when the person has changed jobs between t and t-3 and .57 when the person has kept the same job.

4.2 Results for Married and Unmarried Women

Table 5 compares $\mathrm{var}(\Delta H'_{ijt})$ with $\mathrm{var}(\Delta H_{ijt})$ and $\mathrm{var}(\Delta h'_{ijt})$ with $\mathrm{var}(\Delta h_{ijt})$ for a sample of unmarried women. The variance estimates for unmarried women indicate that hours are heavily influenced by job specific characteristics. For changes in hours/week when k=3, $\mathrm{var}(\Delta H'_{ijt})$ is .1780 while $\mathrm{var}(\Delta H_{ijt})$ is only .0458. The results for k=3 and k=5 suggest that changes in all three hours measures are between 4 and 5 times more variable across jobs than within jobs and this finding holds for actual values of the hours variables as well as logs. (See Table A5.) Adjustment for observed characteristics of jobs makes little qualitative difference in the results. We conclude that the results for unmarried women are qualitatively consistent with those for men.[26]

For married women, data on the occurrence of job changes was collected only in the 1976, 1979-1981 surveys. Consequently, we report results only for 1 year changes (k=1) for this group, since it is not possible to construct 3 year and 5 year changes using the method discussed in Section 3. The results in Table 5 show that $\mathrm{var}(\Delta H'_{ijt})$ exceeds $\mathrm{var}(\Delta H_{ijt})$ by a large margin, although the difference for married women is smaller in percentage terms than it is for unmarried women or for men. This conclusion holds for the adjusted hours change measures as well.[27] Comparison of columns 1 and 2, rows 1-3 and 13-16 indicates that $\mathrm{var}(\Delta H'_{ijt})$ is similar for married and unmarried women but that hours on the same job are more variable for married women. This is consistent with the notion that hours preferences of married women are more variable than those of unmarried women (and men), and that married women tend to select jobs which provide more flexible hours. However, the data on hours for 1979-1981 for married women are more likely to be supplied by another household member than are the data for heads of household. Consequently, measurement error may be more serious for married women than for the other two groups, and thus measurement error might contribute more to the hours variances for married women.

5. Discussion and Conclusion

In this paper we have provided evidence indicating that work hours of individuals are heavily influenced by the characteristics of specific jobs. The empirical work is based upon the following simple idea. To the extent that workers may freely choose hours and hours changes are influenced by shifts over time in individual preferences and resources, the variance in the time change of hours should not depend upon whether or not the particular job to which the individual worker supplies labor has changed. The desire to reduce or increase hours could be acted upon within the current job. On the other hand, suppose the factors which influence hours worked when a person is in a given job are largely specific to that job. In this case, hours changes should be larger when persons switch jobs than when they do not. We find that hours are changes in hours are 2 to 4 times as variable across jobs than within jobs. Our analysis of quits and layoffs indicates that this result is not consistent with the view that workers are able to easily avoid demand constraints by changing jobs whenever they wish to adjust hours, although the desire to adjust work hours might be an important factor in job mobility. Individuals who change jobs as a result of a layoff experience hours changes which are even larger than those who initiate a quit. They do not simply find a new job which offers an hours level similar to the level of their previous job. We conclude that the characteristics of the specific job held have a large influence on the hours worked by individuals at a given point in time.

We have emphasized that there are at least two structural interpretations of these results. One interpretation, which we refer to as LD-IM, is that the freedom of workers to vary hours per week and weeks per year is sharply restricted within a given job. Under this interpretation, hours levels are heavily influenced by firm preferences arising from a variety of factors mentioned in the introduction to the paper. Upon joining the labor force, workers seek jobs which match their labor supply preferences. Much of the variance of hours over time occurs as workers change jobs to seek hours levels which are more in accord with the amount which they currently wish to work, or move to jobs which require less desirable hours but offer an overall job package which is superior to their current one. The second interpretation, model LS-JC, is that many non-wage labor supply determinants are job specific and vary greatly across jobs. Given the absence of data on many of the variables which might influence labor supply to a specific job and errors in the measures which are available, the fact that our results for the adjusted and unadjusted hours measures are similar is not very compelling evidence against a labor supply -job characteristics explanation.

In any case, the finding that job characteristics are a key influence on work hours has important implications for research on structural models of work hours. First, it suggests that research within a labor supply framework should place much greater emphasis on job-related hours determinants other than the wage rate.

Second, the research mentioned in the introduction on aspects of the role of employer preferences in hours of work should be expanded. With data on a cross section of jobs and multiple observations on workers in each type of job, one could attempt to estimate a structural model of hours determination along the lines of Section 2 (see Appendix 1 for more details) as well as study the determinants of the relative weights on the preferences of workers and firms in hours determination.

Finally, the results suggest that job specific labor supply determinants and/or hours requirements vary sufficiently across jobs to warrant a key role in studies of job mobility. Job characteristics which have a large effect on the number of hours workers wish to work or are required to work at a given wage also presumably have a large effect on the desirability of various jobs. Workers whose labor supply preferences change and who wish to reduce or increase hours as a result may be forced to change jobs.[28] The links between labor supply preferences, hours constraints, and job mobility are an interesting topic for future research.

Footnotes

[1] Other recent surveys of the labor supply literature are Heckman and MaCurdy (1981) and Killingsworth (1983).

[2] See also the recent papers by Filer (1986) and Killingsworth (1984).

[3] See Lewis (1969), Rosen (1969), Barzel (1973) and Deardorff and Stafford (1976). Among the early labor demand studies to emphasize employer preferences between hours per worker and employment are Brechling (1965), Ehrenberg (1971), Feldstein (1967) and Nadiri and Rosen (1969). There is, of course, an extensive aggregate time series literature on the demand for labor. See Hamermesh (1985) and Nickel (1985) for recent surveys.

[4] Additional references may be found in these papers and in Killingsworth (1983). Killingsworth (1983, pg. 42) provides references to studies which have examined the implications of rationing of hours for overtime, shift work, and multiple job holding. Ham (1979) and Moffit (1981) estimate models in which workers may be constrained in how little they can work. Moffit's econometric model is very similar to those of Cogan (1981) and Hanoch (1980) (see also Hausman (1980)) who stress labor supply factors as the source of the minimum number of hours people choose to work. Blank (1985) discusses these possibilities in an analysis (like Hanoch's) which distinguishes among hours per week and weeks per year. Dickens and Lundberg (1985) investigate a labor supply model in which persons must select from a finite number of employment opportunities. The jobs require different numbers of hours, although each pays the same hourly wage. In Altonji and Paxson (1985) we investigate the implications of underemployment and overemployment for the pattern of wage changes and hours changes which occur when people change jobs.

[5] See especially Rosen's (1985) presentation of this literature. Abowd and Card (1985) appears to be the first study to use micro data to examine labor supply within an implicit contracts framework. Bernanke (1985) uses a joint model of hours and earnings to study labor market behavior during the Great Depression.

[6] "Firm" and "job" are used synonymously in the paper. In the empirical work, job changes correspond to employer changes. An analysis of changes in position within a firm would be an interesting extention of the study.

[7] In both models complications arise when workers are faced with a nonlinear schedule relating the wage rate to hours of work rather than with a parametric wage ---see Rosen (1976), Moffit (1983) and Lundberg (1984).

[8] Cogan (1981) and Hanoch (1980) discuss preferences for hours per week and weeks per year.

[9] This may be relaxed by expressing w_{ijt} as a function of H_{ijt}, where the function may depend upon firm characteristics, and replacing w_{ijt} in (1) with the derivative of earnings with respect to H_{ijt}. H^s_{ijt} would then be the implicit solution to the modified equation. Similar modifications may be made to other equations in the model.

[10] As noted earlier, changes in expectations of future wages are part of

the vector of labor supply determinants Z_{ijt} and feature prominently in conventional lifecycle models of labor supply. One might expect the variance of changes in these expectations (as well as the current wage) to be greater when the job changes than when it does not to the extent that wages are job specific. Controlling for occupation, union status, and the current wage removes only part of this difference. Consequently, it is at least possible that the large difference between var($\Delta h'_{ijt}$) and var(Δh_{ijt}) is due to a conventional labor supply response to a larger variance across jobs in the change in expectations about lifetime wages. However, such an explanation is implausible given the very large difference in variances which we find, the evidence from a variety of studies that, at least for males, labor supply is not very responsive to current and future wage changes, and the fact that current wage changes explain virtually none of the variance of the hours changes (See Table A1, columns 1, 4, and 7.)

[11]The separation indicator from the PSID required extensive recoding for the years 1968-1973 since quits and promotions are not distinguished in these years. For details on how the separation indicator was constructed, see Altonji and Shakotko (1985, Appendix 2).

[12]When an individual reports a job change in the previous survey year, it is difficult to determine whether the job change occurred prior to January, or between January and the date of the survey. If the job change occurred prior to January, then the hours measures for the previous calendar year reflect hours worked on more than one job; if the job change happened after January, then the hours measures for the current calendar year have this problem. Since data on tenure with employer are usually not precise enough to determine exactly when the separation occurred, hours change measures which are based on the current and the previous calendar year are suspect when a separation is indicated.

[13] See Table A1 and Table A2 for a list.

[14] The observations corresponding to job changes and the observations corresponding to no job change were weighted (respectively) by estimates of the inverse of the standard deviation of $u_{ijt} + \Delta\varepsilon_{ijt}$ when the job has changed and when the job has not changed. This corrects for heteroscedasticity associated with the fact that the variance of the error component of (8) depends on whether or not the job changes. In practice, the weighted estimates of (8) are very similar to unweighted estimates.

[15] The same problem exists for the QES. Unfortunately, the QES does not contain an alternative wage measure to use as an instrument. For the QES, Δw_{ijt} is the change in the log of total annual earnings. See Altonji (1986) for a detailed discussion of the two PSID wage measures and the problems which may arise in using them to estimate an intertemporal labor supply model. For the PSID, the estimate of (8) is based on a subsample of observations, since the change in the log of the reported hourly wage is missing for all workers prior to 1970 and for salaried workers prior to 1976. The parameter estimates are used to compute Δh_{ijt} and $\Delta h'_{ijt}$ for each observation in accordance with equation (9a, 9b) below, regardless of whether that observation was used to calculate $\hat{a}_2$, $\hat{a}'_2$, $\hat{a}_4$, and $\hat{a}'_4$.

[16] The R^2's for equations with hours/week as the dependent variable are very low. The R^2 statistic is much higher for the change in weeks/year and annual work hours, although most of the explanatory power is due to the inclusion of the change in hours of unemployment. The parameter estimates may be of some interest to researchers working on intertemporal labor supply models. The two stage least squares procedure used to estimate columns 1-6 is very similar to one of the procedures in Altonji (1986), although the PSID subsample used in the latter study was restricted to workers who were paid by the hour and who were continuously married to the same wife from 1968 to 1979, and included only limited data from 1980 and 1981. Also, Altonji (1986) does not distinguish between hours changes with and without job changes, analyzes only annual hours/year, does not include interactions among the job change and wage change, and incudes fewer control variables for annual hours. We find that the wage response is about evenly divided between hours per week and weeks per year, although this is less true of the analysis at 3 year intervals. We also find that the response of annual hours to Δw_{ijt} is .1271 with a t-value of 2.52 for those who do not change jobs. However, this response is reduced by -.2023 to -.0752 when a separation occurs. From the standpoint of the life-cycle labor supply framework, the more negative coefficient on the wage when a job change occurs is consistent with the view that wage changes associated with job changes are more permanent and less easily anticipated than those on a continuing job. However, an alternative explanation is that there exists a negative association across jobs between wage rates and the quality of the work environment. It is also worth noting that the separation dummy has only a small effect on expected value of the hours change measures. For the QES sample, the coefficient on earnings of .1699 translates into a wage response of .2047 (.205 = .1699/(1-.1699)). This estimate is within the range of estimates of the intertemporal labor supply elasticity for men reported in earlier studies. It is biased downward by measurement error in earnings and biased upward (toward 1) by the fact that earnings are endogenous in the hours equation. Overall, the point estimates are basically consistent with estimates from previous studies summarized in Ashenfelter (1984), Killingsworth (1983, Ch. 5.4), and Pencavel (1984). Of course, these results and those of the other other studies do not have a clear interpretation if employer preferences have strong influence on hours, or if job mobility is affected by labor supply preferences and hours constraints.

[17] The effect of additive measurement errors in the log of hours and the log of earnings on the variances of the adjusted hours changes within and across jobs can be determined in the following way. Let H^*_{ijt} be the true value of the log of annual work hours for individual i in job j at time t, and let w^*_{ijt} be the true value for the log of hourly earnings. Let e_{ijt} be an additive measurement in the log of earnings which is independent of ε_{ijt}. The fact that the observed value of w_{ijt} is equal to the log of total annual earnings minus the log of observed annual hours implies that observed hours and wages will have the following relationship to true hours and wages:

$$H_{ijt} = H^*_{ijt} + \varepsilon_{ijt}$$

$$w_{ijt} = w^*_{ijt} - \varepsilon_{ijt} + e_{ijt}.$$

Let Δh^*_{ijt} and $\Delta h^{*\prime}_{ijt}$ denote true adjusted hours changes within and across jobs. Then, the variance of hours changes within and across jobs may be expressed as:

$$\mathrm{var}(\Delta h_{ijt}) = \mathrm{var}(\Delta h^*_{ijt}) + (1+\hat{a}_2)^2\mathrm{var}(\Delta\varepsilon_{ijt}) + (\hat{a}_2)^2\mathrm{var}(\Delta e_{ijt})$$

$$\mathrm{var}(\Delta h'_{ijt}) = \mathrm{var}(\Delta h^{*\prime}_{ijt}) + (1+\hat{a}_2+\hat{a}_2')^2\mathrm{var}(\Delta\varepsilon_{ijt}) + (\hat{a}_2 + \hat{a}_2')^2\mathrm{var}(\Delta e_{ijt})$$

The difference between the variance of hours changes across jobs and the variance of hours within jobs is:

$$\begin{aligned}\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt}) = {} & \mathrm{var}(\Delta h^{*\prime}_{ijt}) - \mathrm{var}(\Delta h^*_{ijt}) + \\ & [(1 + \hat{a}_2 + \hat{a}'_2)^2 - (1 + \hat{a}_2)^2]\mathrm{var}(\Delta\varepsilon_{ijt}) + \\ & [(\hat{a}_2 + \hat{a}_2')^2 - \hat{a}_2{}^2]\mathrm{var}(\Delta e_{ijt})\end{aligned}$$

Note that the effects of the measurement error terms in the above equation are 0 if $\hat{a}_2'$ is 0.

[18] The reported standard errors are based on the assumptions that the observations on the change in hours within and across jobs are independent (1) across individuals and (2) over time for a given person. The correlation of the change in hours across individuals in the same year is in fact trivial and may be safely ignored. Correlation over time for a given individual is likely to bias the standard errors downward by a small amount.

[19] We computed the variance of hours within and across jobs for k=3 and k=5, but without setting hours to missing in years in which a separation may have occurred. This resulted in variance estimates closer to those obtained for k=1. For example, when k=3 and no separation checks are performed, $\mathrm{var}(\Delta H_{ijt})$ is .0393, and $\mathrm{var}(\Delta H'_{ijt}) - \mathrm{var}(\Delta H_{ijt})$ is .0446. When separation checks are performed $\mathrm{var}(\Delta H_{ijt})$ is .0360 and $\mathrm{var}(\Delta H'_{ijt}) - \mathrm{var}(\Delta H_{ijt})$ is .0704. Thus when hours measures reflect hours worked in different jobs, $\mathrm{var}(\Delta H'_{ijt})$ is understated.

[20] We experimented with the use of 2-digit occupation dummies and obtained results which are very similar to those reported in the table.

[21] Most of the variability in the 9 one digit occupation measures and the 17 various job characteristics comes from observations across jobs, and there are only 67 observations on job changers. In this situation the "R^2" for observations in which a separation occurs is likely to be substantial even under the null hypothesis that none of the job specific variables have any influence on hour choice. In fact, none of the variables are individually statistically significant, and the joint hypothesis that the coefficients on all of them are 0 easily passes an F-test. To obtain a rough idea of bias from loss of the degrees of freedom in adjusting $\Delta H'_{ijt}$ for changes in job characteristics, we experimented with using (67 - 17 - 9 -1) rather than (67-1) as the degrees of freedom of the sum of squared deviations of $\Delta h'_{ijt}$ from its mean for job changers. In this case, $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ is .0561, which actually exceeds the estimate based upon unadjusted hours. Although this adjustment is crude the evidence indicates that observed job characteristics in the QES do not explain the larger variance in hours/week across jobs than within jobs.

[22] For a number of reasons, $\mathrm{var}(d_{jt})$ might be associated with the frequency with which a person changes jobs. For example, layoffs might be

preceded by an hours reduction. Consequently, a comparison of var($\Delta h'_{ijt}$) and var(Δh_{ijt}) with individual differences accounted for may provide a better indication of var($\Delta h'_{ijt}$) - var(Δh_{ijt}) for a given worker.

[23] In Section 2 we did not mention the possibility that large values of var($\Delta H'_{ijt}$) - var(ΔH_{ijt}) and var($\Delta h'_{ijt}$) - var(Δh_{ijt}) could be reconciled with LS-PC if for some reason the variance of individual specific labor supply determinants depends upon the factors which cause job changes. For example, the occurrence of a divorce may be associated with a geographical move and consequently a job change, as well as large changes in the amount people wish to work. However, we would expect these considerations to be more of a factor for quits than for firm-initiated separations, in which case the evidence in the text suggests that they are not of primary importance. We are grateful to Rebecca Blank for helpful discussions on this issue.

[24] Systematic differences in the hour changes when job changes do and do not occur are accounted for by subtracting the mean algebraic change in ΔH_{ijt} and $\Delta H'_{ijt}$ from ΔH_{ijt} and $\Delta H'_{ijt}$ prior to calculation of the absolute values. In practice, this adjustment makes little difference in the results.

[25] Although our focus is on hours in the main job, we also examined the relationship between changes in hours on the main job and changes in hours on other jobs for our sample of men. We found (1) that the changes in annual hours on the main job have a negative covariance with changes in hours on other jobs and (2) the absolute value of this negative covariance rises proportionately with the higher variance in the hours change on the main job when the main job has changed. We suspect that these results are consistent with both LD-IM and LS-JC. If hours changes over time are determined largely by variation in personal characteristics, we would expect changes in hours on the main job and on extra jobs to be positively correlated. Use of total work hours rather than annual hours on the main job does not have much effect on the results for annual hours in Table 2.

[25] Comparisons of the mean absolute value of ΔH_{ijt} and $\Delta H'_{ijt}$ are reported in Table A4. Similar comparisons for $\Delta\underline{H}_{ijt}$ and $\Delta\underline{H}'_{ijt}$ are presented in Table A6.

[27] For married women, adjustment of the hours measures sharply increases the variance in the change in hours when a separation occurs relative to the variance when the job remains the same. (Compare columns 3, 6, and 9 in rows 13-15.) This is true regardless of whether the hours change measures are adjusted for unemployment. We investigated the reason for the large affect of the adjustment and found that it is related to measurement error in the hours and earnings data in conjunction with the fact that for married women the point estimates of the response of hours to a change in the wage differ sharply depending upon whether or not a job change has occurred. As shown in footnote 17, these two types of measurement error bias the estimates of var($\Delta h'_{ijt}$) and var(Δh_{ijt}) upward, and the size of the bias is increasing in a_2 and $\hat{a}_2'$. To take the most extreme example, the parameter estimates in Table A3 indicate that the response of hours/week to the wage is -.492 when a job change does not occur ($\hat{a}_2$) and 2.14 when a job change does occur ($\hat{a}_2$ + $\hat{a}_2'$). The large value of $\hat{a}_2'$ implies a large upward bias in var($\Delta h'_{ijt}$) if, as the evidence in Altonji (1986) and Duncan and Hill (1984) suggests, measurement error is important. Footnote 17 also shows that var($\Delta h'_{ijt}$) -

$\mathrm{var}(\Delta h_{ijt})$ may be biased up or down, depending on the values of $\hat{a}_2$ and $\hat{a}_2'$ and the importance of measurement error in hours and measurement error in earnings. In the case of married women, the sign of the bias is positive. To get a handle on these issues empirically, we computed alternative measures of $\mathrm{var}(\Delta h'_{ijt})$ and $\mathrm{var}(\Delta h_{ijt})$ after using the reported hourly wage rather than average hourly earnings to adjust annual hours for the wage change. In this case, $\mathrm{var}(\Delta h'_{ijt})$, $\mathrm{var}(\Delta h_{ijt})$ and $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ become 0.495, 0.243 and 0.252 respectively. As a second alternative, we constrained the parameter values of the hours adjustment equation to be the same within jobs and across jobs one obtains estimates, and found that $\mathrm{var}(\Delta h'_{ijt}) - \mathrm{var}(\Delta h_{ijt})$ is much closer to the findings for $\mathrm{var}(\Delta H'_{ijt}) - \mathrm{var}(\Delta H_{ijt})$ which are reported in the table.

[28] Gustman and Steinmeier's (1983, 1984) studies of partial retirement by older workers suggests that this is the case. Kiefer (1984) and Altonji and Paxson (1985) examine the empirical implications of the possibility that given imperfect information workers must tradeoff hours adjustments and wage gains in searching for better jobs. In Altonji and Paxson (1986, in progress) we are investigating whether changes in labor supply preferences induce quits from one firm to another and the extent to which changes in labor supply preferences are reflected in hours changes only if people change employers.

Appendix: A Model of Hours Determination

In this Appendix we present a prototype model of hours determination which combines aspects of three models which have been presented in previous studies: a lifecycle labor supply model, a model of the firm's preferences for hours, and an implicit contracts model. The model provides a concrete example of the framework sketched in Section 2. With more development and a much richer data set, perhaps it could serve as the basis for a structural analysis of hours incorporating the preferences of workers and firm. We also derive complete expressions for the variance in hours changes within jobs and across jobs in terms of the parameters of the model.

A1. The Labor Supply Model

Assume that preferences for consumption and leisure are separable within periods and over time. (Heckman and MaCurdy (1980), Browning et al (1985), MaCurdy (1981, 1983) and the surveys by Killingsworth (1983) and Pencavel (1984) provide detailed discussions of life cycle labor supply models.) Maximization of utility subject to the usual budget constraint yields:

$$(A.1)\quad U_H(X_{ijt},S_{ijt},H_{ijt}) = \lambda(w_{ijt},X_{ijt},S_{ijt})\ \exp(w_{ijt})\ .$$

In (A.1) U_H is the marginal utility of hours worked. $\lambda(w_{ijt},X_{ijt},S_{ijt})$ is the marginal utility of income. $X_{ijt} = \{x_i,x_{it},x_{ij},x_{ijt}\}$ is a vector of observed variables affecting labor supply; the elements of X_{ijt} are defined in section 2 of the paper. The vector S_{ijt} contains the unobserved counterparts to X_{ijt}, and includes expectations of future wages. H_{ijt} is the log of work hours, and w_{ijt} is the log of the wage rate.

For analytic convenience, we assume that ln U_H has the following linear form:

(A.2) $\ln U_H = -\frac{n}{b} X_{ijt} - \frac{\Gamma}{b} S_{ijt} + \frac{1}{b} H_{ijt}$.

Combining (A.1) and (A.2) yields the following equation for the supply of the log of hours, H^s_{ijt} :

(A.3) $H^s_{ijt} = nX_{ijt} + \Gamma S_{ijt} + b \ln \lambda(w_{ijt}, X_{ijt}, S_{ijt}) + b\, w_{ijt}$.

The utility function used in a number of life cycle studies, such as MaCurdy (1981) and Altonji (1986) leads to (A.3) with many of the elements of n and Γ constrained to 0.

A2. The Labor Demand Model

Following the approach taken in the studies cited in fn. 2, assume that output (Q_{jt}) in firm j at time t is a function of the number of workers employed (N_{jt}) and the actual (non-log) number of hours per worker ($\underline{H}_{ijt}$). The production function has the Cobb-Douglas form:

(A.4) $Q_{jt} = P_{jt} N^{\psi+1}_{jt} \underline{H}^{\omega+1}_{jt} \qquad 0 < \psi+1,\ \omega+1 < 1$.

The vector P_{jt} consists of fixed and time-varying factors which affect productivity. The labor cost function $COST_{jt}$ has the form:

(A.5) $COST_{jt} = \underline{w}_{jt} \underline{H}_{jt} N_{jt} + C_{jt} N^{\tau+1}_{jt} \qquad 0 \leq \tau+1 \leq 1$

where $\underline{w}_{jt}$ is the real wage and equals $\exp(w_{ijt})$. The first component of the cost function, $\underline{w}_{jt}\, \underline{H}_{jt}\, N_{jt}$, is the wage bill. The second component, $C_{jt} N^{\tau+1}_{jt}$, is costs which are worker specific. We allow for the possibility that worker specific costs are concave in the number of workers, since costs per worker for such items as recruiting, training, and health and disability insurance may be smaller for firms with more employees.

Maximization of profits yields the following equation for the log of hours demanded of worker i, H^d_{ijt} :

(A.6) $H^d_{ijt} = B\, w_{ijt} + D_{jt}$,

where $B = [\frac{\tau - \psi}{\psi + \omega\tau}]$

$$D_{jt} = [\frac{\psi}{\psi + \omega\tau}] \ln C_{jt} - [\frac{\tau}{\psi + \omega\tau}] \ln P_{jt} + \text{constant} .$$

D_{jt} may be partitioned into those elements which do not vary over time in job j (d_j), and time-varying elements (d_{jt}).

A3. The Implicit Contracts Model

The efficient contract hours level is determined by equating the marginal product of labor with the marginal utility of leisure. Let H^c_{ijt} be the log of the efficient contract hours level, and Θ_{ijt} be the log of marginal product of labor. Since (A.6) relates the marginal product of labor to the wage rate, substitution of H^c_{ijt} for H^d_{ijt} will imply a value of Θ_{ijt} . Specifically:

(A.7) $H^c_{ijt} = B\Theta_{ijt} + D_{jt}$.

Similarly, an efficient contract will require that

$\ln U_H (X_{ijt},S_{ijt},H_{ijt}) = \ln \lambda(w_{ijt},X_{ijt},S_{ijt}) + b\Theta_{ijt}$. Thus, one can modify (A.3) to obtain an expression which relates H^c_{ijt} to Θ_{ijt}:

(A.8) $H^c_{ijt} = nX_{ijt} + \Gamma S_{ijt} + b \ln \lambda(w_{ijt},X_{ijt},S_{ijt}) + b\Theta_{ijt}$.

Solving for H^c_{ijt} from (A.7) and (A.8) yields:

(A.9) $H^c_{ijt} = \frac{b}{b - B} D_{jt} - \frac{B}{b - B} [nX_{ijt} + \Gamma S_{ijt} + b \ln \lambda(w_{ijt},X_{ijt},S_{ijt})]$.

The larger b and the smaller B the less flexible is the firm relative to the worker with respect to hours preferences, and the larger is the relative weight of firm preferences in the determination of H^c_{ijt} .

A4. The Combined Model

How are hours actually determined? A simple rule which nests various alternatives is that actual hours are a weighted average of the hours level desired by firms and workers:

(A.10) $H_{ijt} = m_s H^s_{ijt} + m_d H^d_{ijt} + (1-m_s-m_d) H^c_{ijt} \qquad 0 \leq m_s,m_d,m_s+m_d \leq 1$

Discussions of the feasibility of efficient contracts such as Grossman (1977), Brown (1982), and Rosen (1985) suggest that the degree to which m_d and

m_s differ from 0 will depend upon the existence of shared rents, and reputation effects which provide both parties with the incentive to honor the contract, as well as the degree to which information about the value of marginal utility of labor and the marginal product of labor is available to both the firm and the worker. Suppose that contracts are not fully efficient and both firms and workers use the wage rate as the shadow price of labor in making their supply and demand offers. Unless the firm is indifferent with respect to the choice of hours over the range of variation in the worker's prefernces, changes in the preferences of a given worker and variation in preferences across workers will cause H^s_{ijt} and H^d_{ijt} to diverge. Presumably, the relative values of m_s and m_d reflect the flexibility of worker and firm preferences over hours, as indexed by the wage parameters b and B of the supply and demand functions, just as the weights on firm and worker preferences in the efficient contract level of hours reflect these parameters. If technology is such that the marginal product of labor is highly nonlinear with respect to H_{ijt} in the neighborhood of H^d_{ijt} , then presumably the job is characterized by a value of m_s which is small relative to m_d. Firms and workers may differ in the variability of their hours preferences as well as in the flexibility of the preferences. The expected level of compensation across jobs may vary with m_s and m_d, the variability in non-wage determinants of H^d_{ijt} , as well as with the average level of H^d_{ijt} (across time periods) give a particular wage. Presumably, workers sort themselves across firms to some extent so that inflexible (flexible) workers tend to be matched with flexible (inflexible) employers.

A5. Derivation of the Change in Hours

Both the change in hours wihtin jobs and across jobs will contain a term involving the response of ln λ_{ijt} to shifts in observed and unobserved labor supply determinants. We approximate $\ln \lambda_{ijt}$ with the linear form:

$$\text{(A.11)} \quad \ln \lambda_{ijt} = \Pi w_{ijt} + gX_{ijt} + \kappa S_{ijt}$$

Substituting (A.11) into (A.10) and adding a measurement error component ε_{ijt} yields the hours equation:

$$\text{(A.12)} \quad H_{ijt} = \underline{m}_s(n + bg)X_{ijt} + \underline{m}_s(\Gamma + b\kappa)S_{ijt}$$
$$+ [m_s b + \underline{m}_s b\Pi + m_d B]w_{ijt} + \underline{m}_d D_{jt} + \varepsilon_{ijt} .$$

in which

$$\underline{m}_s = m_s - \frac{B}{b - B}(1-m_s-m_d)$$
$$\underline{m}_d = m_d + \frac{b}{b - B}(1-m_s-m_d) .$$

Equation (A.12) corresponds to equation (3) in section 2 of the text, where $Z_{ijt} = [X_{ijt}, S_{ijt}]$.

Let ΔH_{ijt} denote the change in the log of hours between t and t-k when the job has changed, and let $\Delta H'_{ijt}$ denote the change in hours when the job has not changed. Let Δh_{ijt} and $\Delta h'_{ijt}$ equal ΔH_{ijt} and $\Delta H'_{ijt}$ after adjusting for the effects of all observable labor supply variables which are job-specific (i.e. w_{ijt}, x_{ijt} and x_{ij}). Then, Δh_{ijt} and $\Delta h'_{ijt}$ can be expressed as:

$$\text{(A.13a)} \quad \Delta h_{ijt} = \underline{m}_s[\Delta V_{it} + r_{(4)}\Delta s_{ijt}] + \underline{m}_d[\Delta d_{jt}] + \Delta\varepsilon_{ijt}$$

$$\text{(A.13b)} \quad \Delta h'_{ijt} = \underline{m}_s[\Delta V_{it} + r_{(4)}\Delta s_{ij't} + r_{(3)}\Delta s_{ij'}] + \underline{m}_d[\Delta d_{j'} + \Delta d_{j't}] + \Delta\varepsilon_{ij't}$$

where

$$V_{it} = [n_{(2)} + bg_{(2)}]x_{it} + [\Gamma_{(2)} + b\kappa_{(2)}]s_{it}$$
$$r_{(4)} = \Gamma_{(4)} + b\kappa_{(4)}$$
$$r_{(3)} = \Gamma_{(3)} + b\kappa_{(3)}$$

and $n = \{n_{(1)}, n_{(2)}, n_{(3)}, n_{(4)}\}$ are the coefficients corresponding to $\{x_i, x_{it}, x_{ij}, x_{ijt}\}$ and $\Gamma = \{\Gamma_{(1)}, \Gamma_{(2)}, \Gamma_{(3)}, \Gamma_{(4)}\}$ are the coefficients corresponding to $\{s_i, s_{it}, s_{ij}, s_{ijt}\}$. The same subscript notation is used for g and κ. The variables $\Delta\varepsilon_{ijt}$ and $\Delta\varepsilon_{ij't}$ are the measurement error components for the change in hours within and across jobs.

A6. Derivation of the Variance of Hours Changes

The following assumptions are made about the covariances among the components of $\Delta h'_{ijt}$ and Δh_{ijt}:

i) $cov(s_{ij}, d_{jt}) = cov(s_{ij'}, d_{jt}) = cov(s_{ij}, d_{j't-k}) = 0$

ii) $cov(s_{ijt}, s_{ij't-k}) = 0$

iii) $cov(s_{ijt}, d_j) = cov(s_{ijt-k}, d_j) = cov(s_{ijt}, d_{j'}) = 0$

iv) All variances and covariances are stationary across time, (e.g., $var(s_{ijt}) = var(s_{ij't-k})$ and $var(s_{ijt}) = var(s_{ijt-k})$)

v) The measurement error component ε_{ijt} is independently distributed over time with the same variance for all i and j

Equations (A.13a) and (A.13b), together with the assumptions made above, imply that the population variance of Δh_{ijt} and $\Delta h_{ij't}$ are:

$$
\begin{aligned}
\text{(A.14a)}\quad var(\Delta h_{ijt}) = {} & 2\underline{m}_s{}^2 var(V_{it}) + 2\underline{m}_s{}^2\, r_4^2\, var(s_{ijt}) \\
& - 2\underline{m}_s^2\, cov(V_{it}, V_{it-k}) - 2\underline{m}_s^2\, r_4^2\, cov(s_{ijt}, s_{ijt-k}) \\
& + 2\underline{m}_d^2\, var(d_{jt}) - 2\underline{m}_d^2\, cov(d_{jt}, d_{jt-k}) \\
& + \underline{m}_d\, \underline{m}_s\, 2\, cov(V_{it}, d_{jt}) - \underline{m}_d \underline{m}_s\, cov(V_{it}, d_{jt-k}) \\
& - \underline{m}_d \underline{m}_s\, cov(V_{it-k}, d_{jt}) + 2r_{(4)}\, \underline{m}_d \underline{m}_s\, cov(s_{ijt}, d_{jt}) \\
& - r_{(4)}\, \underline{m}_d \underline{m}_s\, cov(s_{ijt}, d_{jt-k}) - r_{(4)}\, \underline{m}_d \underline{m}_s\, cov(s_{ijt-k}, d_{jt}) \\
& + 2\, var(e_{ijt})\ .
\end{aligned}
$$

$$
\begin{aligned}
\text{(A.14b)}\quad var(\Delta h'_{ijt}) = {} & 2\underline{m}_s^2\, var(V_{it}) + 2\underline{m}_s^2\, r_{(4)}^2\, var(s_{ijt}) + 2\underline{m}_s^2\, r_{(3)}^2\, var(s_{ij}) \\
& - 2\underline{m}_s^2\, cov(V_{it}, V_{it-k}) - 2\underline{m}_s^2\, r_{(3)}^2\, cov(s_{ij}, s_{ij'}) + 2\underline{m}_d^2\, var(d_{jt}) \\
& + 2\underline{m}_d^2\, var(d_j) - 2\underline{m}_d^2\, cov(d_{jt}, d_{j't-k}) - 2\underline{m}_d^2\, cov(d_j, d_{j'}) \\
& + 2\underline{m}_d \underline{m}_s\, cov(V_{it}, d_{jt}) + 2\underline{m}_d \underline{m}_s\, cov(V_{it}, d_j) - \underline{m}_d \underline{m}_s\, cov(V_{it}, d_{j'})
\end{aligned}
$$

$$- \underline{m}_d \underline{m}_s \; cov(V_{it-k}, d_j) + \underline{m}_d \underline{m}_s \; cov(V_{it}, d_{j'''t-k})$$
$$- \underline{m}_d \underline{m}_s \; cov(V_{it-k}, d_{jt}) + 2m_d m_s \; r_{(4)} \; cov(s_{ijt}, d_{jt})$$
$$- r_{(4)} \; \underline{m}_d \underline{m}_s \; cov(s_{ijt}, d_{j'''t-k}) - r_{(4)} \; \underline{m}_d \underline{m}_s \; cov(s_{ij'''t-k}, d_{jt})$$

$$+ 2 \; r_{(3)} \; \underline{m}_d \underline{m}_s \; cov(s_{ij}, \dot{d}_j) - r_{(3)} \; \underline{m}_d \underline{m}_s \; cov(s_{ij}, d_{j'})$$
$$- r_{(3)} \; m_d m_s \; cov(s_{ij'}, d_j) + 2 \; var(e_{ijt}).$$

The difference between $var(\Delta h_{i'jt})$ and $var(\Delta h_{ijt})$ is:

(A.15) $var(\Delta h'_{ijt}) - var(\Delta h_{ijt}) =$

$$2\underline{m}_s^2 \; [r_{(3)}^2 \; var(s_{ij}) + r_{(4)}^2 cov(s_{ijt}, \; s_{ijt-k}) - r_{(3)}^2 \; cov(s_{ij}, \; s_{ij'})]$$
$$+ 2\underline{m}_d^2 \; [var(d_j) - cov(d_j, d_{j'}) - cov(d_{jt}, d_{j'''t-k}) + cov(d_{jt}, d_{jt-k})]$$
$$+ \underline{m}_d \underline{m}_s \; [2 \; cov(v_{it}, d_j) - cov(V_{it}, \; d_{j'}) - cov(V_{it-k}, d_j)]$$
$$+ \underline{m}_d \underline{m}_s \; [cov(V_{it}, d_{jt-k}) - cov(V_{it}, \; d_{j'''t-k})]$$
$$+ r_{(4)} \; \underline{m}_d \underline{m}_s [cov(s_{ijt}, d_{jt-k}) - cov(s_{ijt}, d_{j'''t-k})]$$
$$+ r_{(4)} \; \underline{m}_d \underline{m}_s \; [cov(d_{jt}, s_{ijt-k}) - cov(d_{jt}, s_{ij'''t-k})]$$
$$+ r_{(3)} \; \underline{m}_d \underline{m}_s \; [2 \; cov(s_{ij}, \; d_j) - cov(s_{ij}, d_{j'}) - cov(s_{ij'}, d_j)].$$

For the general case in which the preferences of both worker i and firm j are weighted in hours determination the difference in variances (A.15) involves a large number of terms. The expression simplifies greatly if hours are determined entirely by the worker or entirely by the firm. It would be very difficult to identify richer structural models from the variances and autocovariances of the hours changes within and across jobs without detailed data on some of the determinants of firm and worker preferences. A prototype for such an analysis (using earnings and hours) is Abowd and Card (1985b).

References

Abowd, John M. and Ashenfelter, Orley, "Anticipated Unemployment Temporary Layoffs, and Compensating Wage Differentials" in S. Rosen (ed.) Studies in Labor Markets, University of Chicago Press (1981): 141-170.

__________ and Card, David M., "On the Covariance Structure of Hours and Earnings Changes." Unpublished paper, Princeton University, (December 1985a)

__________ and Card, David M., "Intertemporal Labor Supply and Long Term Employment Contracts." Unpublished paper, Princeton University, (December 1985b)

Altonji, Joseph G., "Intertemporal Substitution in Labor Supply: Evidence from Micro Data", (forthcoming, Journal of Political Economy June 1986.).

__________ and Paxson, Christina H., "Hours-Wage Tradeoffs and Job Mobility," Unpublished paper, Columbia University, (November 1985).

__________ and Paxson, Christina H., "Labor Supply, Hours Constraints, and Job Mobility", (in progress, 1986).

__________ and Shakotko, Robert A., "Do Wages Rise with Job Seniority?" NBER Working Paper No. 1616, (May 1985).

Ashenfelter, Orley, "Unemployment as Disequilibrium in a Model of Aggregate Labor Supply," Econometrica 48, (April 1980): 547-564.

__________, "Macroeconomic Analyses and Microeconomic Analyses of Labor Supply," Carnegie-Rochester Conference Series on Public Policy 16 (1984).

Atrostic, B.K., "The Demand for Leisure and Nonpecuniar Job Characteristics", American Economic Review 72: (June 1982): 428-440.

Barzel, Yorum, "The Determination of Daily Hours and Wages," Quarterly Journal of Economics Vol. 87 (1973): 220-238.

Bernanke, Ben S., "Employment, Hours, and Earnings in the Depression: An Analysis of Eight Manufacturing Industries", NBER Working Paper No. 1642 (June 1985)

Brechling, Frank P. R., "The Relationship Between Output and Employment in British Manufacturing Industries," The Review of Economic Studies Vol. 32 (1965): 187-216.

Blank, Rebecca, "The Supply of Weeks and Hours of Work Among Female Household Heads", Industrial Relations Section, Princeton University (July 1985)

Brown, James N., "How Close to an Auction is the Labor Market?", Research in Labor Economics Vol. 5 (1982): 189-235.

Browning, Martin, Deaton, Angus and Irish, Margaret, "A Profitable Approach to Labor Supply and Commodity Demands over the Life-Cycle," Econometrica (May 1985).

Cline, Harold, "The Effect of the Job and Job Mobility on the Wage," Discussion Paper 79-8, Department of Economics, University of Rochester (December 1979).

Cogan, John F., "Fixed Costs and Labor Supply", Econometrica 49 No. 4 (July 1981): 945-964.

Deardorff, A.V., and F.P. Stafford, "Compensation of Cooperating Factors" Econometrica 44 (July 1976): 671-684

Dickens, William T. and Lundberg, Shelly, "Hours Restrictions and Labor Supply", NBER Working Paper No. 1638 (June 1985).

Duncan, Greg. J. and Hill, Daniel H., "An Investigation of the Extent and Consequences of Measurement Error in Labor Economic Survey Data," Institute for Social Research, The University of Michigan, (July 1984).

Ehrenberg, Ronald S., "Fringe Benefits and Overtime Behavior", Massachusetts, D.C. Health (1971).

__________ and Schumann, Paul L., "Compensating Wage Differentials for Mandatory Overtime," Economic Inquiry 22 No. 4 (October 1984): .

Feldstein, M., "Specification of the Labor Input in the Aggregate Production" Review of Economic Studies 34 (October 1967): 375-86.

Freeman, Richard E., "Unionism and the Dispersion of Wages", Industrial and Labor Relations Review 34 No. 1 (October 1980): 3-23.

Filer, Randall, "The Effects of Nonpecuniary Compensation on Estimates of Labor Supply Functions", (forthcoming in The Quarterly Review of Economics and Business, 1986).

Grossman, Herschel I, "Risk Shifting, Layoff, and Seniority", Journal of Monetary Economics 4 (November): 661-668.

Gustman, Alan L., and Steinmeier, "Minimum Hours Constraints and Retirement Behavior", Contemporary Policy Issues, a supplement to Economic Inquiry, No. 3 (April 1983): 77-91.

__________, "Partial Retirement and the Analysis of Retirement Behavior", Industrial and Labor Relations Review Vol. 37, No. 3 (April 1984): 403-415.

Ham, John C., "Rationing and the Supply of Labor: An Econometric Approach", Industrial Relations Section Working paper No. 103A, Princeton University (May 1979)

__________, "Estimation of a Labor Supply Model with Censoring Due to Unemployment and Underemployment", The Review of Economic Studies 49 No. 3 (July 1982): 335-354.

__________, "Testing Whether Unemployment Represents Life-Cycle Labor Supply Behavior", (forthcoming in The Review of Economic Studies July 1986.),

Hamermesh, Daniel S. "The Demand for Labor in the Long Run," (forthcoming in O. Ashenfelter and R. Layard eds., Handbook of Labor Economics)

Hanoch, Giora, "Hours and Weeks in the Theory of Labor Supply", in JameSmith (ed.), Female Labor Supply: Theory and Estimation. Princeton, NJ: Princeton University Press (1980): 119-165.

Hausman, Jerry A., "The Effect of Wages, Taxes and Fixed Costs on Women's Labor Force Participation," Journal of Public Economics 14 (1980): 161-194.

Heckman, James J. and MaCurdy, Thomas E., "A Life Cycle Model of Female Labor Supply", The Review of Economic Studies, 47 (January 1980): 47-74.

__________, "New Methods for Estimating Labor Supply Functions: A Survey", Research in Labor Economics, Vol 4 (1981): 65-102.

Kiefer, Nicholas M., "Employment Contracts, Job Search Theory and an Empirical Model of Labor Turnover", Department of Economics, Cornell University (August 1984).

Killingsworth, Mark R., Labor Supply. New York: Cambridge University Press (1983).

__________, "A Simple Structural Model of Heterogenous Preferences and Compensating Wage Differentials" Unpublished paper, Rutgers University. (December 1984).

Lewis, H.G., "Employer Interests in Employee Hours of Work," Unpublished English version of "Interes del Empleador en las Horas de Tobajo del Empleado," Cuadernos de Economia 18 (1969): 38-54.

Lundberg, Shelly J., "Tied Wage-Hours Offers and the Endogeneity of Wages", NBER Working Paper No. 1431 (August 1984).

MaCurdy, Thomas, "An Empirical Model of Labor Supply in a Life Cycle Setting", Journal of Political Economy 89 (December 1981): 1059-1086.

__________, "A Simple Scheme for Estimating an Intertemporal Model of Labor Supply and Consumption in the Presence of Taxes and Uncertainty", International Economic Review 24 No. 2 (June 1983): 265-290.

Moffit, Robert, "The Tobit Model Hours of Work and Institutional Constraints", Review of Economics and Statistics (1982): 510-515.

__________, "The Estimation of a Joint Wage-Hours Labor Supply Model", Journal of Labor Economics 2 No. 4 (October 1984) : 550-566

Nadiri, M. Ishaq and Rosen, Sherwin, "Interrelated Factor Demand Functions",American Economic Review 59 (September 1969): 457-471

Nichell, Stephen, "Dynamic Models of Labour Demand", Centre For Labor Economics Discussion Paper No. 197, London School of Economics (July 1984) (forthcoming in O. Ashenfelter and R. Layard (eds.), Handbook of Labor Economics)

Pencavel, John, "Labor Supply of Men", (1984) (forthcoming in O. Ashenfelter and R. Layard (eds.) Handbook of Labor Economics).

Quinn, Robert P., and Staines, Graham., Quality of Employment Survey, 1973-1977: Panel, Institute for Social Research, University of Michigan, (1979).

Rosen, Sherwin, "On the Interindustry Wage and Hours Structure", Journal of Political Economy Vol. 77 (1969): 249-273.

__________, "Implicit Contracts Models---A Survey", Journal of Economic Literature Vol. 23 No. 3 (September 1985): 1144-1175.

Rosen, Harvey S., "Taxes in a Labor Supply Model with Joint Wage-Hours Determination", Econometrica Vol. 64 No. 3 (May 1976): 485-507.

Survey Research Center, A Panel Study of Income Dynamics: Procedures and Tape Codes 1981 Interviewing Year, Institute for Social Research, University of Michigan, Ann Arbor, Michigan. (1982).

Topel, Robert H., "Equilibrium Earnings, Turnover, and Unemployment", Journal of Labor Economics 2 No. 4 (October 1984) :500-522.

TABLE 1

Definitions, Means, and Standard Deviations of Variables. (Standard Deviations in parentheses)

Variable	Definition	PSID Males 1 Year Gap (k=1)	PSID Males 3 Year Gap (k=3)	Unmarried Fems, 1 Year Gap (k=1)	Unmarried Fems, 3 Year Gap (k=3)	Married Fems, 1 Year Gap (k=1)	OES Males 4 Year Gap (k=4)
ΔHours/Week	a) Change in ln(Hours/Week) Within and Across Jobs	.0021 (.21)	−.0004 (.20)	.0065 (.26)	.0076 (.23)	.0098 (.30)	−.0145 (.21)
	b) Change in ln(Hours/Week) Within Jobs (ΔH_{ijt})	.0014 (.44)	−.0025 (.44)	.0096 (.24)	.0067 (.21)	.0128 (.28)	−.0138 (.19)
	c) Change in ln(Hours/Week) Across Jobs($\Delta H'_{ijt}$)	.0062 (.52)	.0365 (.57)	−.0073 (.35)	.0221 (.42)	−.0087 (.36)	−.0169 (.28)
ΔWeeks/Year	a) Change in ln(Weeks/Year) Within and Across Jobs	.0050 (.28)	−.0015 (.21)	.0226 (.42)	.0069 (.31)	.0600 (.46)	
	b) Change in ln(Weeks/Year) Within Jobs(ΔH_{ijt})	−.0001 (.49)	−.0039 (.44)	.0233 (.38)	.0059 (.27)	.0477 (.44)	
	c) Change in ln(Weeks/Year) Across Jobs($\Delta H'_{ijt}$)	.0330 (.67)	.0408 (.62)	.0197 (.56)	.0226 (.61)	.1341 (.55)	
ΔHours/Year	a) Change in ln(Hours/Year) Within and Across Jobs	.0072 (.35)	−.0019 (.30)	.0292 (.53)	.0146 (.40)	.0697 (.55)	
	b) Change in ln(Hours/Year) Across Jobs(ΔH_{ijt}	.0013 (.56)	−.0064 (.53)	.0329 (.48)	.0126 (.36)	.0605 (.53)	
	c) Change in ln(Hours/Year) Across Jobs($\Delta H'_{ijt}$)	.03[illegible]3 (.73)	.0773 (.75)	.0124 (.69)	.0447 (.80)	.1254 (.66)	
EDUCATION	Year of Schooling	11.94 (3.18)	11.89 (3.32)	11.72 (2.72)	11.66 (2.81)	12.44 (2.25)	12.84 (2.88)
AGE	Age of individual	37.61 (10.8)	41.63 (10.01)	39.82 (11.60)	44.83 (10.05)	36.63 (10.6)	36.04 (10.7)
ΔMRD	Change in marital status MRD=1 if married, else 0.	.011 (.23)	.0031 (.26)				.0179 (.35)
ΔHEALTH	Change in health. HEALTH=1 if health limits ability to work	−.002 (.26)	.0041 (.28)	−.0018 (.30)	.0202 (.33)		.0429 (.33)
ΔOTINC	Change in (family income minus individual's labor income)	227.44 (4701.1)	842.73 (6351.1)	7.625 (2321.2)	35.74 (3180.6)	−81.77 (3884.6)	
SEPN	SEPN equals 1 if changed employer, else 0.	.1554 (.36)	.0534 (.22)	.1806 (.38)	.0620 (.24)	.1413 (.35)	.2392 (.43)
ΔUNION	Change in union membership. UNION=1 if union member,else 0.	.0070 (.32)	.0067 (.34)	.0117 (.27)	.0263 (.31)		.0286 (.35)
ΔUNEM	Change in annual hours of unemployment	−1.39 (254.7)	−2.48 (156.45)	−6.37 (345.1)	−3.22 (195.3)	−2.02 (311.4)	
Δw_{ijt}	Change in ln(Average Hourly Earnings)	.0326 (.38)	.0817 (.37)	.0325 (.40)	.0784 (.33)	.0189 (.40)	
$\Delta \ln(\text{EARNINGS}_{ijt})$	Change in ln(Annual Earnings)						.1602 (.35)
ΔKIDS	Change in number of children Younger than 18	.0312 (.87)	−.8525 (1.16)	−.0668 (.60)	−.2903 (.92)	−.0516 (.52)	
ΔKIDS<6	Change in a dummy which equals 1 if any kids are younger than 6 year old.	.0056 (.33)	−.0273 (.46)	.0020 (.22)	.0256 (.28)	−.0016 (.28)	

Table 2

Within and Across Job Variances in Changes in the Log of Hours/Week, Weeks/Year, and Hours/Year
Males - PSID & OES (Standard Errors in Parentheses)

	Unadjusted hours measures			Adjusted hours measures.[a] Not adjusted for hours of unemployment			Adjusted hours measures.[a] Includes adjustment for hours of unemployment		
	Var. Across Jobs	Var. Within Jobs	Difference	Var. Across Jobs	Var. Within Jobs	Difference	Var. Across Jobs	Var. Within Jobs	Difference
	$VAR(\Delta H^{j}_{ijt})$	$VAR(\Delta H_{ijt})$	$VAR(\Delta H^{j}_{ijt})-VAR(\Delta H_{ijt})$	$VAR(\Delta h^{j}_{ijt})$	$VAR(\Delta h_{ijt})$	$VAR(\Delta h^{j}_{ijt})-VAR(\Delta h_{ijt})$	$VAR(\Delta h^{j}_{ijt})$	$VAR(\Delta h_{ijt})$	$VAR(\Delta h'_{ijt})-VAR(\Delta h_{ijt})$
PSID 1 Year Gap (k=1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HOURS/WEEK	.0758 (.004)	.0361 (.002)	.0397 (.005)	.0710 (.004)	.0389 (.002)	.0321 (.004)	.0711 (.004)	.0389 (.002)	.0322 (.004)
WEEKS/YEAR	.1916 (.010)	.0564 (.003)	.1352 (.011)	.1963 (.010)	.0587 (.003)	.1376 (.010)	.0707 (.006)	.0361 (.002)	.0346 (.006)
HOURS/YEAR	.2765 (.012)	.0960 (.004)	.1805 (.012)	.2691 (.012)	.1058 (.004)	.1633 (.013)	.1400 (.007)	.0823 (.003)	.0577 (.008)
OBSERVATIONS	4428	24071		4428	24071		4428	24071	
3 Year Gap (k=3)									
HOURS/WEEK	.1064 (.015)	.0360 (.002)	.0704 (.015)	.1277 (.017)	.0411 (.002)	.0866 (.017)	.1215 (.014)	.0411 (.002)	.0804 (.014)
WEEKS/YEAR	.1496 (.026)	.0372 (.003)	.1124 (.026)	.1475 (.024)	.0370 (.003)	.1105 (.024)	.0986 (.019)	.0264 (.002)	.0722 (.020)
HOURS/YEAR	.3160 (.051)	.0779 (.004)	.2381 (.051)	.3175 (.050)	.0827 (.004)	.2348 (.050)	.2263 (.031)	.0705 (.004)	.1558 (.031)
OBSERVATION	742	13158		724	13158		742	13158	
5 Year Gap (k=5)									
HOURS/WEEK	.0947 (.007)	.0565 (.002)	.0382 (.007)	.0898 (.007)	.0547 (.002)	.0351 (.007)	.0885 (.007)	.0546 (.002)	.0339 (.007)
WEEKS/YEAR	.1227 (.012)	.0666 (.004)	.0561 (.013)	.1224 (.013)	.0665 (.004)	.0559 (.014)	.0755 (.010)	.0434 (.003)	.0321 (.010)
HOURS/YEAR	.2524 (.023)	.1384 (.006)	.1140 (.024)	.2451 (.023)	.1350 (.006)	.1101 (.024)	.1827 (.016)	.1070 (.005)	.0757 (.017)
OBSERVATIONS	2272	14143		2272	14143		22721	14143	
OES									
HOURS/WEEK	.0763 (.015)	.0346 (.006)	.0417 (.016)	.0539 (.010)	.0321 (.006)	.0218 (.011)			
OBSERVATIONS	67	213		67	213				

[a] The procedure used to adjust the hours measures for the effects of job specific variables is discussed in Section 3.2. For the PSID the job specific characteristics are changes in dummies for 1 digit occupation and union status, and the change in the wage as well as (for columns 7-9) the change in annual hours of unemployment. For the OES the job specific characteristics are changes in dummies for 1 digit occupation and union membership, the change in the log of annual earnings, and the changes in 17 variables related to job characteristics. The 17 variables include dummies for whether the job is dangerous, whether it provides daycare, whether the work is interesting, whether the physical conditions are good, in the individual learns a lot on the job, whether a training program is available, whether the worker is free to decide how to do tasks, whether promotion chances are good, whether job security is good, whether the work is steady, whether fringe benefits are good, whether the job gives paid vacation days and sick pay, whether the job requires hard work, and whether travel is convenient; also included are the change in average travel time, and the change in number of people working at the firm. The coefficients used to perform the adjustment are reported in Table A.1

TABLE 3

Estimates of Variances of the Changes in Hours
Controlling for Individual Heterogeneity
PSID Males. 3 Year Gap (k=3) (Standard Errors in Parentheses)*

	Average of Individual Cross-Job Variances	Average of Individual Within Job Variances	Difference ($\hat{y}$) column 1 - column 3
	$\frac{1}{I}\sum_{i=1}^{I} \hat{Var}_i(\Delta h'_{ijt})$	$\frac{1}{I}\sum_{i=1}^{I} \hat{Var}_i(\Delta h_{ijt})$	$\frac{1}{I}\sum_{i=1}^{I} \hat{Var}_i(\Delta h'_{ijt}) - \hat{Var}_i(\Delta h_{ijt})$
	(1)	(2)	(3)
HOURS/WEEK	.1233	.0418	.0815
	(.017)	(.004)	(.017)
WEEKS/YEAR	.1069	.0405	.0664
	(.029)	(.012)	(.030)
HOURS/YEAR	.2433	.0829	.1604
	(.047)	(.012)	(.047)
OBSERVATIONS	447	447	447

* $\hat{Var}_i(\Delta h'_{ijt})$ and $\hat{Var}_i(\Delta h_{ijt})$ are the sample variances of $\Delta h'_{ijt}$ and Δh_{ijt} for person i around the sample means of $\Delta h'_{ijt}$ and Δh_{ijt} computed over all time periods and individuals. I is the size of the subsample of individuals who had at least one observation on $\Delta h'_{ijt}$ and at least one observation Δh_{ijt}. I equals 447.

Table 4

Variance of the Log of Hours for Quits and Layoffs

PSID - Males; 3 Year Gaps (k=3)

(Standard errors in parentheses)[a]

	Variance Across Jobs $Var(\Delta H'_{ijt})$		Variance Within Jobs $Var(\Delta H_{ijt})$	(Variance Across Jobs - Variance Within Jobs) $Var(\Delta H'_{ijt})-Var(\Delta H_{ijt})$	
Unadjusted Hours Measures					
	Quits (1)	Layoffs (2)	(3)	Quits (4)	Layoffs (5)
Hours/Week	.1010 (.021)	.1092 (.021)	.0360 (.002)	.0650 (.021)	.0732 (.021)
Weeks/Year	.0715 (.014)	.2753 (.065)	.0372 (.003)	.0343 (.014)	.2381 (.065)
Hours/Year	.2049 (.054)	.4876 (.106)	.0779 (.004)	.1270 (.054)	.4097 (.106)
Observations	449	267	13158		
Adjusted Hours Measures (including adjustment for hours of unemployment)					
	Variance Across Jobs $Var(\Delta h'_{ijt})$		Variance Within Jobs $Var(\Delta h_{ijt})$	(Variance Across Jobs - Variance Within Jobs) $Var(\Delta h'_{ijt})-Var(\Delta h_{ijt})$	
	Quits	Layoffs		Quits	Layoffs
Hours/Week	.1167 (.018)	.1214 (.020)	.0411 (.002)	.0756 (.018)	.0803 (.020)
Weeks/Year	.0534 (.011)	.1596 (.048)	.0264 (.002)	.0270 (.011)	.1332 (.048)
Hours/Year	.1563 (.028)	.3150 (.067)	.0705 (.004)	.0858 (.028)	.2445 (.067)
Observations	449	267	13158		
Adjusted Hours Measures (including hours of unemployment). Employed at time of survey, t-2 [b].					
	Variance Across Jobs $Var(\Delta h'_{ijt})$		Variance Within Jobs $Var(\Delta h_{ijt})$	(Variance Across Jobs - Variance Within Jobs) $Var(\Delta h'_{ijt})-Var(\Delta h_{ijt})$	
	Quits	Layoffs		Quits	Layoffs
Hours/Week	.1142 (.019)	.1242 (.022)	.0407 (.002)	.0735 (.019)	.0835 (.022)
Weeks/Year	.0500 (.010)	.0976 (.028)	.0249 (.002)	.0251 (.010)	.0727 (.028)
Hours/Year	.1503 (.030)	.2510 (.053)	.0686 (.004)	.0817 (.030)	.1824 (.030)
Observations	421	203	13124		

[a]The procedure used to adjust hours measures for the effects of job-specific variables and annual hours of unemployment is described in Section 3.2 The job-specific characteristics used for adjustment are changes in dummies for 1-digit occupation, change in dummy for union membership and change in the log of average hourly earnings. The coefficients used to perform the adjustments are reported in Table A1.

[b]Restricting the sample to individuals employed at the time of the survey at t-2 means that all individuals in the sample who report a job change in the previous calendar year have obtained another job by the survey data. This ensures that the cross-job variance in weeks/year and hours/year is not due to spells of unemployment, spells out of the labor force, or spells "between jobs."

Table 5

Within and Across Job Variances in Hours
PSID - Married and Unmarried Females (standard errors in parentheses)

	Unadjusted hours measures			Adjusted hours measures.* Not adjusted for hours of unemployment			Adjusted hours measures. Includes adjustment for hours of unemployment		
	Var. Across Jobs $VAR(\Delta H_{i'jt})$	Var. Within Jobs $VAR(\Delta H_{ijt})$	Difference $VAR(\Delta H_{i'jt})-VAR(\Delta H_{ijt})$	Var. Across Jobs $VAR(\Delta h_{i'jt})$	Var. Within Jobs $VAR(\Delta h_{ijt})$	Difference $VAR(\Delta h_{i'jt})-VAR(\Delta h_{ijt})$	Var. Across Jobs $VAR(\Delta h_{i'jt})$	Var. Within Jobs $VAR(\Delta h_{ijt})$	Difference $VAR(\Delta h_{i'jt})-VAR(\Delta h_{ijt})$
UNMARRIED FEMALES 1 Year Gap (k=1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HOURS/WEEK	.1235	.0577	.0658	.1516	.0638	.0878	.1519	.0643	.0876
	(.014)	(.005)	(.015)	(.017)	(.005)	(.018)	(.017)	(.005)	(.018)
WEEKS/YEAR	.3191	.1454	.1737	.3173	.1429	.1744	.1760	.0949	.0811
	(.029)	(.011)	(.031)	(.029)	(.011)	(.031)	(.026)	(.009)	(.027)
HOURS/YEAR	.4817	.2304	.2513	.5136	.2344	.2792	.3551	.1821	.1730
	(.053)	(.018)	(.056)	(.055)	(.018)	(.058)	(.045)	(.016)	(.048)
OBSERVATIONS	979	4442		979	4442		979	4442	
3 Year Gap (k=3) HOURS/WEEK	.1780	.0458	.1322	.2779	.0471	.2308	.2917	.0470	.2447
	(.043)	(.004)	(.043)	(.052)	(.004)	(.052)	(.058)	(.004)	(.059)
WEEKS/YEAR	.3691	.0756	.2935	.4307	.0745	.3562	.2783	.0626	.2157
	(.098)	(.011)	(.099)	(.114)	(.011)	(.114)	(.090)	(.008)	(.090)
HOURS/YEAR	.6438	.1276	.5162	.6566	.1244	.5322	.5035	.1136	.3899
	(.149)	(.016)	(.150)	(.145)	(.015)	(.146)	(.142)	(.013)	(.143)
OBSERVATIONS	133	2013		133	2013		133	2013	
5 Year Gap (k=5) HOURS/WEEK	.2336	.0450	.1886	.2182	.0459	.1723	.2173	.0457	.1716
	(.059)	(.055)	(.059)	(.055)	(.005)	(.058)	(.053)	(.005)	(.053)
WEEKS/YEAR	.3300	.0756	.2544	.3595	.0764	.2831	.2439	.0540	.1899
	(.087)	(.018)	(.089)	(.094)	(.018)	(.096)	(.078)	(.009)	(.078)
HOURS/YEAR	.5710	.1281	.4429	.5897	.1327	.4570	.4819	.1123	.3696
	(.117)	(.019)	(.119)	(.122)	(.019)	(.123)	(.114)	(.013)	(.114)
OBSERVATIONS	180	1318		180	1318		180	1318	
MARRIED FEMALES 1 Year Gap (k=1) HOURS/WEEK	.1270	.0840	.0430	.9433	.0905	.8528	.9576	.0903	.8673
	(.031)	(.010)	(.032)	(.135)	(.009)	(.136)	(.142)	(.009)	(.142)
WEEKS/YEAR	.2994	.1925	.1069	.4837	.1841	.2996	.3744	.1569	.2175
	(.038)	(.020)	(.043)	(.046)	(.019)	(.050)	(.037)	(.017)	(.041)
HOURS/YEAR	.4341	.2819	.1522	2.2249	.2630	1.9619	2.1909	.2394	1.9515
	(.064)	(.025)	(.069)	(.265)	(.023)	(.266)	(.265)	(.021)	(.266)
OBSERVATIONS	359	2181		359	2181		359	2181	

* The method of adjusting hours measures is discussed in Section 3.2. For unmarried females, hours were adjusted for the effects of changes in 1 digit occupation dummies, change in a dummy for union membershipchange in the log of average hourly earnings, and (for columns 7-9) change in annual hours of unemployment. For married females, hours were adjusted for occupation and hourly earnings only, since data on union membership was unavailable. The coefficients used for adjustment are reported in Table A3.

Table A1

Equations for Change in the Log of Hours Used to Construct Adjusted Hours Measures Δh_{ijt} and $\Delta h^{!}_{ijt}$
PSID & QES — Males*
Weighted 2-stage least squares** (t-statistics in parentheses)

	PSID - 1 Year Gap (k=1)			PSID - 3 Year Gap (k=3)			QES-K=4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ΔHOURS/WEEK	ΔWEEKS/YEAR	ΔHOURS/YEAR	ΔHOURS/WEEK	ΔWEEKS/YEAR	ΔHOURS/YEAR	ΔHOURS/WEEK
EDUCATION	.0005 (.90)	.0003 (.51)	.0007 (.91)	.0006 (.68)	.0003 (.45)	.0009 (.76)	.0029 (.62)
AGE	.0005 (.47)	-.0005 (.46)	-.0001 (.07)	-.0010 (.45)	.0002 (.13)	-.0007 (.25)	-.0170 (1.69)
AGE^2	-.0000 (.43)	.0000 (.46)	.0000 (.09)	.0000 (.48)	-.0000 (.24)	.0000 (.20)	.0002 (1.59)
RACE	.0013 (.40)	-.0018 (.55)	-.0005 (.11)	-.0012 (.24)	.0032 (.71)	.0021 (.31)	
ΔMRD	-.0043 (.60)	.0020 (.27)	-.0024 (.22)	.0039 (.42)	.0169 (2.00)	.0209 (1.60)	-.0039 (.10)
ΔHEALTH	.0025 (.41)	-.0196 (3.16)	-.0174 (1.88)	-.0158 (1.93)	-.0116 (1.57)	-.0273 (2.240	-.0273 (.70)
ΔOTINC/100	-.0001 (1.50)	-.0004 (5.23)	-.0005 (4.58)	-.0002 (2.48)	-.0003 (4.00)	-.0004 (4.39)	
$\Delta OTINC^2/1000$	.0000 (1.07)	.0000 (2.56)	.0000 (2.51)	.0000 (.91)	.0000 (2.06)	.0000 (2.00)	
SEPN	.0104 (1.68)	.0019 (.31)	.0121 (1.37)	-.0142 (.60)	.0069 (.29)	-.0073 (.21)	-.0519 (1.42)
ΔUNION	.0140 (2.65)	.0089 (1.65)	.0229 (2.85)	.0050 (.72)	.0010 (.16)	.0060 (.62)	-.0840 (2.16)
SEPN x ΔUNION	-.0140 (1.01)	.0046 (.33)	-.0093 (.47)	-.0134 (.31)	.0140 (.32)	.0006 (.01)	
ΔUNEM/100	.0008 (.44)	-.0229 (12.82)	-.0221 (8.30)	-.0013 (.43)	-.0270 (9.81)	-.0283 (6.69)	
$\Delta UNEM^2/1000$	-.0000 (1.70)	-.0004 (27.67)	-.0004 (19.66)	-.0000 (.39)	-.0004 (15.82)	-.0004 (10.57)	
SEPN x ΔUNEM	-.0011 (.32)	-.0057 (1.59)	-.0068 (1.33)	.0128 (.83)	.0002 (1.56)	.0375 (1.67)	
SEPN x $\Delta UNEM^2$	.0000 (.16)	.0001 (2.33)	.0001 (1.73)	-.0002 (2.13)	-.0003 (2.34)	-.0005 (3.12)	
Δw_{ijt}	.0577 (1.74)	.0698 (2.06)	.1271 (2.52)	.0967 (2.91)	-.0258 (.86)	.0709 (1.54)	
$\Delta \ln(EARNINGS_{ijt})$							.1699 (3.89)
SEPN x ΔW_{ijt}	-.1429 (2.72)	-.0599 (1.13)	-.2023 (2.64)	.0355 (.31)	-.1065 (.93)	-.0709 (.44)	
DFF	13374	13374	13374	5843	5843	5843	242
R^2	.005	.45	.29	.009	.36	.21	.16

* Also included in equations 1-6 were: change in the number of kids, change in a dummy variable which equals 1 if any children are under the age of 6, changes in 1 digit occupation dummies, and nine change in occupation/change in job interactions. Also included in equation 7 were: the number of children under the age of 15 in 1977, the number of children under the age of 12 in 1973, the change in the number of children under the age of five, change in 1 digit occupation dummies, and the change in 17 variables relating to job characteristics. The 17 variables include dummies for whether the job is dangerous, whether it provides daycare, whether the work is interesting, whether the physical conditions are good, whether the individual learns a lot on the job, whether a training program is available, whether the worker is free to decide how to do tasks, whether promotion chances are good, whether job security is good, whether the work is steady, whether fringe benefits are good, whether the job gives paid vacation days and sick pay, whether the job requires hard work, and whether travel is convenient; also included are the change in average travel time, and the change in number of people working at the firm. The point estimates for these additional variables are reported in Table A2.

** See footnote 16 for a discussion of the first stage equations for Δw_{ijt} and SEPN x Δw_{ijt} in the estimation of columns 1-6. The weight for observations with and without job changes are equal to 1 over the square root of the estimated residual variances (from the unweighted estimates) of the hours equation for observations with job changes and for observations without job changes, respectively. Column 7 was estimated by weighted least squares.

Appendix Table A2

Change in Hours Equations — PSID & OES — Males
Variables not reported in Table A1 (t-statistics in parentheses)

VARIABLE	PSID k = 1 (1) ΔHOURS/WEEK	 (2) ΔWEEKS/YEAR	 (3) ΔHOURS/YEAR	PSID k = 3 (4) ΔHOURS/WEEK	 (5) ΔWEEKS/YEAR	 (6) ΔHOURS/YEAR
INTERCEPT	-.0206	.0019	-.0161	.0014	-.0129	-.0105
	(.90)	(.08)	(.46)	(.03)	(.31)	(.16)
Δ(KIDS)	.0004	-.0021	-.0019	-.0034	.0037	.0002
	(.15)	(.86)	(.52)	(1.31)	(1.59)	(.07)
Δ(KID<6)	.0059	-.0014	.0045	-.0030	.0028	-.0003
	(1.22)	(.27)	(.61)	(.56)	(.59)	(.03)
Δ(OCC1)	-.0061	-.0381	-.0443	.0133	-.0245	-.0112
	(.38)	(2.33)	(1.82)	(.61)	(1.23)	(.36)
Δ(OCC1)xSEPN	.0343	.0335	.0678	-.1142	.0593	-.0548
	(.88)	(.85)	(1.21)	(.82)	(.42)	(.27)
Δ(OCC2)	-.0055	-.0354	-.0410	.0134	-.0028	.0106
	(.37)	(.78)	(1.81)	(.65)	(.15)	(.37)
Δ(OCC2)xSEPN	.0692	.0298	.0990	-.0712	-.0160	-.0871
	(1.83)	(.78)	(1.82)	(.64)	(.14)	(.54)
Δ(OCC3)	-.0243	-.0106	-.0350	.0153	.0174	.0327
	(1.59)	(.68)	(1.51)	(.75)	(.94)	(1.15)
Δ(OCC3)xSEPN	.0530	.0252	.0782	-.1079	-.0653	-.1730
	(1.40)	(.66)	(1.44)	(.81)	(.48)	(.90)
Δ(OCC4)	-.0054	-.0218	-.0273	.0193	.0013	.0206
	(.37)	(1.47)	(1.23)	(.98)	(.07)	(.76)
Δ(OCC4)xSEPN	.0520	.0242	.0762	-.0917	-.0523	-.1439
	(1.48)	(.68)	(1.51)	(.82)	(.46)	(.89)
Δ(OCC5)	-.0046	-.0124	-.0171	.0127	.0038	.0166
	(.31)	(.83)	(.77)	(.64)	(.21)	(.60)
Δ(OCC5)xSEPN	.0445	.0124	.0569	-.1074	-.0184	-.1257
	(1.27)	(.35)	(1.13)	(.90)	(.15)	(.73)
Δ(OCC6)	-.0090	-.0154	-.0245	.0022	.0037	.0059
	(.60)	(1.00)	(1.07)	(.11)	(.20)	(.21)
Δ(OCC6)xSEPN	.0220	.0038	.0257	-.0942	-.0600	-.1541
	(.61)	(.10)	(.50)	(.80)	(.50)	(.90)
Δ(OCC7)	.0074	-.0266	-.0193	.0162	.0118	.0279
	(.43)	(1.52)	(.74)	(.68)	(.55)	(.84)
Δ(OCC7)xSEPN	-.0112	.0208	.0095	-.1235	-.0779	-.2013
	(.26)	(.49)	(.16)	(.91)	(.57)	(1.03)
Δ(OCC8)	-.1161	.0008	-.1165	-.1585	.0554	-.1030
	(2.76)	(.02)	(1.85)	(2.62)	(1.01)	(1.22)
Δ(OCC9)	.0126	.0060	.0185	.0054	.0052	.0106
	(.39)	(.18)	(.38)	(.10)	(.11)	(.14)
Δ(OCC9)xSEPN	.0324	-.0362	-.0039	-.1455	-.0093	-.1548
	(.46)	(.51)	(.04)	(.59)	(.04)	(.44)

VARIABLE	OES k = 3 (7) ΔHOURS/WEEK
INTERCEPT	.2532
	(1.32)
KIDS<15 (1977)	.0032
	(.25)
KIDS<12 (1973)	-.0161
	(.48)
Δ(KIDS<5)	-.0101
	(.60)
Δ(DANGEROUS)	.0091
	(.38)
Δ(DAYCARE)	-.1456
	(.99)
Δ(FRINGE BEN)	-.0086
	(.36)
Δ(FIRM SIZE)	-.0000
	(.76)
Δ(FREE TO DO TASKS)	.0082
	(.40)
Δ(WORK INTERESTING)	.0183
	(.74)
Δ(LEARN ON JOB)	.0354
	(1.52)
Δ(GOOD PHYSICAL CONDITIONS)	.0265
	(1.02)
Δ(GOOD PROMOTION CHANCE)	-.0104
	(.38)
Δ(JOB SECURITY)	-.0086
	(.39)
Δ(SICK PAY)	-.0098
	(.32)
Δ(STEADY WORK)	-.0450
	(.73)
Δ(TRAINING PROGRAM)	-.0188
	(.77)
Δ(TRAVEL CONVENIENT)	-.0005
	(.47)
Δ(TRAVEL TIME)	-.0022
	(.10)
Δ(PAID VACATION DAYS)	-.0073
	(.20)
Δ(WORK HARD)	-.0102
	(.40)
Δ(OCC2)	-.0233
	(.51)
Δ(OCC3)	-.0110
	(.16)
Δ(OCC4)	-.0064
	(.09)
Δ(OCC5)	.0281
	(.49)
Δ(OCC6)	-.0206
	(.34)
Δ(OCC7)	.0489
	(.65)
Δ(OCC8)	-.0364
	(.47)
Δ(OCC9)	-.0584
	(.28)
Δ(OCC10)	.0299
	(.33)

Table A3

Change in Hours Equations — PSID
Married and Unmarried Females (t-statistics in parentheses)
Weighted 2 Stage Least Squares*

	Unmarried Females k=1			Unmarried Females k=3			Married Females k=1		
VARIABLE	(1) ΔHOURS/WEEK	(2) ΔWEEKS/YEAR	(3) ΔHOURS/YEAR	(4) ΔHOURS/WEEK	(5) ΔWEEKS/YEAR	(6) ΔHOURS/YEAR	(7) ΔHOURS/WEEK	(8) ΔWEEKS/YEAR	(9) ΔHOURS/YEAR
INTERCEPT	-.0993 (1.89)	-.0556 (.89)	-.1560 (1.78)	-.0324 (.32)	-.0339 (.29)	-.0666 (.43)	.0973 (1.01)	.2027 (1.43)	.3004 (1.79)
EDUCATION	.0002 (.11)	.0003 (.15)	.0005 (.20)	-.001 (.85)	.0001 (.04)	-.0017 (.52)	-.0004 (.15)	-.0057 (1.36)	-.0074 (1.49)
AGE	.0057 (1.98)	.0020 (.64)	.0077 (1.79)	.0031 (.67)	.0020 (.36)	.0051 (.72)	-.0040 (.84)	-.0028 (.39)	-.0057 (.69)
AGE^2	-.0001 (2.07)	-.0000 (.49)	-.0001 (1.73)	-.0000 (.75)	-.0000 (.39)	-.0006 (.80)	.0001 (.83)	.0000 (.19)	.0001 (.49)
RACE	-.0050 (.60)	.0009 (.10)	-.0041 (.33)	-.0080 (.72)	-.0007 (.05)	-.0092 (.54)	-.0106 (.78)	-.0337 (1.66)	-.0518 (2.17)
Δ(KIDS)	.0059 (.74)	.0017 (.19)	.0073 (.61)	-.0137 (2.27)	.0120 (1.71)	-.0017 (.19)	-.0173 (1.37)	.0130 (.71)	-.0066 (.30)
Δ(KID<6)	-.0108 (.66)	.0014 (.08)	-.0089 (.36)	-.0020 (.12)	-.0022 (.11)	-.0013 (.05)	-.0237 (1.00)	.0010 (.03)	-.0324 (.78)
ΔOTINC/100	-.0005 (1.71)	-.0020 (5.91)	0.0025 (5.40)	-.0007 (2.52)	-.0007 (2.17)	-.0015 (3.31)	.0018 (4.67)	-.0005 (.77)	.0015 (2.19)
$\Delta(OTINC^2)/1000$	.0000 (.59)	.0000 (3.47)	.0000 (2.93)	.0000 (1.00)	.0000 (1.53)	.0000 (1.82)	-.0000 (5.07)	-.0000 (.61)	-.0000 (2.57)
SEPN	-.0125 (.75)	-.0106 (.65)	-.0231 (.99)	.0130 (.20)	.0277 (.47)	.0408 (.47)	-.1155 (.96)	.0447 (.51)	-.0715 (.36)
ΔUNION	-.0131 (.80)	.0148 (.84)	.0017 (.07)	-.0056 (.31)	.0240 (1.15)	.0182 (.67)			
ΔUNIONxSEPN	.1331 (2.75)	-.0368 (.79)	.0963 (1.43)	.0248 (.14)	.0192 (.12)	.0441 (.19)			
ΔUNEM/100	-.0004 (.08)	-.0110 (2.17)	-.0114 (1.61)	-.0055 (.77)	-.0152 (1.82)	-.0207 (1.90)	.0096 (1.45)	.0031 (.31)	.0013 (1.11)
$\Delta UNEM^2/1000$	-.0001 (2.27)	-.0005 (12.02)	-.0006 (10.08)	.0001 (.86)	-.0002 (2.99)	-.0002 (1.72)	-.0003 (.54)	-.0005 (6.33)	-.0005 (5.75)
SEPN x ΔUNEM/100	-.0019 (.20)	-.0166 (1.72)	-.0185 (1.34)	-.1309 (1.09)	.1717 (1.57)	.0407 (.25)	-.0952 (1.01)	-.0480 (.70)	-.1433 (.92)
SEPN x $\Delta UNEM^2/1000$	.0001 (1.38)	.0002 (2.46)	-.0003 (2.70)	.0006 (.92)	-.0001 (2.10)	-.0007 (.74)	.0008 (1.00)	.0004 (.70)	.0012 (.91)
ΔW_{ijt}	.0924 (1.25)	-.0515 (.65)	.0409 (.37)	.0393 (1.65)	-.1220 (1.74)	-.0824 (.90)	-.4919 (5.02)	-.0928 (.62)	-.5816 (3.40)
ΔW_{ijt} x SEPN	.0770 (.48)	.0067 (.04)	.0838 (.38)	.3741 (.54)	-.2346 (.38)	.1406 (.15)	2.1447 (1.33)	.9630 (.83)	3.1088 (1.16)

(continued on following page)

Table A3 (continued)

	Unmarried Females(k=1)			Unmarried Females(k=3)			Married Females (k=1)		
	(1) Hours/ Week	(2) Weeks/ Year	(3) Hours/ Year	(4) Hours/ Week	(5) Weeks/ Year	(6) Hours/ Year	(7) Hours/ Week	(8) Weeks/ Year	(9) Hours/ Year
ΔHEALTH	.0026	.0008	.0224	-.0047	.0218	.0171			
	(1.62)	(.06)	(1.07)	(.29)	(1.18)	(.71)			
ΔOCC1	-.0256	.0245	-.0010	.0275	-.0181	.0091	.0367	.2547	.2901
	(.54)	(.49)	(.01)	(.44)	(.25)	(.09)	(1.03)	(4.79)	(4.67)
SEPN x ΔOCC1	.0929	-.0190	.0738	-.5862	.4305	-.1560	-.1989	-.3085	-.5042
	(.74)	(.16)	(.42)	(.92)	(.75)	(.18)	(.98)	(1.99)	(1.50)
ΔOCC2	-.0751	.0078	-.0672	.0014	-.0107	-.0095	.0566	.1968	.2535
	(1.61)	(.16)	(.96)	(.02)	(.14)	(.10)	(1.55)	(3.60)	(3.97)
SEPNxΔOCC2	-.0957	-.0903	-.1860	-.1321	-.0060	-.1384	.0648	-.0975	-.0305
	(.77)	(.75)	(1.07)	(.29)	(.01)	(.23)	(.29)	(.58)	(.08)
ΔOCC3	-.0068	.0240	.0174	.0302	-.0121	.0179	.0526	.2425	.2944
	(.16)	(.54)	(.28)	(.53)	(.18)	(.21)	(1.80)	(5.54)	(5.75)
SEPNxΔOCC3	.0960	-.0453	.0507	-.3517	.1139	-.2383	-.0541	-.1233	-.1760
	(.81)	(.39)	(.31)	(.68)	(.24)	(.34)	(.32)	(.96)	(.63)
ΔOCC4	-.0378	.0776	.0397	.0206	.0124	.0328	.0381	.1229	.1613
	(.74)	(1.41)	(.52)	(.31)	(.16)	(.33)	(.64)	(1.39)	(1.56)
SEPN x ΔOCC4	.0014	-.0343	-.0329	-.2287	.3312	.1018	.7354	.3034	1.045
	(.01)	(.21)	(.14)	(.32)	(.51)	(.11)	(.78)	(.45)	(.67)
ΔOCC5	-.0053	.0611	.0558	.0028	-.0342	-.0372	.0600	.0915	.1517
	(.11)	(1.19)	(.77)	(.05)	(.48)	(.40)	(1.46)	(1.49)	(2.12)
SEPN x ΔOCC5	.1262	.0003	.1265	-.1079	.0571	-.0513	-.4305	-.2068	-.6374
	(1.00)	(.00)	(.72)	(.21)	(.12)	(.07)	(1.22)	(.80)	(1.09)
ΔOCC6	-.0454	.0941	.0488	-.0278	-.0165	-.0445	-.0842	-.0759	-.1598
	(.98)	(1.83)	(.68)	(.47)	(.24)	(.50)	(1.48)	(.89)	(1.61)
SEPN x ΔOCC6	.2639	-.0791	.1847	-.1055	-.0245	-.1303	.1164	.0788	.2013
	(2.04)	(.63)	(1.02)	(.21)	(.05)	(.20)	(.31)	(.28)	(.33)
ΔOCC7	-.0684	.0462	-.0222	-.0143	-.0510	-.0653	.0733	.2877	.3601
	(1.46)	(.92)	(.32)	(.24)	(.74)	(.73)	(2.04)	(5.34)	(5.72)
SEPN x ΔOCC7	.1241	-.0168	.0173	.0466	-.0379	.0086	-.0594	-.1931	-.2512
	(1.00)	(.14)	(.62)	(.09)	(.08)	(.01)	(.28)	(1.23)	(.73)
DFE	2759	2759	2759	1071	1071	1071	1999	1999	1999
R^2	.027	.38	.27	.033	.19	.13	.04	.18	.15

*The weights for observations with and without job changes are equal to the inverse of the square root of the estimated residual variances for observations with and without job changes.

TABLE A4

Average Absolute Deviations from the Mean of the Change in the Log of Unadjusted Hours Measures *
Within and Across Jobs
PSID - Males, Married and Unmarried Females
Standard Errors in Parentheses

	1 Year Gaps (k=1)			3 Year Gaps (k=3)		
	Average Absolute Deviations from Mean of Hours Changes Across Jobs	Average Absolute Deviations from Mean of Hours Changes Within Jobs	Difference (column 1 - column 2)	Average Absolute Deviations from Mean of Hours Changes Across Jobs	Average Absolute Deviations from Mean of Hours Changes Within Jobs	Difference (column 4 - column 5)
	(1)	(2)	(3)	(4)	(5)	(6)
MALES						
Hours/Week	.1629 (.003)	.0941 (.001)	.0688 (.003)	.1962 (.010)	.0992 (.001)	.0970 (.010)
Weeks/Year	.2495 (.005)	.0888 (.001)	.1607 (.005)	.1738 (.013)	.0766 (.002)	.0972 (.013)
Hours/Year	.3384 (.006)	.1558 (.002)	.1826 (.006)	.3155 (.017)	.1506 (.002)	.1649 (.017)
Observations	4428	24071		742	15138	
UNMARRIED FEMALES						
Hours/Week	.1856 (.010)	.1044 (.003)	.0812 (.010)	.2598 (.030)	.1014 (.004)	.1584 (.030)
Weeks/Year	.3466 (.014)	.1636 (.005)	.1830 (.015)	.2979 (.050)	.1145 (.006)	.1834 (.050)
Hours/Year	.4393 (.017)	.2303 (.006)	.2090 (.018)	.4822 (.060)	.1831 (.007)	.2991 (.060)
Observations	979	4442		133	2146	
MARRIED FEMALES						
Hours/Week	.1822 (.016)	.1309 (.006)	.0513 (.017)			
Weeks/Year	.3618 (.022)	.2004 (.008)	.1614 (.023)			
Hours/Year	.4369 (.026)	.2797 (.010)	.1572 (.028)			
Observations	359	2181				

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*Average Absolute Deviations from the Mean of Hours Changes Across Jobs is measured as: $\text{Mean}|\Delta H'_{ijt}-\text{Mean}(\Delta H'_{ijt})|$
Average Absolute Deviations from the Mean of Hours Changes Within Jobs is measured as: $\text{Mean}|\Delta H_{ijt}-\text{Mean}(\Delta H_{ijt})|$

Table A5

Within and Across Job Variances in Actual Hours (Non-Log)

Unadjusted Hours Measures

PSID - Males, Married and Unmarried Females

(Standard Errors in parentheses; $\underline{H}_{ijt} = \exp(H_{ijt})$]

	1 Year Gaps (k=1)			3 Year Gaps (k=3)		
	Variance Across Jobs $Var(\Delta\underline{H}'_{ijt})$	Variance Within Jobs $Var(\Delta\underline{H}_{ijt})$	Difference $Var(\Delta\underline{H}'_{ijt})-Var(\Delta\underline{H}_{ijt})$	Variance Across Jobs $Var(\Delta\underline{H}'_{ijt})$	Variance Within Jobs $Var(\Delta\underline{H}_{ijt})$	Difference $Var(\Delta\underline{H}'_{ijt})-Var(\Delta\underline{H}_{ijt})$
	(1)	(2)	(3)	(4)	(5)	(6)
Males						
Hours/Week	132.79 (4.93)	60.62 (1.28)	72.17 (5.09)	161.13 (12,71)	65.74 (1.88)	95.39 (12.84)
Weeks/Year	152.05 (4.57)	43.91 (1.08)	108.14 (4.70)	107.76 (10.83)	35.63 (1.27)	72.13 (10.88)
Hours/Year	553,267 (15,760)	213,893 (3,872)	339,374 (16,229)	558,491 (38,629)	224,886 (5,716)	333,605 (39,040)
Observations	4428	24071		742	13158	
Unmarried Females						
Hours/Week	110.52 (9.85)	45.92 (2.58)	64.60 (10.18)	141.34 (23.05)	43.26 (3.29)	98.08 (23.30)
Weeks/Year	206.96 (10.98)	88.27 (4.01)	118.69 (11.69)	199.14 (38.90)	57.48 (4.40)	144.66 (39.10)
Hours/Year	482,092 (28,622)	228,622 (8,830)	253,470 (29,953)	557,162 (76,759)	168,096 (9,574)	389,066 (77,354)
Observations	979	4442				
Married Females						
Hours/Week	80.38 (10.93)	45.33 (3.12)	35.05 (11.36)			
Weeks/Year	218.87 (19.02)	106.10 (6.35)	112.77 (20.05)			
Hours/Year	407,167 (35,907)	226,726 (12,098)	180,441 (37,890)			
Observations	359	2181				

Table A6

Average Absolute Deviations from Means of Actual Hours Changes (Non-Log)

Unadjusted Hours Measures

PSID - Males, Married and Unmarried Females

[Standard errors in Parentheses: $\underline{H}_{ijt} = \exp(H_{ijt})$]

	1 Year Gaps (k=1)			3 Year Gaps (k=3)		
	Average Absolute Deviations From Means of Cross-Job Changes in Actual Hours Mean$\lvert\Delta\underline{H}'_{ijt}$ -Mean$(\Delta\underline{H}'_{ijt})\rvert$	Average Absolute Deviations From Means of Within-Job Changes in Actual Hours Mean$\lvert\Delta\underline{H}_{ijt}$ -Mean$(\Delta\underline{H}_{ijt})\rvert$	Difference (Column 1 - Column 2)	Average Absolute Deviations From Means of Cross-Job Changes in Actual Hours Mean$\lvert\Delta\underline{H}'_{ijt}$ -mean$(\Delta H'_{ijt})\rvert$	Average Absolute Deviations From Means of Within-Job Changes in Actual Hours Mean$\lvert\Delta\underline{H}_{ijt}$ -Mean$(\Delta\underline{H}_{ijt})\rvert$	Difference (Column 1 - Column 2)
	(1)	(2)	(3)	(4)	(5)	(6)
Males						
Hours/Week	7.20 (.13)	4.21 (.04)	2.98 (.14)	8.40 (.35)	4.56 (.06)	3.84 (.36)
Weeks/Year	8.25 (.14)	3.29 (.04)	4.96 (.15)	5.72 (.32)	3.04 (.04)	2.68 (.32)
Hours/Year	542.79 (7.64)	287.39 (2.33)	255.40 (7.99)	529.81 (19.33)	298.58 (3.21)	231.23 (19.59)
Observations	4428	24071		742	13158	
Unmarried Females						
Hours/Week	6.02 (.28)	3.31 (.09)	2.71 (.29)	8.03 (.76)	3.31 (.13)	4.72 (.77)
Weeks/Year	10.34 (.32)	5.07 (.12)	5.27 (.34)	8.49 (.98)	4.12 (.14)	4.37 (.99)
Hours/Year	511.15 (15.03)	277.25 (5.50)	233.90 (16.00)	539.70 (44.90)	258.61 (7.09)	281.09 (44.50)
Observations	979	4442		133	2146	
Married Females						
Hours/Week	5.36 (.38)	3.57 (.12)	1.79 .40			
Weeks/Year	10.90 (.53)	5.82 (.18)	5.08 .56			
Hours/Year	481.45 (22.10)	300.74 (7.91)	180.71 (23.50)			
Observations	359	2181				