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Abstract

Multiple job-holding is a significant characteristic of the labor market, with approximately 6 percent of all employed males reporting a second job in 1993 (Mishel and Bernstein, 1995, p. 226). Moonlighting reflects growing financial stress arising from declining earnings, as well as an increased need for flexibility to combine work and family. Approximately 40 percent of moonlighters report taking the second job due to economic hardship. Additionally, moonlighting is a reflection of the worker's choice to pursue entrepreneurial activities while maintaining the financial stability offered by the primary job.

To restate in economic terminology, moonlighting arises from at least two distinct reasons. First, many individuals hold multiple jobs due to some sort of constraint on the primary job that limits that job's earnings capacity. Second, moonlighting may arise because the labor supplied to the two jobs are not perfect substitutes. That is, the wage paid and utility lost from the forgone leisure may not completely reflect the benefits and costs to working. For example, working on the primary job may provide the worker with the credentials to acquire a higher paying second job, such as a university psychologist testifying in a jury trial. Or, working on the second job may provide some satisfaction not received in the same amount or manner from the primary job, such as a comedian who has a "regular" job by day and performs at night. In either example, the costs and benefits of both jobs are more complex than the monetary wages paid and the forgone value of leisure. When faced with such nonpecuniary benefits and costs, optimizing behavior may lead a worker to take two jobs. In contrast to workers who moonlight because they are constrained on their primary jobs (PJ), we expect these kinds of moonlighters to moonlight for longer periods of time because optimizing behavior leads them to supply labor to more than one job, even in the long run. We might also expect to see smaller wage differences between jobs for such workers and the second job (SJ) wage could even be higher than the primary job wage in some situations.

Previous research on moonlighting, including Shishko and Rostker (1976), O'Connell (1979) and Krishnan (1990), acknowledges that multiple motives may exist but focuses only on the constraint motive. In related studies, Paxson and Sicherman (1994) explore moonlighting as an alternative avenue for adjusting short-run labor supply, and Abdukadir (1992) examines the possibility that moonlighting is caused by short-term liquidity constraints. Another possible motivation for moonlighting is that certain types of job situations present greater opportunities for tax evasion. Plewes and Stinson (1991) provide survey evidence from the 1989 Current Population Survey of the many distinct reasons for moonlighting reported by workers. The only research in the moonlighting literature that models the joint motives for moonlighting correctly while controlling for the endogeneity of primary job hours are Lilja (1991) and Conway and

Kimmel (1994).[1] The latter improves upon Lilja (1991) by specifying a more plausible utility maximizing model and developing a superior instrument for PJ hours.

This research examines the characteristics of moonlighters and the length of their moonlighting episodes with the goal of understanding who moonlights and why. The data are for prime-aged men and are drawn from the 1984 Survey of Income and Program Participation (SIPP) panel. The primary advantages of the SIPP are the detailed information provided on up to two jobs (including job start and end dates) and the relatively short length of time (four months) covered by each interview of the survey. Both of these qualities make it possible to identify brief (as well as long) periods of moonlighting, movements into and out of jobs, and the characteristics associated with each job. Because moonlighting may be motivated by short-term financial needs, being able to observe short moonlighting durations is important.

We begin by studying the personal and job-related characteristics of moonlighters and how the length of the moonlighting episode varies with these characteristics. We then estimate a duration model with unobserved heterogeneity to identify formally the determinants of moonlighting behavior when multiple motives may exist. Our expectation is that individuals who moonlight because they are constrained on their primary jobs might do so for shorter periods than those who are "job-packaging." Therefore, the hazard rate for workers who moonlight because of primary job constraints should be greater than for those with alternative motives, ceteris paribus. The mixed hazard function will vary as the composition of the sample changes with the duration of the moonlighting episode. By exploring the importance of heterogeneity and the direction of duration dependence of the mixed and structural hazard functions, we gain new insights into the determinants of moonlighting behavior.

The descriptive analyses reveal that most moonlighters in our sample work fulltime on their primary jobs and 15 to 20 hours a week on lower paying second jobs, and, in spite of those long hours, tend to be poorer than the average worker. Yet, a significant minority earns a higher wage on their second job. Our duration model results suggest that the structural hazard increases over time and there is significant unobserved heterogeneity. Taken together, these results are consistent with the presence of multiple motives for moonlighting, with the constraint motive being the most common.

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[1]Regets (1991), Lakhani (1994), and Mehay (1991) investigate a closely related issue, whether serving in the military reserves is moonlighting in the usual sense or is instead a case of compensated leisure.

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I. Moonlighting Trends and Data Description

Despite the importance of moonlighting to workers in today's economy, little comprehensive descriptive information exists in the economics literature. Two notable exceptions are Paxson and Sicherman (1994) and Levenson (1995). However, the former relies on data from the Panel Study of Income Dynamics (PSID), which the authors themselves acknowledge is less than ideal because the specific survey questions make it unclear whether the jobs were held simultaneously or sequentially, and many of the survey responses to critical moonlighting questions are missing or unreported (Paxson and Sicherman, 1994, pp. 3-4). Also, because the PSID is an annual survey, it may miss short moonlighting episodes. Levenson (1995) focuses mainly on the links between moonlighting and part-time employment trends and therefore has little to say about the different motivations for moonlighting.

While only 6 percent of workers report holding two or more jobs at any given time in recent years, a much larger percentage moonlights at some time in their working lives. According to Paxson and Sicherman, over half of men who work continuously moonlight at some point in their working lives. Moonlighting rates peak for workers in their 30's and 40's, perhaps due to some combination of the financial burdens of raising children, purchasing a home, and saving for college. (Unpublished BLS data summarized in Kimmel, 1995) Or, the demands of family may lead workers to increase the flexibility of their work schedules through "job-packaging." Workers in this age group are also more likely to have the work experience and credentials to enjoy some of the nonwage benefits of moonlighting mentioned earlier.

The steadiness in male moonlighting rates in the past 25 years, combined with the increase in labor force participation for wives, suggests that workers are facing growing financial pressures.[2] Real wages for men with a high school education or less have fallen nearly 30 percent in the past two decades, while real home prices and rental rates have risen 20 percent and 13 percent, respectively, during the same period. Additionally, real wages for higher-educated workers have remained stagnant. (*The State of America's Children*, 1994)

Many of these broader moonlighting trends are reflected in the data set used in this paper's empirical analyses. These data are drawn from the 1984 Panel of the Survey of Income and Program Participation, a nationally representative panel survey data set that contains detailed job information for up to two jobs in each four-month survey period or "wave." Included in the job details are specific job start and stop dates, which are used to identify the precise starting and stop

[2]Krishnan (1990) investigates the empirical relationship between moonlighting by the primary earner and the labor supply decisions of the spouse.

dates of each moonlighting episode.[3] The data are restricted to prime-aged men who work continuously throughout the three-year panel, yielding a sample of 203 moonlighting males.[4]

Two problems are encountered in undertaking a study of this kind. The first problem arises because individual and job characteristics may change over the course of the moonlighting episode. Because our data are observed in four-month intervals, a particular moonlighting episode may span several waves and the characteristics may change during the episode. For instance, the wage on the primary job may be different in the last wave of the episode from that in the first. Our duration model described in the next section takes account of this problem by permitting time-varying covariates.

In our descriptive analysis, however, the solution is not so straightforward. We must choose a unit of measurement—one observation per moonlighting wave, per moonlighting episode, or per moonlighting individual. Using the wave-level observation describes the typical moonlighter more accurately at a given point in time, but it weights the analysis more heavily towards longterm moonlighters.[5] Using this measure may skew our analysis towards those workers who moonlight for reasons other than the constraint motive. If we choose the episode or individual as our unit of measurement (the two will only differ for the people who have more than one episode), we must decide how to assign variable values for the entire episode. This measure more accurately describes the qualities of individuals who moonlight at some point during the panel, and weights all moonlighters equally, regardless of the length of their episode. Thus, for some of the analyses it makes sense to use the wave as the unit of measurement, while for others the episode is the more logical choice. The unit of measurement is listed at the bottom of each table, and the variable values are from the first wave of the episode when the episode is the unit of measurement. Our total sample consists of 203 individuals, 261 episodes, and 586 observations/waves.

The second problem is that some individuals were moonlighting when the survey began and others were still moonlighting when the survey ended. These individuals are typically referred to as having left-censored and right-censored episodes, respectively. [The reported job start dates do not precede the beginning the survey, making it impossible to identify the beginning

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[3]A potential source of error is that persons with brief periods of nonemployment during a wave may have their weeks employed overstated because of misreported or misleading job start and end dates in the SIPP's monthly records. Extensive data checks confirmed that the possibly overstated hours of work (and therefore understated imputed wages) for persons briefly without jobs is of no empirical importance to our results. We thank Theresa Devine for bringing this subtlety of the SIPP's monthly records to our attention.

[4]We restrict our sample to those who moonlight at least five days because shorter episodes are more likely job changes. We also exclude self-employed workers from our sample because their wage reflects the returns to both their labor and capital. Thus, the marginal wage received from working one more hour is nearly impossible to measure.

[5]For instance, the characteristics of a person who held two jobs for three years would enter into the calculation of the sample means nine times (a three-year episode would span nine four-month intervals), whereas the characteristics of a person who held two jobs for three months would enter into the calculation only once.

of a left-censored episode.] These individuals only pose a problem when we examine the length of the moonlighting episode because this variable is measured with error and is biased downward. For instance, an individual who moonlights continuously for the entire panel is both left- and right-censored in our data and has a reported episode length of three years—the entire length of the panel. On the other hand, the individual's personal and job-related characteristics should be valid. Twenty-one percent of our observations involve a left-censored episode (affecting 54 individuals), while the same percent involve a right-censored episode. Only nine individuals are both left- and right-censored.

In section II we focus on the length of the episode by constructing and estimating a duration model. Whereas duration models are designed to deal with the problem of censoring, the presence of time-varying covariates requires that we omit left-censored episodes.[6] This selection yields a sample of 149 moonlighters, 207 episodes and 388 observations/waves. Therefore, in order for our descriptive analysis to be comparable to our duration model results, we report the results for the moonlighting sample both with and without left-censored episodes. When the focus of the descriptive analysis is on the length of the moonlighting episode, we report results both with and without left- **or** right-censored episodes because either type has a mismeasured episode length.

A. Who Moonlights?

Variable definitions are given in Figure 1 and means are given in Table 1. The table shows means for the full sample of moonlighters, plus the subsample that omits left-censored episodes and is used in estimating the hazard functions. This table also provides means for a male comparison group (also from the 1984 SIPP panel) that does not stratify on moonlighting status. This comparison group permits us to study the differences between male moonlighters and the overall male labor force, thereby shedding additional light on the characteristics of moonlighters and the possible motivations for moonlighting.

Table 1, Part A reports the demographic characteristics of the moonlighters. Here we choose the individual as the unit of measurement because these variables do not vary much over the course of the moonlighting episode or across episodes. The typical moonlighter is 33 years old and has 13.5 years of education. Nearly 75 percent are married, and on average have more than one child in the family. Forty percent have children under the age of 6 in the family, and 11 percent are nonwhite. Very few (3 percent) report having a physical problem that makes it difficult to work. Finally, see that nonlabor income is, on average, relatively high. This reflects the selection of the sample on males who work continuously for the duration of the panel. In general, moonlighters tend to be a little younger, slightly better educated, have more children, and are more likely to be single than the comparison group of male workers.

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[6]We discuss this issue further in Section II.

Figure 1
Variable Definitions

AGE:	individual's age in years.
YRSEDUC:	number of completed years of education.
NUMKIDS:	total number of children in the household.
KIDSLT6:	0-1 dummy for the presence of children $<$ 6 in household.
MARRY:	0-1 dummy which equals 1 if married with spouse present.
NONLABY:	individual's total nonlabor income for the wave, including all household income minus own earned income and work-tied transfers.
UNEMPL:	state monthly unemployment rate.
PJWAGE:	hourly wage on the primary job.
SJWAGE:	hourly wage on the secondary job.
SUMMER:	0-1 dummy, equals 1 if episode started in summer.
SPRING:	0-1 dummy, equals 1 if episode started in spring.
WINTER:	0-1 dummy, equals 1 if episode started in winter.
EPISODE:	a counter for the individual's moonlighting episode, equals 1 for his first episode, etc.
LNTIME:	natural logarithm of the moonlighting duration measured in days.
DELTA:	0-1 dummy, equals 1 if the moonlighting episode is right or left censored.
PJCLERIC:	primary job occupation: administrative support
PJLABOR:	primary job occupation: farming, labor.
PJMANAGE:	primary job occupation: managerial.
PJOCRAFT:	primary job occupation: precision production, craft, or repair.
PJOPTIV:	primary job occupation: machine operators, transportation.
PJPRTECH:	primary job occupation: professional or technical occupations.
PJSALES:	primary job occupation: sales.
PJSERVWK:	primary job occupation: service.
LOGPJHRS:	natural logarithm of primary job hours for the four-month interview period

Table 1
Variable Means

A. Demographic Characteristics

Variables	Moonlighting Individuals: Full[1]	Moonlighting Individuals: Exclude Left-Censored[2]	Comparison Group[3]
# observations	203	149	1832
AGE	33.21	33.03	35.58
YRSEDUC	13.54	13.31	13.14
NUMKIDS	1.09	0.98	0.91
KIDSLT6	0.40	0.32	0.26
MARRIED	0.73	0.72	0.75
DIVORCED	0.06	0.07	0.07
SINGLE	0.21	0.21	0.18
NONWHITE	0.11	0.09	0.10
SICK	0.03	0.03	0.04
NONLABY	4042.67	4253.39	3909.18

[1]Includes first wave observation from first moonlighting episode.
[2]Estimating Sample: Includes same as above, but excludes episodes that begin prior to start of panel.
[3]Comparison sample of men from same panel survey, with moonlighters and non-moonlighters; includes first observation per individual.

B. Primary Job Characteristics

Variables	Moonlighting Individuals: Full[1]	Moonlighting Individuals: Exclude Left-Censored[2]	Comparison Group[3]
# observations	586	388	16488
PJWAGE	9.05	8.29	10.12
PJ Weekly Hours	40.38	40.49	43.06
PJCLERIC	0.11	0.08	0.07
PJLABOR	0.04	0.05	0.07
PJMANAGE	0.14	0.16	0.16
PJOCRAFT	0.14	0.16	0.22
PJOPTIV	0.11	0.12	0.18
PJPRTECH	0.19	0.14	0.15
PJSALES	0.07	0.06	0.09
PJSERVWK	0.19	0.23	0.07

[1]Unit of measurement is the wave.
[2]Estimating sample: as above but excludes left-censored observations.
[3]Comparison sample: includes each observation for all individuals.

C. Secondary Job Characteristics for Moonlighters

Variables	Full Sample[1]	Exclude Left-Censored[2]
# observations	586	388
SJWAGE	6.61	6.42
SJ Weekly Hours	17.47	19.75
WINTER	0.17	0.23
SPRING	0.15	0.20
SUMMER	0.44	0.24
FALL	0.24	0.32
SJCLERIC	0.06	0.06
SJLABOR	0.12	0.12
SJMANAGE	0.09	0.09
SJOCRAFT	0.07	0.09
SJOPTIV	0.06	0.07
SJPRTECH	0.13	0.15
SJSALES	0.18	0.15
SJSERVWK	0.27	0.27

[1]Unit of measurement is the wave.
[2]Unit of measurement is the above, but excludes left-censored observations.

Table 1, Parts B and C report the primary job and secondary job characteristics. Because these characteristics do change during the moonlighting episode, we choose the wave as our unit of measurement. We define the primary job as the one for which the individual receives the highest earnings.[7] The wage measures are the reported earnings for the job divided by the reported hours. The average primary job wage is nearly 50 percent higher than the average secondary job wage, at $9.05 an hour versus $6.61 an hour. However, almost 25 percent of the sample received a higher wage on their second job. This suggests that while the "university professor who consults" model of moonlighting is important, it is not the most common. Average weekly hours worked on the primary job are 40.38, while average weekly hours on the second job are 17.47. The typical moonlighter therefore works full time on the primary job and moonlights on a lower paying, part-time job, a portrait consistent with the constraint motive for moonlighting. This conclusion is reinforced when we examine the comparison group. Moonlighters in general earn a lower wage and work fewer hours on the primary job than the average worker, again suggesting that financial need is the impetus for moonlighting.

The most common primary job occupations for moonlighters are service work (19 percent of all moonlighters), professional/technical occupations (19 percent), production and crafts (14

[7]Defining the PJ as the one with the highest hours worked affects only 4.1 percent of the observations.

percent), and managerial occupations (14 percent). The most common moonlighting occupations are again service work occupations (27 percent), sales (18 percent), and professional or technical occupations (13 percent). And, approximately 37 percent of the moonlighting episodes are in jobs for which the primary job and secondary job occupations are the same. Compared to the average worker, moonlighters are much more likely to hold primary jobs in a service occupation and are less likely to be in production, craft or repair occupation (PJCRAFT) or be a machine operator or work in transportation (PJOPTIV). This suggests that if the service sector continues to grow, as predicted, then so too may the proportion of workers who moonlight.

All of these results point to financial need as the motive for moonlighting. To further investigate this, Table 2 shows the relationship between working two jobs and poverty status. Again, because household income changes during the moonlighting episode, the wave is the unit of measurement. Based on government standards for poverty status (corresponding to the same time period as the data), column 1 shows the percentage of individuals with household income at four different poverty levels: below the poverty threshold, between one and two times the poverty line, between two and three times the poverty line, and greater than three times the poverty line. Column 2 repeats this percentage using a measure of household income that excludes earnings from the moonlighting job. Column 3 repeats the same percentages for the comparison group of male workers. However, earnings from both jobs are an endogenous outcome of utility maximizing behavior, so that workers who are "job-packaging" may appear poor if only one job is considered. In other words, job-packagers may have been able to earn more on their primary job had they not chosen to take a secondary job. To address this endogeneity, we also report these poverty figures for the large subgroup of moonlighters who work fulltime (35 hours or more per week) on their primary jobs. Most moonlighters are in this subgroup, and their poverty rates for the different categories are quite similar to the rates for the full moonlighting group.

This table provides a rough picture of the percentages of workers who change their poverty level status by taking a second job. As the table reveals, earnings from the second job have a significant impact on poverty level status. Overall, poverty rates are very low in this sample because it is comprised of men who work continuously on at least one job for the entire panel. Still, the percent of the sample in poverty doubles if the income from the second job is taken away. And the percentage that is below two times the poverty threshold rises from approximately 17 percent to almost 25 percent. In total, 35 percent change poverty level status when earnings from the second job are excluded. Note also that, with the exception of those below the poverty threshold, moonlighters as a group are poorer than the comparison group, with or without the earnings from the second job. Thus, even though they are working a second job and working significantly longer total hours, moonlighters are still poorer than the average worker. All of this evidence points to the constraint motive as the most common reason for moonlighting.

Table 2
Poverty Status and Moonlighting*

Poverty Level	Full HH Income		HH Income less SJ Income		Comparison Group[3]
	Full[1]	FT on PJ[2]	Full[1]	FT on PJ[2]	
Sample:					
< Threshold	1%	0.4%	2.0%	1.3%	2.0%
Between 1 and 2 Times Threshold	16.7	16.2	22.9	22.4	12.2
Between 2 and 3 Times Threshold	25.0	24.5	27.7	27.3	21.5
> 3 Times Threshold	57.3	58.9	47.4	49.0	63.8

* Numbers in table are percentages and reflect percent of relevant sample in each poverty status category.
[1]Includes all moonlighting observations (586 observations).
[2]Sample as above but includes only those individuals working 35 or more hours per week on primary job (531 observations).
[3]Comparison sample of men from same panel survey, with moonlighters and non-moonlighters; includes all observations in this sample (16,488 observations).

B. How Long do People Moonlight?

We believe the length of the moonlighting episode differs depending upon the motive for moonlighting—individuals who moonlight due to constraints should do so for shorter periods of time than those with alternative motives. We also expect the wage on the primary job to be higher than that on the second job if the constraint motive is the primary reason for moonlighting. Table 3 shows figures for the average moonlighting duration (in days), and primary and secondary job wages and weekly hours for a variety of different subgroups of the full moonlighting sample. The unit of measurement is the episode. The final column of the table shows the average moonlighting duration for a sample that excludes both left and right censored episodes, since the duration is mismeasured for these observations. However, by omitting these episodes we are likely excluding those with the longest durations. By analyzing the relationship between these characteristics and the duration of the episode, we can evaluate our hypothesis.

Divorced men have the longest moonlighting duration with and without the censored episodes (259 and 144 days), but the married group is close (244 and 127 days) and far more significant given its much larger size. Having children in the household is associated with a

Table 3
Moonlighting Duration and PJ and SJ Wages and Hours

Group [# obs]	Full Moon Sample[1] DURATION (s. dev.)	PJWAGE	SJWAGE	PJHOURS	SJHOURS	Non-censored[2] DURATION (s. dev.)	[# obs]
All [261]	227.8 (268)	8.20	6.02	40.5	21.3	119.2 (135)	[162]
Married [195]	244.4 (281)	8.74	6.46	41.8	21.4	127.2 (141)	[118]
Divorced [14]	259.0 (233)	9.90	6.10	38.1	17.4	143.6 (130)	[9]
Single [52]	156.9 (217)	5.69	4.34	36.1	22.1	86.0 (111)	[35]
Marry w/kids [146]	269.1 (294)	8.58	6.44	42.3	20.8	133.3 (153)	[85]
Marry, no kids [49]	170.9 (224)	9.22	6.52	40.3	23.4	111.6 (106)	[33]
Nonwhite [32]	270.9 (278)	5.91	4.87	39.7	19.9	137.6 (131)	[17]
PJOCC = mgt [34]	215.8 (209)	11.09	8.32	42.0	20.8	129.2 (147)	[21]
prof/tech [45]	276.0 (332)	9.81	8.14	43.1	27.1	146.1 (186)	[26]
sales [18]	282.2 (356)	7.87	6.27	40.3	22.1	82.2 (86)	[11]
clerical [28]	315.2 (378)	8.20	5.84	37.6	18.9	107.0 (128)	[13]
services [46]	232.7 (244)	6.80	5.23	38.9	17.0	149.5 (163)	[29]
laborers [18]	141.9 (151)	5.03	3.72	34.2	19.7	104.3 (104)	[14]
crafts [40]	148.2 (178)	8.29	5.31	41.3	22.5	85.8 (80)	[30]
operatives [32]	206.2 (206)	6.71	3.90	42.4	21.2	118.8 (108)	[18]
SJOCC = mgmt [27]	207.3 (280)	9.13	6.85	44.4	28.3	111.4 (202)	[17]

Table 3
(Continued)

Group [# obs]	Full Moon Sample[1] DURATION (s. dev.)	PJWAGE	SJWAGE	PJHOURS	SJHOURS	Non-censored[2] DURATION (s. dev.)	[# obs]
prof/tech [39]	252.2 (287)	10.92	10.07	42.1	21.9	127.8 (108)	[24]
sales [35]	304.0 (306)	8.38	4.83	38.0	14.6	157.7 (160)	[21]
clerical [17]	288.5 (338)	8.27	5.87	43.5	18.9	92.0 (121)	[8]
services [61]	260.0 (268)	6.45	4.61	39.2	16.8	120.3 (103)	[33]
laborers [38]	172.4 (246)	6.85	4.94	39.2	23.0	131.0 (182)	[22]
crafts [21]	128.7 (150)	9.45	6.74	40.4	23.6	87.2 (88)	[18]
operatives [23]	145.6 (180)	7.86	4.92	39.8	31.7	99.4 (97)	[19]
EDUC < 12 [25]	205.2 (193)	6.28	5.20	40.5	21.4	163.3 (179)	[18]
EDUC = 12 [99]	212.4 (257)	7.04	4.43	40.4	21.6	105.8 (104)	[65]
12 < EDUC < 16 [50]	196.6 (226)	7.69	4.82	39.2	17.6	99.8 (105)	[30]
EDUC GE 16 [87]	269.6 (317)	10.35	8.74	41.2	23.3	132.8 (165)	[49]
HH Income:							
< Pov [4]	85.2 (82)	3.23	2.36	31.5	17.0	85.2 (82)	[4]
1-2 Times Pov [51]	191.1 (233)	6.25	5.47	41.4	17.6	92.4 (85)	[34]
2-3 Times Pov [72]	261.0 (295)	7.69	4.52	39.0	20.5	149.4 (191)	[39]
> 3 Times Pov [134]	228.1 (268)	9.36	7.14	41.1	23.4	117.7 (121)	[85]

Table 3
(Continued)

Group [# obs]	Full Moon Sample[1] DURATION (s. dev.)	PJWAGE	SJWAGE	PJHOURS	SJHOURS	Non-censored[2] DURATION (s. dev.)	[# obs]
Moon No Changes Pov [157]	246.1 (291)	8.77	6.30	40.5	21.7	124.0 (144)	[94]
Moon Yes Changes Pov [104]	200.0 (229)	7.32	5.59	40.4	20.8	112.6 (122)	[68]
Age < 30 [103]	168.6 (212)	6.30	4.66	40.4	22.2	104.2 (114)	[75]
30 ≤ Age ≤ 45 [121]	270.7 (303)	9.41	6.78	40.2	20.1	136.0 (161)	[67]
Age > 45 [37]	251.9 (265)	9.50	7.31	41.5	22.9	119.6 (107)	[20]
Age ≥ 30 [158]	266.3 (294)	9.43	6.90	40.5	20.8	132.2 (150)	[87]

Notes: Number of observations for final column showing figures for just the noncensored observations will differ from numbers shown in left column.
[1]First observation from each moonlighting episode.
[2]Sample as above, but excludes left- and right-censored episodes.

longer episode. Note that the group with the shortest duration, single males, also have the lowest wages on both jobs. This is probably because they are younger on average. In contrast, nonwhite workers, who also had low wages on both jobs, had moonlighting episodes that lasted longer than average.

The patterns in average duration by occupation are much more affected by excluding the censored episodes. When these episodes are included, clerical and sales workers moonlight the longest, while laborers and crafts workers exhibit the shortest moonlighting durations. However, almost half of the clerical and sales workers have censored episodes so that when those episodes are omitted, these two occupations have a shorter duration than average. None of the other occupations are affected nearly as dramatically, suggesting that the really long-term moonlighters disproportionately are sales and clerical workers. The secondary jobs with the longest moonlighting durations are again sales and clerical workers, although the conclusion is also affected by omitting the censored episodes. The long durations for sales workers are related to the prevalence of part-time jobs in this job sector.

The levels of and difference in wages over the two jobs varies a great deal by occupation as well. Workers with primary or second jobs in a professional or technical occupation tend to have higher wages and smaller PJ-SJ wage differences, as well as above average durations. This suggests that workers in these occupations are more likely to moonlight for alternative reasons. Another interesting pattern emerges from workers in a managerial occupation on either their primary or second job. When the primary job is a managerial one the wages on both jobs tend to be higher, the hours worked lower, and the episode longer than when the second job is a managerial one. This may be evidence of the wide range of managerial jobs available, and reflects that workers with PJ managerial jobs are less likely to be moonlighting due to constraints than those with SJ managerial jobs. Finally, moonlighters with primary jobs as laborers and/or second jobs in service work tend to earn the lowest wages and work fewer total hours.

Turning to the effects of education, moonlighters at the two extremes appear the most similar in episode duration. Moonlighters with four or more years of college or those with less than a high school education have the longest moonlighting durations on average and the smallest difference in wages. [As expected, the wage *levels* are higher the more educated the worker.] This suggests that moderately educated workers (high school education, maybe some college) are most likely to moonlight for short periods of time on jobs that pay much lower wages—a pattern consistent with the constraint motive. Highly educated or poorly educated workers are more likely job-packaging.

Focusing on poverty status, workers with household incomes between two and three times the poverty threshold have the longest moonlighting duration. However, this is also the group with the largest wage difference, so we would expect them to be moonlighting due to the constraint motive and therefore have a shorter duration. The lower income groups (in poverty or one to two times the poverty threshold) have shorter durations, yet have a much smaller difference in wages. Thus, when we examine the length of the episode it appears that low income workers are more likely to be moonlighting due to constraints, but if we look at the wage differences we arrive at the opposite conclusion. This apparent ambiguity may be due to the very low primary job wages received by the lowest income groups; minimum wage laws and other institutions may prevent the second job wages from being much lower.

As each of these tables have shown, there is significant variety within our sample of moonlighters. Tables 1 and 2 revealed that, on average, moonlighters receive lower wages, work longer hours and are poorer than the average worker. The average moonlighter works full-time on the primary job and works 15 to 20 hours a week on the second job to receive an hourly wage that pays approximately 25 percent less than the primary job. The vast majority of moonlighters are not in poverty and would not be even if they did not moonlight; however, taking a second job does have a significant impact on their standard level of living. Yet, these sample averages mask important differences and patterns across variables that are only hinted at in Table 3. For example, the most- and least- educated workers tend to moonlight the longest and on jobs that pay similar wages. Similarly, workers in professional or technical occupations also tend to moonlight longer and receive similar wages on both jobs. These two findings suggest that these kinds workers are more likely to moonlight for an alternative motive, such as job-packaging.

II. Constructing and Estimating a Duration Model of Moonlighting

The large differences across groups of moonlighters revealed in Tables 1 through 3 emphasize the importance of seeking further insight with a formal econometric model. Estimating hazard functions will explain more accurately the factors underlying moonlighting durations. It also allows us to isolate the effect of each variable, such as education, while dealing with the problems of censored episodes and time-varying variables. And, by estimating a baseline hazard function, we can see whether individuals are more or less likely to continue moonlighting as their episode progresses.

What does economic theory suggest about the duration of moonlighting? How long a worker chooses to moonlight is likely to depend upon his or her motive for moonlighting. Labor supply constraints typically are believed to be temporary, and the worker will find other avenues for adjusting to any long-lasting constraints, such as finding a new job (e.g. Altonji and Paxson 1988, Paxson and Sicherman 1994). Thus, if the worker moonlights in response to a constraint on the primary job then the episode may be fairly short. On the other hand, workers who are moonlighting for other reasons, such as "job-packaging," may tend to moonlight for longer periods.[8]

Applying existing theories of moonlighting behavior to the duration of moonlighting suggests that the length of the moonlighting episode should depend upon the same factors that influence the decision to moonlight (as well as the number of hours to supply to the SJ) under both motives, plus any factors that help determine which motive is more important. It also suggests that different individuals will exhibit different probabilities of "leaving" the moonlighting state and that many of these differences will be unobserved. Thus, one way to explore why people moonlight is to identify the factors that are most significant in explaining the length of the moonlighting episode, as well as the duration dependence exhibited by the hazard function and the effect that unobserved heterogeneity has on the estimated structural model.

A. Theoretical Issues

Following Kiefer (1988) and Greene (1993), we define F(t) as the probability that the moonlighting episode will last no longer than t periods. The survival function, S(t), is the probability that the episode will last at least t periods and is therefore equal to 1- F(t). The hazard rate or function, $\lambda(t)$, is the probability that the episode will end at period t, given that it has lasted t periods already, and $\lambda(t) = f(t)/S(t)$, where f(t) is the probability density function

[8]The duration dependence of the hazard function, or how the probability of ending the episode changes over time, also may differ across motives. For instance, the probability that a constrained worker will quit moonlighting may increase as the duration of the moonlighting episode increases, whereas the probability for a heterogeneous jobs moonlighter could be either constant or decreasing over time. Unfortunately, the conventional ways of introducing unobserved heterogeneity and explanatory variables into the duration model do not permit either to affect the duration dependence of the hazard function. Allowing duration dependence to differ by motive is beyond the scope of the present paper, but is a topic worthy of future research efforts.

associated with F(t). Duration dependence refers to how the hazard rate changes with time, which is the sign of $\partial\lambda(t)/\partial t$. Negative duration dependence means that the probability that the episode will end decreases as t increases, or that $\partial\lambda(t)/\partial t < 0$. Conversely, positive duration dependence suggests that $\partial\lambda(t)/\partial t > 0$. Specification of the hazard function dictates the type of duration dependence permitted by the model.

Unobserved heterogeneity across observations will lead to a downward bias in the estimates of $\partial\lambda(t)/\partial t$ (Kiefer 1988, pp. 671-72). To illustrate, suppose that we have two discrete groups in our sample, (1) "constrained" moonlighters and (2) "job-packaging" moonlighters. Suppose also that Group (1) has a higher, but constant, hazard rate than Group (2)'s constant hazard rate. The estimated hazard function for these two groups combined will exhibit negative duration dependence by the simple fact that over time more members of Group (1) will quit moonlighting, leaving disproportionately more members of Group (2) in the sample, which are observations with a lower hazard rate. Thus, the hazard rate for the merged sample will decrease over time.

Multiple motives for moonlighting makes controlling for unobserved heterogeneity quite important. However, it is unlikely that our sample truly falls into two discrete groups. There may be many reasons for moonlighting (Plewes and Stinson 1991) and the reasons are not necessarily mutually exclusive. Thus, even if we could identify the *main* motive for moonlighting (which we cannot with our data), there could still be unobserved heterogeneity as other motives might also be playing a role in the decision. This heterogeneity may best be treated as a continuous random variable, rather than the discrete one suggested in the above example.

We estimate our duration model of moonlighting behavior using three distributions for the hazard function, (1) the Weibull, (2) the Log-logistic, and (3) the Weibull with unobserved heterogeneity modeled as a continuous random effect that follows a gamma distribution. The technical appendix discusses these distributions and their characteristics in more detail. Duration dependence is revealed through the parameter p and unobserved heterogeneity through the strictly non-negative parameter θ. The Weibull distribution allows for strictly positive, negative or zero duration dependence depending on whether p is greater than, less than or equal to 1.0, respectively, whereas the Log-logistic distribution allows for first positive and then negative duration dependence as t increases, as long as $p > 1.0$. (If $p \leq 1.0$, then the hazard rate always decreases with time.) If $\theta = 0$ then there is no unobserved heterogeneity, whereas if it is greater than zero there is.

With multiple motives for moonlighting, we expect the first distribution to suggest negative or constant duration dependence ($p \leq 0$) because of the neglected heterogeneity and the third distribution to reflect the importance of heterogeneity ($\theta > 0$). We estimate the log-logistic distribution because it allows the hazard to first increase and then decrease; this would also be consistent with the existence of two general groups of moonlighters, one with an increasing hazard and one with a decreasing or constant hazard (see footnote 8).

We expect the probability of ending the moonlighting episode to not only depend on the length of the episode but on other variables as well. The explanatory variables are permitted to shift the hazard function upwards or downwards over all t, but generally are not allowed to affect the duration dependence or slope of the hazard function (Greene 1993, p.721). Variables likely to influence the duration of the moonlighting episode include the wages on both jobs and other characteristics of the two jobs, such as the worker's occupation. For example, the higher the wage on the second job, given the wage on the first job, the more likely one would be to continue moonlighting. Also, as revealed in Tables 1 through 3, several other job-related and personal characteristics are potentially important. Some occupations might lend themselves to greater opportunities for job-packaging, such as the college professor example given earlier, and therefore have a lower hazard rate. Demographic variables also appear to play a role, so variables such as age, education, and family structure are included. Local economic conditions might influence the probability of being constrained on the first job, as well as the severity and permanence of those constraints, so we include the local unemployment rate and seasonal dummy variables. Finally, if one believes that all workers who moonlight are constrained on their primary job (i.e. there is only one reason for moonlighting), then the number of hours on the PJ should not only be important, but exogenous as well. Therefore, we re-estimate all models including PJ hours as an explanatory variable. If the constraint motive is paramount, then this variable may greatly reduce the explanatory power of the other job-related variables.

As mentioned in section I, many of these variables, such as wages, income and local economic conditions, vary over the length of the moonlighting episode, necessitating the inclusion of time-varying covariates. In essence, including time-varying covariates allows the hazard function to shift upward or downward at each discrete time interval (in our case, the survey wave) as the explanatory variables change. However, permitting time-varying covariates greatly complicates the problem of left-censored episodes. Recall that a left-censored episode is one that begins prior to the start of the survey panel and a right-censored episode is one that is still underway when the survey panel ends. In both cases, the observed duration is a lower bound on the true duration. If the explanatory variables do not vary over time, then left-censored and right-censored episodes are equivalent—both provide information on durations of at least *t*, and it is straightforward to deal with this censoring via maximum likelihood estimation (Greene 1993).

With time-varying covariates, however, left-censored episodes have unobserved explanatory variables. The first observation for a left-censored episode is not the first interval of the moonlighting episode, so the explanatory variables do not correspond to the episode's first interval. In fact, because we do not know when a left-censored episode began, we do not know which wave(s) of the moonlighting episode we are observing. If the explanatory variables vary over time then this problem becomes critical because we cannot match the correct variable values with the correct piece of the baseline hazard. Incorporating time-varying covariates dictates that we know the value of each regressor for each interval of the moonlighting episode, particularly the first period. This is not a problem for right-censored episodes because we observe the start of those episodes.

Therefore, in order to permit time-varying covariates, we must eliminate all left-censored episodes. We recognize that by eliminating these observations we may be excluding the people who moonlight the longest. To explore the severity of this problem we also estimate the model including the left-censored episodes, and (1) allow time-varying covariates, then (2) restrict the regressors to be constant over the episode by using the values from the first wave. Although both of these estimates will be biased, they may yield insight into the severity of the left-censoring problem.

In our primary estimating sample, there are 207 total episodes, with an average moonlighting duration of 175.49 days. Sixty-five percent of the moonlighting episodes last one wave or less, and 13 percent cross only two waves. Finally, 67.1 percent of the individuals have one moonlighting episode, 26.8 percent have two episodes, and 6.0 percent have three episodes. The natural log of the number of days of the moonlighting episode duration is the dependent variable in the survival function. Variables included as explanatory variables are: AGE, YRSEDUC, NUMKIDS, KIDSLT6, MARRY, DIVORCED, UNEMPL, PJWAGE, SJWAGE, NONLABY, WINTER, SPRING, SUMMER, plus primary and secondary job occupations. An extra set of regressions were run with primary job hours (LOGPJHRS) included as a regressor.

B. Empirical Results

Table 4 reports the key parameter estimates for three different hazard functions. For the sake of brevity and because the results are nearly identical, we do not present the estimates for these models when the log of primary job hours is included as a regressor. These results are available upon request from the authors.

These results reveal a pattern across the different hazard specifications consistent with multiple motives for moonlighting. Although the estimated Weibull model without unobserved heterogeneity suggests positive duration dependence ($\hat{p} > 1$), the hypothesis that $p = 1$ cannot be rejected. Permitting unobserved heterogeneity, found to be statistically important (θ is statistically significant), more than doubles the estimate of p such that the results now suggest statistically significant positive duration dependence. As first increases and then decreases with the length of the episode. This, too, is consistent with a group of workers who moonlight for different reasons.

Because unobserved heterogeneity is statistically significant and the coefficients have a clearer interpretation in the Weibull model than in the Log-logistic model, we focus on the results from the Weibull model with heterogeneity. However, these estimates are fairly robust across the specifications. Two variables of interest, the wages on the discussed earlier, this pattern follows directly from the downward bias in $\hat{p}$ when unobserved heterogeneity is ignored. Finally, the Log-logistic model yields an estimate of p that is statistically greater than 1.0, suggesting that the probability of ending the moonlighting episode two jobs, never have a significant effect on the length of the duration episode. This result could arise because the wage is a very noisy indicator of the desirability of either job—a result that is consistent with multiple moonlighting

Table 4
Parameter Estimates for the Duration Model+
(standard errors in parentheses)

	Weibull	Weibull with Heterogeneity	Log-Logistic
AGE	-0.017	-0.026*	-0.021
	(0.01)	(0.01)	(0.01)
YRSEDUC	0.048	0.037	0.049
	(0.05)	(0.04)	(0.04)
NUMKIDS	-0.186*	-0.089	-0.116
	(0.10)	(0.10)	(1.0)
KIDLT6	0.338	-0.008	0.150
	(0.26)	(0.24)	(0.25)
MARRY	-0.188	0.026	-0.087
	(0.37)	(0.36)	(0.37)
DIVORCED	-0.869**	-0.183	-0.466
	(0.44)	(0.43)	(1.07)
UNHELTHY	-0.088	-0.272	-0.060
	(0.60)	(0.68)	(0.70)
NONLABY	0.029	0.037***	0.033**
(in 1000s)	(0.02)	(0.02)	(0.02)
UNEMPL	0.002	0.019	-0.4E-3
	(0.06)	(0.05)	(0.05)
PJWAGE	-0.015	-0.007	-0.007
	(0.02)	(0.02)	(0.02)
SJWAGE	-0.019	-0.002	-0.017
	(0.02)	(0.02)	(0.02)
WINTER	0.003	0.220	0.102
	(0.28)	(0.25)	(0.26)
SPRING	0.055	0.061	0.030
	(0.27)	(0.25)	(0.25)
SUMMER	0.072	0.124	0.099
	(0.24)	(0.24)	(0.25)
CONSTANT	-5.003***	-4.035***	-4.519***
	(1.02)	(0.99)	(1.0)
SIGMA	0.862***	0.364***	0.538***
	(0.07)	(0.06)	(0.04)

	Weibull	Weibull with Heterogeneity	Log-Logistic
THETA	---	2.541***	---
		(0.75)	
P	1.160***	2.746***	1.857***
	(0.10)	(0.44)	(0.14)
LOG-LIKELIHOOD	-1033.2	-1012.9	-1017.3

+ Estimated with time-varying covariates and excludes left censored.
*, **, *** Indicates significance at the 10 percent, 5 percent, and 1 percent levels.

motives. In other words, there are benefits and costs to each job that are not reflected in the wage.

Nonlabor income has a positive and statistically significant effect on the probability of ending the moonlighting episode at time t. This result has at least two possible interpretations: (1) individuals with high nonlabor incomes more likely moonlight because of constraints on the primary job, and (2) an individual who moonlights because he is constrained on the PJ may need to do so for a shorter period of time, the higher his nonlabor income. The only demographic variables that are ever statistically significant are the individual's age, being divorced, and the number of children, all of which affect the hazard rate negatively. It is rather surprising that education has no effect, given the results of the descriptive analyses. To explore this further, we also estimated a specification that included age squared and education squared; however, none of the coefficients were ever statistically significant and no other results changed.

Similar to the descriptive analyses, we find the SJ occupation is important. Individuals working second jobs in farming or labor (SJLABOR), sales (SJSALES), service (SJSERVWK), or in professional or technical fields (SJPRTECH) moonlight for longer periods. In contrast, the occupation of the primary job appears to be unimportant. Finally, none of the variables reflecting local economic conditions are statistically significant.

The final variable of interest is the hours worked on the primary job. If all workers moonlight because they are constrained on the PJ, then hours worked on the PJ is exogenous and will be very important to the duration of the moonlighting episode. Including this variable has little effect on the other parameter estimates, except for causing some of the coefficients to become less statistically significant and a very slight increase in $\hat{p}$. Thus, including hours on the PJ does not substantially diminish the importance of the other variables. The coefficient is negative and statistically significant, suggesting that the more hours an individual works on his first job, the longer his moonlighting episode. This implies that individuals who work more hours on their PJ are more likely to job-package and moonlight for longer periods. In addition, PJ hours may be an indication of the individual's tastes for work that are not captured by the other demographic variables. (Individuals with high PJ hours like to work more, and therefore moonlight for longer periods.) However, in order for PJ hours to be a valid regressor it must be exogenous, which is inconsistent with the heterogeneous jobs motive.

How sensitive are these results to the exclusion of left-censored episodes or to permitting time-varying covariates? As discussed in Section III, permitting time-varying covariates requires eliminating left-censored episodes in order to avoid measurement error in the regressors. However, excluding left-censored episodes also may be omitting those observations with the longest durations. To explore this problem, we estimate the above specifications both with and without left-censored episodes, and both with and without time-varying covariates. (In the latter, we use the value of the variables in the first observed wave of the episode. Note that Table 4 reports the estimates from the specification without left-censored episodes and with time-varying covariates.) This exercise reveals the separate influences of allowing time-varying covariates and eliminating left-censored episodes. Both experiments lead to very similar results, with the only notable change being a lower estimate of p. Also, by using more data (including left-censored episodes) or asking less of the model (treating the covariates as time-invarying) additional coefficients, such as the local unemployment rate, the summer seasonal dummy and the primary job wage, often become statistically significant and of the correct sign. Thus, our rather bland results in Table 4 may be due to the fact that we have eliminated some of the most interesting data and are asking a lot of the model simultaneously .

In sum, then, our estimates of the determinants of moonlighting duration are fairly robust with respect to the hazard function specified, the treatment of left-censored episodes and the presence of time-varying covariates. However, the estimated duration dependence, $\hat{p}$, is sensitive to these choices. Allowing for observed or unobserved heterogeneity or omitting left-censored episodes increases $\hat{p}$ and suggests positive duration dependence. Although the point estimates of p vary, once unobserved heterogeneity is permitted, they all are statistically significantly greater than 1.0. This suggests that individuals are more likely to quit moonlighting as their episode lengthens, which hints at the constraint motive as the primary reason for moonlighting.

One problem in interpreting our estimates of the determinants of moonlighting behavior is that each variable may have two separate and potentially opposing effects on the hazard function. Each variable may influence the individual's initial reason for moonlighting (constraint versus heterogeneous jobs), as well as the length of time the individual chooses to moonlight. The estimated effect of nonlabor income is a good example. An individual with high nonlabor income may be less likely to moonlight because he is constrained, and therefore have a lower hazard rate. Conversely, given that the individual has chosen to moonlight, he may need to do so for a shorter period of time. The wages on each job, the local unemployment rate and primary job hours may also have these dual effects on moonlighting behavior. We examined the importance of these two effects with those four variables by estimating an alternative model that includes the value of the variable in the first wave of the episode, plus a second variable that captures the change in the variable across waves over the course of the episode. Additionally, all specifications were re-estimated including both the level and change in primary job hours. Unfortunately, this alternative model is not successful in isolating the separate effects of these key variables (with the exception of PJ hours). The most likely explanation is that most of our moonlighting episodes last less than one wave, eliminating the importance of the change variables. A sample with a more even distribution of episode durations or a shorter time interval would likely yield much more interesting results.

III. Concluding Remarks

This research investigates the factors associated with moonlighting using a superior data set and presents the first duration model of moonlighting behavior (to our knowledge) to appear in the literature. Using data from the SIPP, we first examine the characteristics of our moonlighting sample and compare them to our total sample of male workers. The typical moonlighter appears to be poorer than the average worker, despite working fulltime on his primary job and part-time on a lower paying second job. Yet, there are many exceptions to this depiction, and the length of the moonlighting episode varies with many demographic and job-related variables.

To isolate the effects of these variables, control for problems in the data, and consider multiple motives for moonlighting, we estimate a duration model of moonlighting. Our results suggest that unobserved heterogeneity is important, and that once it is controlled, the probability of ending the moonlighting episode increases over time. Our interpretation of the factors affecting the length of the moonlighting episode is clouded by the dual effects that any given variable might have—it may affect the reason for moonlighting as well as have a direct effect on the duration of the episode. We propose an alternative model to address this problem, but our data do not appear to be rich enough to exploit it fully. However, this alternative model may prove fruitful for other research endeavors. For example, AFDC recipients have been characterized frequently as belonging to two distinct groups, a group of short-term recipients who use AFDC during a period of transition (such as divorce) and a group of long-term recipients who receive AFDC as a long term source of income. In such a setting, a particular variable such as the local unemployment rate may have two effects by determining the type of AFDC recipient, as well as having a direct effect on the length of the episode.

In sum, all of our results point to the presence of multiple motives for moonlighting. However, the typically assumed motive of primary job constraints appears the most common, and taking a second job often is not enough to raise the family's income to the level of the average family.

Technical Appendix[9]

The different distributions and corresponding characteristics of the hazard models estimated in Section III are discussed in more detail here. Our primary distribution is the Weibull, which can be written as

$$\lambda(t) = \lambda p (\lambda t)^{p-1} . \qquad \textbf{(1)}$$

The Weibull distribution allows for strictly positive, negative or zero duration dependence depending on whether p is greater than, less than or equal to 1.0, respectively. The Log-logistic distribution, with hazard

$$\lambda(t) = \frac{\lambda p (\lambda t)^{p-1}}{\left[1 + (\lambda t)^{p}\right]} , \qquad \textbf{(2)}$$

allows for first positive and then negative duration dependence as t increases, as long as $p > 1.0$. If $p \leq 1.0$, then the hazard rate always decreases with time.

We choose a common specification for the unobserved heterogeneity; it is modeled as a continuous random effect, v, with a probability density function,

$$f(v) = \frac{k^{k}}{\Gamma(k)} \quad e^{-kv} v^{k-1} , \qquad \textbf{(3)}$$

which is a gamma distribution with a mean of 1.0 and variance of 1/k. The survival function conditional upon v, or $S(t\,|v)$, is specified as a Weibull distribution,

$$S(t|v) = e^{-(v\lambda t)^{p}} . \qquad \textbf{(4)}$$

The mixed hazard function can then be derived as

$$\lambda(t) = \lambda p \,(\lambda t)^{p-1} \left[S(t)\right]^{1/k}, \qquad \textbf{(5)}$$

where

$$S(t) = \int_{o}^{\infty} f(v)\, S(t|v)\, \partial v = \left[1 + \frac{1}{k}(\lambda t)^{p}\right]^{-k} . \qquad \textbf{(6)}$$

The parameter k, or the more commonly discussed parameter θ, where $\theta = 1/k$, indicates the degree of unobserved heterogeneity in the sample. If $\theta = 0$ then there is no heterogeneity and

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[9]This summary of the hazard function model is drawn from Greene (1993).

the hazard written in equation (5) collapses into the simple Weibull hazard written in equation (1). If $\theta > 0$ then unobserved heterogeneity exists and the mixed and structural hazards differ.[10] In particular, if $p \leq 1$, the mixed hazard exhibits negative duration dependence, whereas the structural hazard only exhibits negative duration dependence if $p < 1$. (It is constant if $p = 1$.) If $p > 1$, then the structural hazard exhibits positive duration dependence and the mixed hazard is ambiguous.

[10]Recall that $\theta = 1/k$ is the variance of the random variable, v, and therefore must be strictly non-negative.

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