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Abstract

Research on health-related work absenteeism focuses primarily on moral hazard issues but seldom discriminates between the types of illnesses that prompt workers to stay home or seek care. This paper focuses on chronic migraine, a common and acute illness that can prove to be relatively debilitating. Our analysis is based upon the absenteeism of workers employed in a large Fortune-100 manufacturing firm in the United States. We model their daily transitions between work and absence spells between January 1996 up until December 1998. Only absences due to migraine and depression, its main comorbidity, are taken into account. Our results show that there is considerable correlation between the different states we consider. In addition, workers who are covered by the Blue Preferred Provided Organization tend to have longer employment spells and shorter migraine spells than workers cover by other insurance packages.

Keywords: Migraine, absenteeism, insurance policies, transition models, unobserved heterogeneity

JEL: I10, J32

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1. Introduction

The research of the past two decades on work absenteeism has focused primarily on moral hazard issues [Barmby (2002), Gilleskie and Lutz (2002), Gilleskie (1998), Puhani and Sonderhof (2010), Johansson and Palme (2005)]. It is usually acknowledged that insurance schemes tend to lengthen the spells of absenteeism [Gilleskie (1998, 2010), Barmby (2002), Puhani and Sonderhof (2010)], although their impact on the incidence of absenteeism *per se* is not so clear-cut. While the empirical research has found that men are more sensitive to financial incentives [Vistnes (1997), Gilleskie (2010)], the relative importance of socio-economic characteristics and financial incentives in explaining the length of work absences has not yet been settled [Vistnes (1997), Barmby et al. (2004)].[1]

The empirical literature on health-related work absenteeism focuses for the most part on acute or temporary illnesses [Gilleskie (1998, 2010), Cockburn et al. (1999)]. While concern for moral hazard is still very much at the heart of the research, some have found that insurance schemes or sick pay policies may be beneficial to both firms and individuals. Indeed, employer-provided health insurance can improve productivity by enhancing workers' health status and work effort, thereby reducing absenteeism and workmen's compensation [Nguyen and Zawacki (2009)]. Beneficial impacts on worker turnover have also been found, although this is still disputed [Gilleskie and Lutz (2002)]. Another strand of the literature has generally found work absenteeism to be relatively sensitive to publicly mandated sick leave policies, although the majority of papers do not account explicitly for the type of illness motivating the absence [see Henrekson and Persson (2004) for an analysis of the Swedish case, and Ziebarth and Karlsson (2010) and Puhani and Sonderhof (2010) for the German case].

Most empirical studies do not discriminate between the types of illnesses that prompt workers to stay home or seek care. Yet the incidence and duration of absence spells, and their responsiveness to financial incentives, certainly depend upon the nature of the health shock. In this paper we focus on chronic migraine, a common and acute illness that can prove to be relatively debilitating.[2,3] Indeed, migraines can last anywhere between 4 and 72 hours [Evans and Mathew (2000)], are often associated with other symptoms such as nausea and photophobia which can be more debilitating than the headache *per se* [Evans and Mathew (2000)], and cause approximately 30% of migraineurs to be bedridden [Pryse-Phillips et al. (1992)]. More importantly, chronic migraine is often associated with various psychiatric disorders such as anxiety, agoraphobia and depression.[4]

Workers who suffer from chronic migraine need not always stay away from work each time an episode strikes.[5] Because work absenteeism in the manufacturing sector can be costly if production is disrupted or significantly disturbed, it is important to determine whether migraine-related absenteeism responds to financial incentives. Our analysis thus focuses on the absenteeism of workers

[1] Ichino and Moretti (2009) have recently found that menstruation can explain a significant share of female absenteeism and earnings gap. Likewise, Brown et al. (1999) have found that profit-sharing schemes and share ownership in French enterprises significantly reduce work absenteeism.

[2] Migraine is a common disease in the United States. Its prevalence is estimated at 13.2% among those aged between 18 and 65 [Evans and Mathew (2000), Schwartz et al. (1997)] and is highest among the working age population [Lipton et al. (2007)]. The economic burden, including absenteeism, lower productivity and medical costs, is estimated at about 50 billion U.S. [National Headache Foundation (2010)]

[3] The only other study we know of that looks at the relationship between migraines and insurance status is that of Wilper et al. (2010). They report that individuals with no insurance or Medicaid were less likely than the privately insured to receive abortive therapy or prophylactic therapy.

[4] Breslau and Davis (1993) estimate that chronic migraineurs are 4.2 times more likely to suffer from depression than otherwise healthy individuals. See also Senaratne et al. (2010).

[5] It is estimated that only half of episodes require a leave from work [Caro et al. (2001)] but of those, the majority require treatment [Clouse and Osterhaus (1994)]. Yet the productivity of those who remain at work may nevertheless be seriously negatively impacted [see, *e.g.* Cockburn et al. (1999)].

employed in a large Fortune-100 manufacturing firm in the United States who are diagnosed with chronic migraine. We model their daily transitions between work and absence from January 1996 up until December 1998. Only absences due to migraine and depression, its main comorbidity, are taken into account. Workers could subscribe to three different insurance packages with varying premiums. Our goal is to determine whether there is any indirect evidence that both the frequency and the duration of absence spells are affected by the type of insurance policy that are available to the workers.

The paper is structured as follows. Section 2 presents the sample and *prima facie* evidence on the link between medication, insurance and the duration of absence spells. Section 3 presents the econometric model. We also show how potential selectivity issues arising from the choice of a particular insurance package are dealt with. The transition model along with the unobserved heterogeneity specification are presented in details. Section 4 presents the main results. Finally Section 5 concludes the paper.

2. Data and Setting

2.1. Migraines and Available Treatments

Migraines are characterized by unilateral or bilateral headaches in 60% and 40% of cases, respectively. The intensity of the pain is related to the extent of the vasodilatation and the hyperpulsatility of the arteries of the brain. Migraines usually consist of four phases: prodrome, aura, headache and postdrome [Evans and Mathew (2000)]. The prodrome, which occurs 24 hours before the onset of the aura is a period of tiredness, irritability and loss of concentration. The aura, in turn, consist of visual disturbances including blind spots and/or flashes. The aura occurs about an hour before the onset of the migraine. The third phase is accompanied by headache symptoms (nausea, photophobia). Finally, the postdrome is characterized by fatigue and exhaustion. It can last a few hours or several days [Evans and Mathew (2000)]. Over half of all individuals suffering from migraine have to leave work when an episode strikes and most seek medical treatment.

Three main drug groups can be used to treat migraines: analgesics (painkillers), ergot alkaloids and triptans. Analgesics simply act on the pain and are often used to treat mild headaches [Antonaci et al. (2010)]. The ergot alkaloids are vasoconstrictors that are used to treat moderate to severe migraines [US Headache Consortium (2000)]. Finally, triptans (sumatriptan, rizatriptan, naratriptan and zolmitriptan) are serotonin receptor agonists. They are also used to treat spells of moderate to severe migraines [US Headache Consortium (2000)] but are much more expensive than alkaloids.

2.2. Data and Sampling Scheme

The main goal of this paper is to determine whether variation in duration and occurrence of migraine spells, is partly linked to financial incentives. In order to achieve this, we need very precise and detailed data. Our analysis is based on the claims records of a national Fortune-100 American corporation with more than 100,000 employees. The files contains health care and disability information for the period spanning 1996 through 1998. For each worker in the file, the records show the year of birth, sex, state of residence, type of health plan and treatment. Expenditures for each worker's claims paid by the employer during the period of enrollment were recorded by date of service and nature of the ailment. Periods of disability and payments received from the corporation were recorded, as were dates of medical care.

Diagnoses are coded using the International Classification of Diseases, Ninth Edition (ICD-9), and drugs are categorized according to the National Drug Code (NDC). To be included in our sample, workers had to have filed at least one migraine-related claim between January 1st 1996 and December 31st 1998.[6] Individuals suffering from cancer (ICD-9: 140-239), infections (ICD-

[6] Migraines are coded ICD-9 = 346.0, 346.1, 346.9.

9: 036.0-036.9, 320.0-320.9), cluster headaches (ICD-9: 346.2), hemiplegic or ophtalmoplegic migraines (ICD-9: 346.8) are excluded from the sample. These exclusion criteria are standard in the medical literature [Schulman et al. (2001)]. In addition, workers 65 years of age and over are excluded to avoid retirement-related issues. Finally, individuals in our sample had to be covered by one of three insurance policies offered by the employer for the whole period. The three insurance plans are the Blue Standard Plan (BSP), the Blue Preferred Provider Organization (BPPO), and the SelectCare PPO (SCPPO). All three plans offer members discounts when they obtain care from within the plans' network. Members can self-refer to any physician or provider in the network. Care can be sought outside the network but out-of-pocket expenses are usually higher.

Workers in our sample were treated with two different drugs when treatment was deemed required. The first will be referred to as "Drug A". It is a combination medication containing isometheptene (vascular constrictor), acetaminophen (analgesic), and dichloralphenazone (mild sedative). The second will be referred to as "Drug B" and is a triptan sulfa drug containing a sulfonamide group. Drug A is more often used to treat mild and intermediate migraines and Drug B more often used for severe migraines, although both can be prescribed in either cases. The use of a particular drug will proxy for the severity of a given migraine spell.

2.3. Descriptive Statistics

The data files at our disposal contain information on 60,622 employees. Of this total, only 1,236 workers reported ever suffering from migraines and fewer than 543 sought treatment at least once between 1996 and 1998. Our analysis focuses on this subgroup of employees. Applying the exclusion restrictions further reduced our sample size to 303 observations.[7]

Table 1 presents the main characteristics of our sample. Males and Females employees are equally represented in our data. Most reside in the north-eastern region of the country. A significant proportion live in rural areas as many plants are located outside city centres. The majority of employees are covered by the Blue Preferred PPO insurance policy, whereas the Blue Standard and SelectCare PPOs cover more or less 10% each of the workforce. Unfortunately, we have no information on the specificities of individual contracts. The empirical analysis will therefore be limited to assessing the mean impact of the different insurance policies on individual behaviour, if any. The last section of the table shows that workers are more likely to use Drug B when a migraine occurs. As mentioned earlier, Drug A is less expensive than Drug B and is usually recommended for the treatment of less acute migraines.[8]

Table 2 reports the mean duration and mean frequency of various states, broken down by insurance policy.[9] The table shows that irrespective of the state we consider, employees covered by the BSP have longer work and absence spells. Absences due to treated and untreated migraines last almost twice as long as those of employees covered by the BPPO and SelectCare policies. For obvious reasons, longer spells tend to occur less frequently over the data window.

Table 3 focuses on the relation between spell duration, frequency and medication. The mean in each column is computed using individuals who have only used Drug A or Drug B, respectively, for each spell of migraine they experienced. Individuals who alternated between the two are not included in the calculations. With the exception of untreated migraines, individuals who use Drug

[7] We discarded 240 additional observations for the following reasons: 76 individuals were not employed continuously during our study window, 149 were diagnosed with cancer, and 15 were diagnosed with cluster or hemiplegic migraines.

[8] In a recent study, Freitag et al. (2001) found no statistically significant differences in headache recurrence over a 24-hour evaluation period for those patients responding in the first 4 hours. In those with headache recurrence, it was statistically significantly more severe in those patients treated with sumatriptan succinate. The study concluded that both treatments are effective when used early in the treatment of an acute migraine.

[9] The figures are tabulated as of the first spell of migraine to occur between 1996 and 1998 for each worker. Consequently, very few workers are observed for three consecutive years. The shortest observation period is 16 days and on average workers are observed for 650 consecutive days.

Table 1: Summary Statistics

Variable	Percentage	Std-Dev
Demographics		
Male	49.308	
Rural area	41.749	
North-East	78.359	
Age	39.618	8.738
Insurance Plan		
Blue Preferred PPO	79.545	
Blue Standard PPO	9.782	
SelectCare PPO	10.473	
Treatment		
Drug A	33.862	
Drug B	67.461	
Number of observations	303	

Table 2: Mean Duration and Frequency of Spells, by Insurance Plan†

	Mean duration			Mean frequency		
Insurance plan	BSP	BPPO	Select	BSP	BPPO	Select
Untreated migraines	4.096	1.385	1.109	1.741	2.738	2.000
	(11.790)	(9.666)	(0.899)	(1.607)	(2.687)	(1.859)
Treated migraines	7.681	1.759	3.511	1.500	1.905	1.692
	(7.689)	(5.581)	(6.728)	(0.859)	(2.208)	(1.543)
Depression	20.583	7.874	20.079	3.000	3.536	9.000
	(16.995)	(14.896)	(16.998)	(2.366)	(4.647)	(11.314)
Work	231.096	183.935	196.219	2.302	3.655	2.892
	(242.256)	(190.144)	(242.563)	(2.315)	(4.143)	(3.430)

†Notes:
1. Duration is expressed in day. The frequencies are computed over 1996–1998.
2. Standard deviation between parentheses.
3. Work duration does not account for right censoring.

B have shorter migraine spells, depression spells and work spells. Their untreated migraine spells are longer but have a much larger standard deviation. On the other hand, workers who are treated with Drug B seem to experience more frequent spells of migraines (treated or not) and depression.

Finally, a number of papers [see, *e.g.* Barmby et al. (1991), Barmby (2002)] have found that absence spells often begin on fridays or mondays. This can simply result from the censoring of sickness spells which might have started on Saturday or Sunday. Yet, because migraine spells are relatively short, a high concentration of spells beginning on either weekdays may indicate that workers respond positively to financial incentives to seek care and stay home. Figure 1 reveals no such pattern for either type of migraines. The distribution is relatively flat, except for saturdays and sundays, reflecting the fact that few workers work on weekends.

2.4. Prima Facie Evidence

The previous tables suggest that the duration and frequency of absenteeism might be loosely related to the type of insurance coverage. To the extent the type of treatment proxies the severity of the migraine spells, the relation between absenteeism and insurance needs to conditioned on the severity of the migraine spells.[10] We investigate this crudely by looking at the individual quarterly

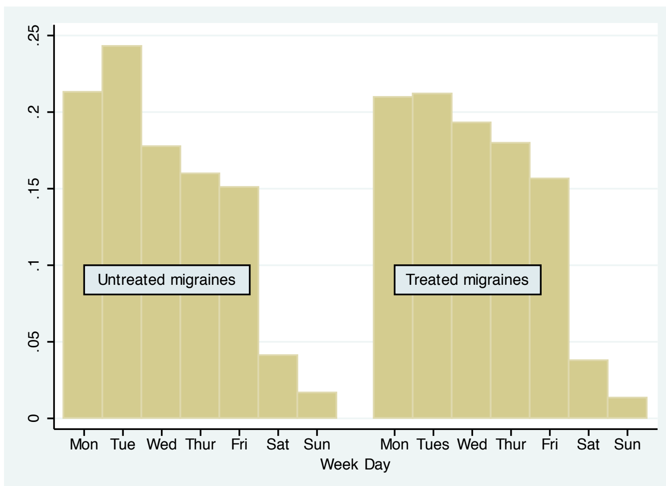
[10] The data reveal no statistically significant relation between insurance policies and medication. A simple contingency test yields $\chi^2(1) = 0.343$ with a P-value of 0.558.

Table 3: Mean Duration and Frequency of Spells, by Treatment[†]

	Mean duration		Mean frequency	
Medication	Drug A	Drug B	Drug A	Drug B
Untreated migraines	0.810	1.412	1.242	1.612
	(0.959)	(6.084)	1.779)	(2.765)
Treated migraines	3.283	1.965	1.626	2.163
	(9.571)	(3.751)	(1.397)	(2.361)
Depression	12.214	6.440	0.667	0.736
	(26.668)	(8.854)	(2.603)	(2.893)
Work	230.624	172.541	3.586	4.543
	(207.684)	(193.464)	(3.606)	(5.078)

[†]Notes:
1. Duration is expressed in day, and the frequencies are computed over 1996–1998.
2. Standard deviation between parentheses.
3. Employment duration does not account for right censoring.

Figure 1: Beginning Day of Migraine Spells



count of absence spells. This allows us to control for quarterly fixed effects in addition to demographic variables. Focusing on quarterly data rather than the 3-year sample window necessarily increases the number of zero counts. We thus use a Poisson hurdle model. The hurdle model relaxes the assumption that the zeros and the positives come from the same data-generating process. A zero count may indeed result from the fact that no migraine spell was experienced by the worker or conversely that he decided not to seek care even if one did occur. On the other hand, conditional on having experienced a migraine spell, the number of quarterly absence spells may depend upon an entirely different process. The zeros are determined by the density $f_1(\cdot)$, so that $P(y=0) = f_1(0)$. The positive counts come from the truncated density $f_2(y|y>0) = f_2(y)/(1-f_2(0))$. The density of the count is thus given by:

$$g(y) = \begin{cases} f_1(0) \text{ if } y = 0 \\ \left[\frac{1-f_1(0)}{1-f_2(0)}\right] \times f_2(y) \text{ if } y > 0. \end{cases}$$

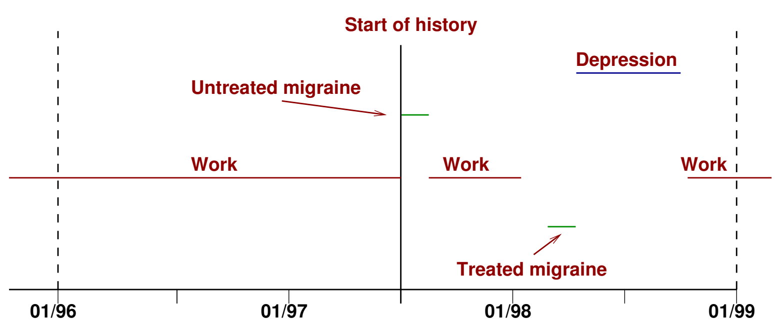
For our purposes, we assume that $f_1(\cdot)$ is logit and $f_2(\cdot)$ is Poisson. Maximum likelihood estimation of the logit-Poisson model is straightforward as each density can be estimated separately.

The results of fitting the model are reported in Table 4. The specifications includes all the covariates that are available in the administrative files. The files include few individual characteristics, but the specification if very similar to that found in Wilper et al. (2010). The table distinguishes between the total number of individual quarterly absences and those absences that are motivated by the onset of a migraine or a depression. The left-hand side column of each specification focuses on the logit specification, *i.e.* $f_1(\cdot)$, while the right-hand side column focuses on the poisson process, *i.e.* $f_2(\cdot)$. The parameter estimates show no particular pattern. Hence, age, gender, rural and northern regions all have an effect on either the logit or the Poisson process of one or more specifications. The more interesting results concern the parameters of the insurance dummy variables. Indeed, it turns out that being insured with either the Blue Standard or the Blue Preferred insurance policies has a significant negative impact both on the likelihood of missing work at all during a given quarter (save for depressions) and the number of absence spells, conditional on being greater than zero (censored Poisson) relative to workers covered by the SelectCare PPO. In addition, the quarterly dummy variables show that there is considerable variations in the probability of experimenting an absence spell. The number of spells *per se* does not depict such a sensitivity, except when pooling all spells together.[11]

3. Transition Model

The previous section brought to bear evidence that the frequency and the occurrence of absence spells may be linked to the type of coverage provided by the insurance policy. Our data is rich enough to allow modelling the transitions between work and absence jointly. To do so we use a multi-state multi-episode transition model. To illustrate the approach, Figure 2 depicts the history of hypothetical worker over the sample window. The dashed vertical lines delimit the period of observation. Thus as of January 1996, the worker in our example was in the midst of a work spell that lasted until June 1997. A spell of (untreated) migraine forced her away from work for a couple of days. After returning to work for a few weeks, she then suffered a severe spell of migraine that required treatment and eventually lead to spell of depression. Finally, her last employment spell is censored at the end of December 1998.

Figure 2: Employment History of a Hypothetical Worker



The figure illustrates the complexity of individual histories. It also underscores the many statistical challenges that must be tackled. To start with, we must acknowledge that the initial migraine spell is not random. Indeed it is itself the result of a sequence of transitions that predates January

[11] There is too little variation in the number of depression spells quarterly-wise to introduce quarter fixed effects.

Table 4: Logit-Poisson Hurdle Regression of Total Quarterly Number of Absence Spells†

	Total (1)		Untreated Migraines (2)		Treated Migraines (3)		Depressions (4)	
	Logit	Poisson	Logit	Poisson	Logit	Poisson	Logit	Poisson
Intercept	1.706	-0.177	1.178	-0.151	-0.557	0.577	-4.075	-1.054
	(4.42)	(0.41)	(2.73)	(0.22)	(1.23)	(0.63)	(4.87)	(0.90)
Age	-0.015	-0.001	-0.028	-0.012	0.002	-0.006	-0.010	0.037
	(2.74)	(0.19)	(4.12)	(1.00)	(0.31)	(0.43)	(0.73)	(1.82)
Male	0.098	-0.142	-0.056	-0.317	0.373	0.270	-0.236	-0.275
	(0.93)	(1.19)	(0.44)	(1.56)	(2.69)	(0.90)	(0.92)	(1.01)
North	-0.517	-0.140	-0.648	-0.178	-0.316	-1.013	0.346	0.954
	(3.76)	(0.94)	(4.11)	(0.76)	(1.76)	(2.92)	(0.94)	(1.80)
Rural	-0.082	0.081	-0.176	0.005	-0.056	-0.071	0.231	0.153
	(0.83)	(0.71)	(1.46)	(0.03)	(0.44)	(0.27)	(0.95)	(0.54)
Insurance								
Blue Standard PPO	-0.088	-0.562	-0.084	0.183	-0.567	-0.468	1.200	-1.660
	(0.41)	(2.34)	(0.32)	(0.39)	(2.01)	(0.85)	(2.05)	(3.34)
Blue Preferred PPO	0.138	-0.461	0.024	0.105	-0.077	-0.708	0.798	-0.963
	(0.86)	(2.77)	(0.12)	(0.30)	(0.38)	(1.82)	(1.52)	(2.77)
SelectCare PPO (omitted)								
Quarter (I=01-03 1996)								
I	15.411	0.288	0.790	-0.666	0.779	0.580		
	(0.03)	(0.79)	(2.01)	(1.00)	(1.99)	(0.98)		
II (omitted)								
III	-1.083	0.402	-0.569	-0.551	-0.467	0.160		
	(3.58)	(1.21)	(1.79)	(0.92)	(1.46)	(0.27)		
IV	-1.734	0.736	-1.106	0.447	-1.030	-0.643		
	(5.72)	(2.27)	(3.37)	(0.95)	(3.09)	(0.78)		
V	-1.022	0.563	-0.591	0.424	-0.944	-0.076		
	(3.62)	(1.88)	(2.02)	(1.01)	(3.02)	(0.12)		
VI	-1.511	0.485	-1.020	0.072	-0.973	-0.677		
	(5.39)	(1.55)	(3.42)	(0.15)	(3.21)	(0.95)		
VII	-1.819	0.785	-1.436	0.369	-1.267	0.445		
	(6.44)	(2.63)	(4.61)	(0.81)	(4.07)	(0.82)		
VIII	-1.941	0.601	-1.560	0.214	-1.440	-0.346		
	(6.89)	(1.93)	(4.98)	(0.44)	(4.57)	(0.49)		
IX	-1.970	0.662	-1.145	0.008	-1.736	-0.110		
	(7.02)	(2.14)	(3.93)	(0.02)	(5.26)	(0.15)		
X	-1.588	0.620	-1.038	-0.314	-1.227	0.696		
	(5.86)	(2.13)	(3.66)	(0.64)	(4.13)	(1.35)		
XI	-1.995	0.563	-1.378	0.050	-1.468	-0.197		
	(7.27)	(1.84)	(4.73)	(0.11)	(4.85)	(0.30)		
XII	-2.135	0.471	-1.490	0.510	-1.776	-0.213		
	(7.75)	(1.51)	(5.08)	(1.21)	(5.62)	(0.30)		
log-likelihood	-1917.838		-1222.576		-1013.387		-415.645	

†Note: Absolute value of T-statistic in parentheses.

1996 and which are potentially linked to observed and unobserved individual characteristics. Further, the potential self-selectivity into the insurance policies must be addressed carefully. Finally, the right-censored spells must also be treated explicitly. Fortunately, the multi-state multi-episode model can relatively easily account for all these complexities.

An additional benefit of multi-state multi-episode models is to allow past occurrences of migraine spells to impact the likelihood of current spells of migraine, depression and employment. Furthermore, observed and unobserved heterogeneity can easily be incorporated into the model. Such heterogeneity is a potentially important determinant of the type of coverage a worker may choose.

3.1. Modelling individual histories

Table 5 shows the transitions that were experienced by the individuals in our sample between 1996 and 1998. Overall, the 303 workers made over 2,024 transitions. Not surprisingly, nearly every migraine and depression spells end with a transition back to work. The table also shows that the transitions between treated and untreated migraines and depression are simply too few to be considered. Although not shown, our data also reveal that over 90% of all migraine spells last a single than a day and more than 69% last only half a day. Because there if little variation in duration, we will treat migraine spells as discrete events. Work and depression spells, on the other hand, depict large duration variation. These will thus be modelled explicitly.

Table 5: Observed Transitions

Origin/Destination	Untreated Migraine	Treated Migraine	Depression	Work	Total
Untreated migraine	–	0	1	489	490
Treated migraine	0	–	1	377	378
Depression	0	1	–	144	145
Work	490	377	143	–	1,012
Total	489	378	145	1,012	2,024

Let m denote the total number of episodes experienced by a given individual. The claims data are arranged so that individuals are initially observed away from work due to the onset of an untreated or a treated migraine. Naturally, the initial state is itself endogenously determined by previous transitions and observable and unobservables variables. This "initial conditions" problem has been extensively studied in the literature [see, *e.g.* Brouillette and Lacroix (2010), Gritz (1993), Heckman and Singer (1984)]. Here we follow Wooldridge (2005) and treat the initial state as exogenous but condition all the following transitions on r_0, the initial state. Let U denote an untreated migraine, T a treated migraine, D a depression spell, and W a work spell. Each work episode is characterized by its duration and the state that succeeds it (destination state). Write the endogenous variables as (δ_j, r_j), where δ_j is the duration of the j^{th} episode and r_j is the destination state that brings it to an end, $j = 1, \ldots, m-1$ [see Lawless (2003), Mealli and Pudney (2003)]. More precisely, let $f^W(\delta_j, r_j | X_j, \nu, r_0)$ be the joint density of the duration and destination state of the j^{th} employment spell. The density is conditional on a vector of observed characteristics which may include earlier state and duration variables to allow for occurrence dependence.[12] The variables are all spell-specific and are assumed constant over the duration of a given spell. Similarly, let $f^D(\delta_j | X_j, \nu, r_0)$ be the density of the duration of the j^{th} depression spell.[13] The term ν is a vector of unobserved individual random effects that are constant over time. This constancy is likely to generate serial dependence

[12]See Doiron and Gorgens (2008) for a recent and in-depth analysis of state dependence in labour market outcomes.

[13]Because all the depression spells end in a transition to employment, there is no need to model the destination state.

in the sequence of episodes. The last observed spell is necessarily still in progress in December 1998 [see Figure 2]. Its distribution is thus characterized by a survivor function, $S^W(\delta_m|X_m,\nu)$.

As mentioned above, we treat migraine spells as discrete events. We thus model the probability that a given spell lasts half a day (as opposed to more than half a day). The probability that this occurs is given by $Pr^K(\delta_j \leq 1/2|X_j,\nu,r_0)$, where $K = U, T$. Finally, selection into a particular insurance policy must be accounted for. The majority of the workers in our sample are covered by the Blue Preferred Provider Organization (220/303). The two other policies are equally important (43 for BSP and 40 for SelectCare). Because there are too few workers subscribing to the latter two policies, with lump them into a single category and model the choice between BPPO and this other aggregate policy. We thus write $P^{\mathrm{INS}}(\mathrm{BPPO}=1|X,\nu)$ for the probability of being insured under BPPO. The probability is not conditioned on the initial state because the choice of a particular policy was made at the time of hiring and predates the first spell of migraine.

The likelihood function of a sequence of transitions is given by:

$$f(\cdot) = P^{\mathrm{INS}}(\mathrm{BPPO}=1|X,\nu) \times \left[\prod_{j=1}^{m-1} f^W(\delta_j, r_j|\cdot)^{W=1} f^D(\delta_j|\cdot)^{D=1} P^T(\delta_j \leq 1/2|\cdot)^{T=1} P^U(\delta_j \leq 1/2|\cdot)^{U=1}\right] \times S^W(\delta_m|X_m,\nu,r_0), \tag{1}$$

where the subscripts indicate which transition occurs during the j^{th} spell, and where each term inside the square brackets is conditioned upon X_j, ν, r_0. Because the error terms ν are unobserved, we must specify a distribution function, $G(\nu)$, say, to make equation (1) an estimable econometric model. Obviously, the computation of the multi-dimensional integral over the domain of ν is technically demanding. As is now customary, we approximate the integral by an average over H pseudo-random deviates. Let $\hat{l}_i(\nu^h)$ denote the contribution of individual i to the log-likelihood function for a given draw ν^h. The approximate log-likelihood we maximize is the following:

$$\widehat{\ln L} = \sum_{i=1}^{N} \ln\left(\frac{1}{H}\sum_{h=1}^{H} \hat{l}_i(\nu^h)\right), \tag{2}$$

where H is the number of draws. The maximization of the simulated likelihood function yields consistent and efficient parameter estimates if $\sqrt{N}/H \to 0$ when $H \to +\infty$ and $N \to +\infty$ [see (Gourriéroux and Monfort, 1991; Gouriéroux and Monfort, 1996)].[14]

3.2. Transition intensity and probability functions

The transition components of the model, $[f^W(\cdot)$ and $S^W(\cdot)]$, give the instantaneous probability of exit from work to a specific destination at a particular time conditional on no previous exit having occurred. Thus, for a given episode the l^{th} transition intensity function $\lambda_l^W(t|X,\nu,r_0)$ if given by:

$$Pr(r = l, \delta \in (t, t+dt)|\delta \geq t, X, \nu, r_0) = \lambda_l^W(t|X,\nu,r_0)dt,$$

where X is spell-specific as mentioned above. The joint probability of exit route r and duration δ is given by:

$$f^W(\delta, r|X,\nu,r_0) = \lambda_r^W(\delta|X,\nu,r_0)\exp\left[-\sum_{l\neq W} l_l^W(\delta|X,\nu,r_0)\right], \tag{3}$$

[14]While the literature has established that $H = 20$ appears adequate [see Laroque and Salanié (1993), Kamionka (1998)], we have chosen $H = 100$ even though the slope parameters are relatively insensitive to the number of draws we use.

where $I_l^W(\delta|X,\nu,r_0)$ is given by:

$$I_l^W(\delta|X,\nu,r_0) = \int_0^\delta \lambda_l^W(t|X,\nu,r_0)\mathrm{d}t.$$

The transition intensity function we use is of the Weibull type:

$$\lambda_l^W(t|X,\nu,r_0) = \alpha_l t^{\alpha_l-1}\exp(-X'\beta_l - \gamma_l r_0)\exp(-\nu), \tag{4}$$

$\alpha_l \in \boldsymbol{R}$. If $\alpha_l > 1$ then the hazard function is increasing with respect to t. Conversely, if $\alpha_l < 1$ then the hazard is decreasing with respect to t, while if $\alpha_l = 1$, then the hazard function is constant.[15] The associated survival function is given by:

$$S^W(t|X,\nu,r_0) = \exp\left[-\exp(-X'\beta_l - \gamma_l r_0)\exp(-\nu)\sum_{l\neq W} t^{\alpha_l}\right], \tag{5}$$

where X is a row-vector of observable characteristics (including possibly past occurrence of migraines), β_l is an appropriately dimensioned destination-specific vector of parameters, and α_l are also destination-specific parameters. The parameters γ_l measure the impact of the initial state on each type of transition.[16]

The density function (1) involves three probabilities. The first concerns the type of insurance coverage and the other two relate to the probabilities that treated and untreated migraine spells last at most half a day. All three probabilities are modelled using a logistic distribution:

$$\begin{aligned}
P^{\mathrm{INS}}(\mathrm{BPPO}=1|X,\nu) &= \frac{\exp(X\beta_I+\nu)}{1+\exp(X\beta_I+\nu)} \\
P^T(\delta \leq 1/2 \text{ day}|X,\nu,r_0) &= \frac{\exp(X\beta_T+\gamma_T r_0+\nu)}{1+\exp(X\beta_T+\gamma_T r_0+\nu)} \\
P^U(\delta \leq 1/2 \text{ day}|X,\nu,r_0) &= \frac{\exp(X\beta_U+\gamma_U r_0+\nu)}{1+\exp(X\beta_U+\gamma_U r_0+\nu)}
\end{aligned} \tag{6}$$

3.3. Unobserved heterogeneity

The next issue that must be addressed to make the model amenable to estimation is to specify the manner in which unobserved heterogeneity enters the above specification. Most applications rely on the work of Heckman and Singer (1984) and approximate arbitrary continuous distributions using a finite number of mass points [see Gritz (1993), Ham and Rea (1987), Doiron and Gorgens (2008)]. A number of recent papers use flexible specifications that allow the heterogeneity terms to be correlated across states [see Ham and LaLonde (1996), Eberwein et al. (2002)]. These specifications are sometimes referred to as single or double-factor loading distributions and are also based on a finite set of mass points.

The approach proposed by Heckman and Singer (1984) is impractical in our setting as it would involve too many parameters. Instead we use a two loading factor specification, where each of the two random effects are constant over time and linked to a particular state of origin. To fix ideas, let $\nu = (\nu_1,\ldots,\nu_K)$ be a vector of unobserved heterogeneity variables, with ν_k an origin-specific

[15] The hazard function of the Weibull model with unobserved heterogeneity need not be monotonic. In fact, if the the unobserved heterogeneity follows a Gamma distribution, then the hazard function is non-monotonic and is known as the Singh-Maddala function [see Kamionka and Lacroix (2008)].

[16] The density function of the depression state is modeled using the same functional form as the employment state.

component ($k = 1, \ldots, 4$). Consider a two-factor loading model [see Van den Berg (1997)] such that

$$\nu_k = \begin{cases} \exp(\theta_k^1 \xi_1 + \theta_k^2 \xi_2) & \text{if } k \in \{\text{W, D}\} \\ \theta_k^1 \xi_1 + \theta_k^2 \xi_2 & \text{if } k \in \{\text{INS, T, U}\}, \end{cases} \tag{7}$$

where ν_k is the random effect associated with state k, θ_k^1 and θ_k^2 are loading factors for state k, and ξ_1 and ξ_2 are independent random draws from the standard normal distribution.[17] To insure identification of the parameters, we impose $\theta_k^1 = 1, k \geq 2$ and $\theta_1^2 = 1$.

4. Econometric Results

Table 6 presents the parameter estimates of the transition model. The table is divided vertically into two parts. Columns (1)–(3) present the parameter estimates of the discrete variables, *i.e.* type of insurance and duration (half a day *vs* longer) of treated and untreated migraines. Columns (4)–(7) focus on the duration of employment and depression spells. The table is also divided horizontally into five parts. The top panel looks at the impact of observable individual characteristics on outcome variables.[18] The second and third panels focus on past duration and beginning and ending-day-of-week effects, respectively. The fourth panel presents estimates of the effect of insurance and medication on the duration of different spells. As mentioned earlier, because BPPO was the most prevalent insurance policy, we contrast the impact of this insurance policy with respect to the other two. Finally, the last panel presents the estimates of the ancillary parameters of the model.

4.1. Parameter estimates

We begin our discussion of the econometric results with the Weibull shape parameters. These characterize the duration dependence. The parameter estimate in the state of depression is not statistically different from zero. This implies that the hazard rate is flat, *i.e.* that the probability of leaving the state of depression is independent of the duration [see equation (4)]. The hazard rates out of employment, on the other hand, are all monotonically decreasing irrespective of the state of destination. In other words, the conditional probability of leaving work due to a migraine or a depression decreases with the duration of the work spell.

Recall that all the density functions are conditioned on the initial state, r_0 (untreated migraine). The parameter estimates show that the initial state has no impact on the duration of future treated and untreated migraines or depressions. On the other hand, future employment spells need to be conditioned on the initial spell. Indeed, workers first observed suffering from an untreated migraine will have shorter work spells ending in a depression or a treated migraine, and longer work spells ending in an untreated migraine than workers first observed suffering from a treated migraine.

To the extent our specification adequately accounts for potential selectivity in the various states, the slope parameters can be considered void of systematic biases. We thus turn to the top panel of the Table 6. The parameter estimates of the demographic variables show interesting results. To begin with, it seems older employees and those from the northern region and rural areas are less likely to subscribe to the BPPO insurance policy. The probability that a spell of migraine lasts less than half a day is higher for male workers if the migraine does not require treatment. Otherwise, there appears to be no differences between male and female workers. The slope parameters of the duration model tell an interesting story. First, the duration of a depression spell is found to be

[17] A similar approach has been used by Bonnal et al. (1997), Mealli and Pudney (2003) and Brouillette and Lacroix (2010).

[18] We can not control for the region of residence in the duration of depression spells because the majority of individuals experiencing such spells live in the North (121 out of 135, or 89.7%).

independent of individual characteristics. In fact the only covariate that has any explanatory power on the duration is the use of an antidepressant drug: Workers who are prescribed the drug have significantly longer spells. A number of demographic variables have a statistically significant impact on the duration of the work spells. Hence, older workers have longer spells, irrespective of the destination state. Workers from the northern part of the country have generally longer work spells, save for transitions into depressions.

The next panel of the table investigates whether past occurrences of migraines and depressions have an impact on the occurrence of future spells. Both variables, *# Past migraines* and *# Past depressions*, are defined as the total number of completed spells that occurred between January 1996 and the current ongoing spell.[19] The number of past migraines aggregates both treated and untreated migraine spells into a single index. The parameter estimates show that past migraine occurrences have no impact on the probability that the current migraine lasts less than half a day. On the other hand, it does indicate that the transition rate between employment and treated migraine will be lower if past migraines are more numerous. On the other hand, the cumulative number of past depressions has no impact on the duration of the current depression.

The next set of parameter estimates focuses on the days effects. Contrary to earlier findings [Barmby et al. (1991), Card and McCall (1996), Ichino and Moretti (2009)], our estimates show very little "monday" or "friday" effects. If anything, untreated migraines are more likely to last less than half a day if they are diagnosed on monday. The parameter estimate is only statistically significant at 6.6%. As in Barmby et al. (1991), this could reflect a censoring or a "bunching" problem: The migraine spell may have begun over the weekend and care sought only on monday when they are available.

Finally the last section of the table focuses on the impact of subscribing to the BPPO insurance policy and on the impact of medication. Recall that our data does not allow us to distinguish between the insurance policies in terms of cost or coverage. The parameter estimates thus only identifies the effects of this particular policy relative to those of the SelectCare PPO and Blue Standard PPO. Despite the fact that the policies can not be ranked in terms of coverage, the Blue preferred PPO impacts the transitions across the different states in a statistically significant manner. Hence it is found that workers subscribing to the latter are more likely to be away from work for less than half a day than workers subscribing to the other policies. Furthermore they systematically experiment longer employment spells, irrespective of the state in which they transit. Thus once we condition for as many covariates as there are available, and once we control for unobserved heterogeneity, we still find that insurance policies may at least partly explain the variation in the duration of absence spells among chronic migraine sufferers. The table also shows that Drug A decreases the probability that a given migraine spell lasts half a day or less. This is consistent with the fact that Drug A may be less efficient in treating severe migraines.

The marginal impact of exogenous variables such as Drug A and BPPO is difficult to ascertain in our model due to the nonlinear response ant the complex correlations between the different states. This is better ascertained through numerical simulations to which we now turn.

4.2. Simulation results

The unobserved heterogeneity variables capture permanent characteristics that are individual specific and which may impact different outcome variables in a specific manner. Because our regressions include few control variables, it is important to investigate the role played by unobserved heterogeneity in explaining the transitions between spells of work and spells away from work. The best way to achieve this is through stochastic simulations. We first start by drawing 1,000 values

[19]Because we do not have any information prior to 1996, we underestimate the cumulative number of events. The parameter estimate risks being biased unless we assume that only recent events matter in explaining current events.

of ξ_1 and ξ_2 in order to compute each ν_k [see equation (7)]. For each pair of random draws, we next simulate 1,000 three-year work histories for a representative worker in our sample based on the parameter estimates of the model. Likewise we repeat the exercise by arbitrarily changing a number of exogenous covariates and compute 1,000 three-year work histories for each pair of random draws. The histories are then summarized by computing the mean cumulative stays in each potential state considered in the model.[20]

The algorithm works as follows. We determine the initial state randomly between treated or untreated migraine using a random draw from the normal distribution. Conditional on the initial state, we then compute the duration of the work spell for each possible exit route. The shortest duration then determines the exit route. If depression is the transition state, we compute its duration based on the appropriate parameter estimates. If the exit route is treated or untreated migraine, we compute the probability that the spell lasts less than half a day and compute its duration accordingly. We record the cumulative number of treated and untreated migraines as well as the total number of depressions because the current duration in various states is conditioned upon past occurrences. We repeat the process until the total duration of the sequence reaches 1,095 days. The last spell is censored if it lasts beyond three years. By drawing 1,000 values for both ξ_1 and ξ_2 we span their entire distributions.

Table 7 reports the main findings. The simulations are conducted for a male worker who is 40 years of age and resides in a northeastern rural area. The first two panels of the table focus on the impact of using Drug A relative to Drug B under the assumption that the worker is assumed not to be prescribed an antidepressant drug when going through a depression. The next two panels are identical to the first two except that the worker is now assumed to be prescribed an antidepressant. The last two panels investigate the potential impact of self-selection into insurance policies (without antidepressant, as in the majority of cases in our sample). The first column reports the expected impact at the mean of the unobserved heterogeneity component of the work equation $[E(\nu_W) = E(\theta_W^1\xi_1 + \theta_W^2\xi_2) = 0]$ while columns (2)–(5) report the results for the quartiles of the distribution of ν_W.

The simulations on the impact of the two drugs are conducted by simply turning the dummy variable Drug A on and off when generating the sequences of transitions. As mentioned earlier, Drug B is usually thought to be preferable when the migraine is deemed particularly severe, although drug A can also be prescribed in such cases, and *vice versa*. Controlling for drug type may be thus be akin to controlling for severity. The simulations show that workers who are prescribed Drug B work on average 3 fewer days over a 3-year cycle than those who are prescribed Drug A [column (1)]. The difference is greater for those who have long work spells [first and second quartiles] but is much smaller for those who have short work spells [third and fourth quartiles]. Interestingly, the number of lost days of work due to treated and untreated migraines is almost identical irrespective of whether Drug A or Drug B is used. The main differences relate to the duration of depression spells, a comorbidity that is much harder to diagnose. One must be cautious in interpreting these results since the possibility that work and migraine outcomes might have been worse had it not been for Drug B can obviously not be ruled out. Our simulations simply can not account for such a counterfactual.

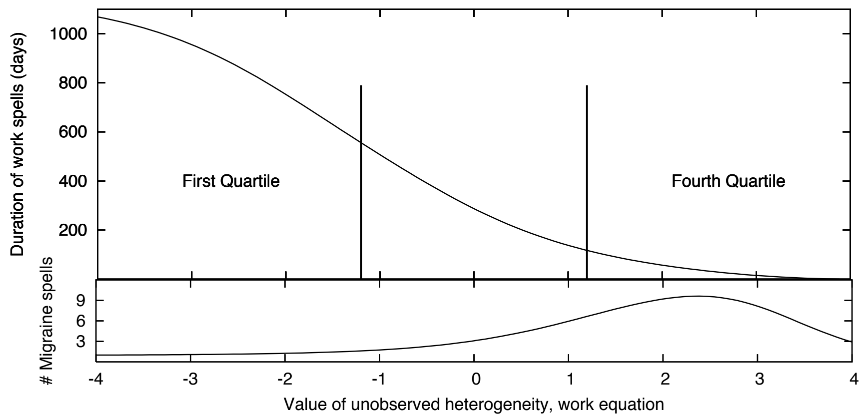
Simulations (C) and (D) are identical to simulations (A) and (B) except that they assume workers are prescribed an antidepressant when experimenting a depression due possibly to its severity. As expected the number of days lost to migraines in simulations (C) and (D) are very similar to those of simulations (A) and (B). The duration of depression spells, on the other hand, increases dramatically.

[20]Recall that the duration of both types of migraines are modeled as lasting either less than half a day or more. In the latter case, we assume the migraine lasts an entire day, despite the fact that a number of migraine spells last longer.

Interestingly, workers who are prescribed Drug B now appear to work more days out of the 3-year cycle than those who are prescribed Drug A.

Figure 3 depicts the (kernel smoothed) relation between ν_W, and the duration of individual work spells and the frequency of migraine spells. It clearly shows that two identical mean-modal workers

Figure 3: Work Duration and Migraine Frequencies



may behave entirely differently. One will have very long work spells and rarely miss out on work despite being diagnosed with chronic migraine problems. At the other extreme, an observationally identical worker will have very short work spells and be absent from work on a regular basis. The sensitivity of our results to the unobserved heterogeneity components may underscore the fact that our regressions are not controlling for important factors. But it may also be a reflection of the fact that chronic diseases are intrinsically complex and that such wide variations are to be expected, irrespective of the number of control variables entering the model.

The relative benefits of Drugs A and B can be ascertained through a simple cost-efficiency analysis. The data files at our disposal provide detailed information on the cost of each claim to the employer. These include doctor consultations fees, hospital inpatient and outpatient charges, drug fees, laboratory fees and medical equipment fees. The average cost of all migraines and depression spells associated with Drug A over the 3-year cycle amounts to 983.90$ (1998$) while the cost for those associated with Drug B amounts to 1,277.31$. The differential cost (1,277.31$ - 983.90$ = 293.41$) can be weighted against the differential in the number of worked days. Obviously, Drug B is not cost-efficient in the scenario depicted in simulations (A) and (B). On the other hand, it is cost efficient in simulations (C) and (D).

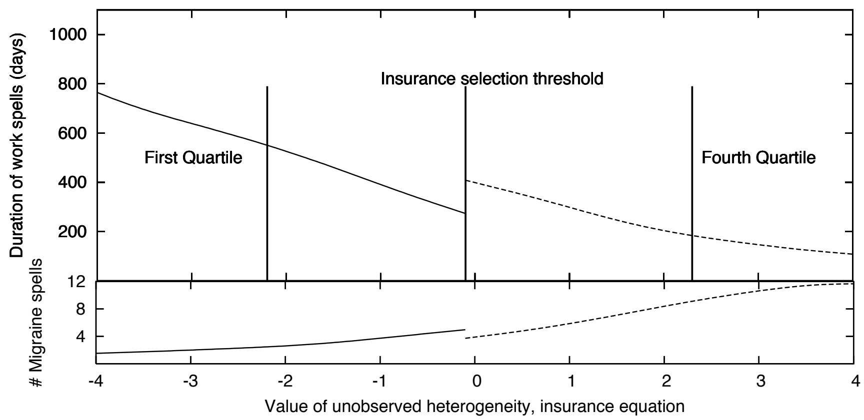
Simulations (E) and (F) in Table 7 investigate the potential selection bias into the insurance policies and its consequences on various outcomes. From equations (6) and (7) we can easily establish that

$$
\begin{aligned}
\theta_k^1\xi_1 \quad &+ \quad \theta_k^2\xi_2 \geq -X\beta_I, k = \text{INS} \Rightarrow BPPO \\
\theta_k^1\xi_1 \quad &+ \quad \theta_k^2\xi_2 < -X\beta_I, k = \text{INS} \Rightarrow BSP + SelectCare.
\end{aligned}
$$

A comparison between the two scenarios reveal a sizable difference in the number of worked days. Indeed, workers who subscribe to the BPPO work on average 7.5 fewer days over the 3-year cycle, but have shorter depression spells and much longer migraine spells. As previously, the difference are very sensitive to the value of ν_W, the unobserved heterogeneity component of the work equation.

The sensitivity of individual work spells and migraine occurrences relative to ν_k, k = INS, is depicted in Figure 4. The middle vertical line is the threshold value that determines whether BPPO is selected. Workers who subscribe to the BPPO are to its right and those who subscribe to the BSP/Select Care to its left. The differences between the two groups are striking. Despite a small discrete jump around the threshold, (smoothed) work duration decreases continuously with ν_k, $k =$ BPPO. Likewise, the small discrete fall in migraine frequency is immediately followed by a continuous increase.

Figure 4: Work Duration and Migraine Frequencies



5. Conclusion

The research of the past two decades on work absenteeism has focused primarily on moral hazard issues. The empirical literature on health-related work absenteeism has dealt for the most part on acute or temporary illnesses. Surprisingly, the majority of empirical studies do not discriminate between the types of illnesses that prompt workers to stay home or seek care. Yet the incidence and duration of absence spells, and their responsiveness to financial incentives, certainly depend upon the nature of the health shock.

In this paper we focus on chronic migraine, a common and acute illness that can prove to be relatively debilitating. Our analysis is based upon the absenteeism of workers employed in a large Fortune-100 manufacturing firm in the United States. We model their daily transitions between employment and absenteeism between January 1996 up until December 1998. Only absences due to migraine and depression, its main comorbidity, are taken into account.

Workers in our sample could subscribe to three different insurance packages. Our goal is to determine whether the insurance policies influence the duration of employment and absence spells once we condition on observable and unobservable covariates, on medication and once we take into account potential selectivity into insurance coverage. Our results show that there is very little past occurrence dependence in the data: past migraine and depression spells have little predictive power on the duration of future employment and migraine spells. Perhaps because we focus on a very narrowly defined disease, we do not find any evidence of "monday" or "friday" effects contrary to what is usually found in the literature on absenteeism. As expected, the duration of depression spells, the main comorbidity associated with migraines, varies very little with individual characteristics. Except for the use of antidepressant drugs, not a single covariate depicts any explanatory power on duration. For all intents and purposes, the duration of the depression spells can be considered exogenous from both the worker and the employer's points of view.

Perhaps more importantly, we do find considerable evidence of correlation between the different states we consider. In particular, workers who are more likely to choose the Blue Preferred Provider Organization (BPPO) insurance policy are also more likely to have longer employment spells and thus less frequent absence spells. Yet their absence spells due to migraines are found to be generally shorter than those of workers subscribing to either the SelectCare PPO or the Blue Standard PPO insurance policies. Our results thus provide weak indirect evidence that workers suffering from chronic migraines adapt their work/absence behaviour according to the provisions of the insurance policy they subscribe to.

Table 6: Parameter Estimates of the Transition Model†

Variable	Logit Model			Duration Model			
	Insurance BPPO *vs* Others (1)	Untreated migraine (2)	Treated migraine (3)	Depression (4)	Work → depression (5)	Work → treated migraine (6)	Work → untreated migraine (7)
Demographic variables							
Intercept	6.059*	1.855	-3.792**	-4.176	-5.631*	-4.810*	-2.652*
	(0.000)	(0.165)	(0.068)	(0.140)	(0.000)	(0.000)	(0.002)
Age	-0.435*	-0.528**	0.452	0.088	-0.263	-0.239*	-0.685*
	(0.048)	(0.078)	(0.171)	(0.448)	(0.114)	(0.031)	(0.000)
Gender (Male)	-0.104	1.018**	-0.587	-0.037	-0.103	0.299	0.124
	(0.418)	(0.063)	(0.262)	(0.484)	(0.350)	(0.127)	(0.320)
North	-2.567*	-1.046**	1.664*		0.713*	-0.897*	-0.797*
	(0.004)	(0.091)	(0.045)		(0.039)	(0.007)	(0.016)
Rural	-1.549*	-0.230	-1.476*	0.413	0.318	-0.096	-0.274
	(0.001)	(0.377)	(0.032)	(0.356)	(0.157)	(0.348)	(0.129)
Past occurrences							
# Past migraines		-0.059	0.022		0.033	-0.042*	-0.030
		(0.212)	(0.460)		(0.180)	(0.050)	(0.146)
# Past depressions				0.008			
				(0.455)			
End-Beginning of week							
Monday		0.967**	0.979				
		(0.066)	(0.136)				
Friday		0.546	-0.593				
		(0.117)	(0.260)				
Insurance and treatments							
Blue Preferred PPO		0.654	2.255*	1.044	-1.168*	-0.837*	-0.720*
		(0.192)	(0.015)	(0.278)	(0.003)	(0.017)	(0.034)
Drug A			-1.123**				
			(0.081)				
Antidepressant				-2.446*			
				(0.000)			
Ancillary parameters							
Initial state (γ_k)		0.478	-0.336	-0.483	-0.616*	-0.729*	0.485*
(Untreated migraine)		(0.267)	(0.349)	(0.301)	(0.019)	(0.000)	(0.014)
Weibull (α_k)				1.121	0.664*	0.859*	0.749*
				(0.192)	(0.011)	(0.019)	(0.000)
Loading factors (θ_k)	0.816**	-1.741*	0.773	-2.464*		-0.616*	
	(0.088)	(0.000)	(0.167)	(0.000)		(0.000)	

†Note: P-Values in parentheses. * Less than 5%. ** Less than 10%.

Table 7: Expected Cumulative Spell Durations, Unobserved Heterogeneity and Policy Variables[†]

	Mean	First quartile	Second quartile	Third quartile	Fourth quartile
	(1)	(2)	(3)	(4)	(5)
	(A)	Drug A, Antidepressant: No			
Untreated migraine	4.30	0.36	0.70	2.03	14.11
Treated migraine	1.69	0.28	0.49	0.78	5.20
Depression	18.34	9.75	25.48	22.78	15.34
Work	1070.65	1084.60	1068.33	1069.40	1060.27
	(B)	Drug B, Antidepressant: No			
Untreated migraine	4.15	0.35	0.78	1.77	13.69
Treated migraine	1.79	0.35	0.57	1.01	5.23
Depression	21.78	16.71	28.67	25.00	16.72
Work	1067.29	1077.59	1064.99	1067.23	1059.35
	(C)	Drug A, Antidepressant: Yes			
Untreated migraine	4.34	0.34	0.69	1.72	14.59
Treated migraine	1.52	0.28	0.50	0.86	4.43
Depression	72.77	11.43	78.33	99.24	102.08
Work	1016.35	1082.95	1015.48	993.17	973.82
	(D)	Drug B, Antidepressant: Yes			
Untreated migraine	4.66	0.35	0.74	1.63	15.92
Treated migraine	2.01	0.31	0.42	1.06	6.26
Depression	64.58	3.68	70.48	92.76	91.39
Work	1023.74	1090.65	1023.35	999.55	981.41
	(E)	Insurance: BSP+SelectCare[‡]			
Untreated migraine	1.30	0.55	1.02	1.23	2.39
Treated migraine	0.84	0.48	0.61	0.93	1.35
Depression	21.47	7.57	16.77	19.21	42.35
Work	1071.34	1086.38	1076.60	1073.61	1048.78
	(F)	Insurance: BPPO[§]			
Untreated migraine	9.87	3.52	4.54	7.62	23.80
Treated migraine	4.00	1.61	2.17	3.03	9.19
Depression	17.13	4.42	12.21	16.43	35.48
Work	1063.99	1085.49	1076.10	1067.91	1026.47

[†]Simulation results are ordered relative to ν_W, *i.e.* the unobserved heterogeneity component of the work duration equation.

[‡] BSP is selected if $\theta_k^1\xi_1 + \theta_k^2\xi_2 < -X\beta_I, k = \text{INS}$

[§] BPPO is selected if $\theta_k^1\xi_1 + \theta_k^2\xi_2 \geq -X\beta_I, k = \text{INS}$

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